

Submission on the Climate Change Commission's draft Advice to Government

Submission from: Centre for Sustainability, University of Otago

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This combined submission is a research-informed perspective on the CCC's draft Advice.

Our Big Thing: Coordinated research for a low carbon future

Key message:

Achieving a low carbon future in the most efficient way possible requires a long-standing, inter-disciplinary, multi-institutional programme of research and innovation. The low-carbon transition will require sector-specific technological innovations, new understandings of carbon sources and sinks, system-wide socio-technical transformations, and – importantly - coordination between all of these. None of the current sources of research funding supports such a targeted programme, although NSC or SSIF funding could potentially be applied to this end.

Currently, research to support NZ's low-carbon transition is competing with all other research proposals and dependent on individual researchers' interests and efforts. Without targeted and coordinated science funding, research efforts will remain fragmented, it will be difficult to identify and support priority areas, and we risk vital research not being funded.

We request that, in its final Advice, the Climate Change Commission includes a discussion of the need for a targeted, coordinated, interdisciplinary and pan-institutional research platform, and recommends that the government establishes such a platform.

Research for a low-carbon transition

The CCC's draft Advice frequently mentions that the low-carbon transition will require significant innovation, although it is not explicit about who and how this innovation is to occur. Its only explicit mention of the need for research relates to technological innovations in three areas: agricultural emissions reduction, industrial processes, and waste. Yet the Advice makes it clear that transformational change is required across all sectors of New Zealand's economy, all businesses, institutions and communities.

Because of the scope and scale of change, and the short time frame, the low-carbon transition will require a great deal more innovation than technology alone: it will involve innovation that enables (amongst other things):

- incorporation of mātauranga and Te Ao Māori across all of the items below,
- adoption of new/different technologies,
- changes to behaviours, expectations and aspirations,
- developing effective communication approaches,
- better understanding of the sources and sinks of emissions,

- empirical data on the co-benefits and co-costs of climate actions (e.g. to health and wellbeing),
- realisable options for fundamental changes to long-established systems (e.g. transport, energy, agriculture),
- establishing a circular economy,
- new policies and changes to governance and institutions,
- ensuring innovations in all of these areas will be well suited for purpose and socially acceptable,
- ensuring justice, equity and fairness, and

To achieve simultaneous innovation across all of these fields requires a concerted effort. It will involve:

- expertise from almost all disciplines: physical sciences, social sciences, engineers, economists, business expertise, health sciences, science communication and the arts,
- researchers working closely with each other across diverse disciplines and fields of endeavour to ensure coordination, identification of research gaps, and reduction in duplication of effort,
- researchers working closely with innovators and end-users amongst iwi, communities, businesses, government agencies and NGOs,
- collaboration across universities, wānanga, polytechnics, Crown Research Institutes, and other research agencies to bring together the best teams we can muster, and
- building more capacity and capability amongst our new and emerging researchers so they are ready to take on upcoming challenges.

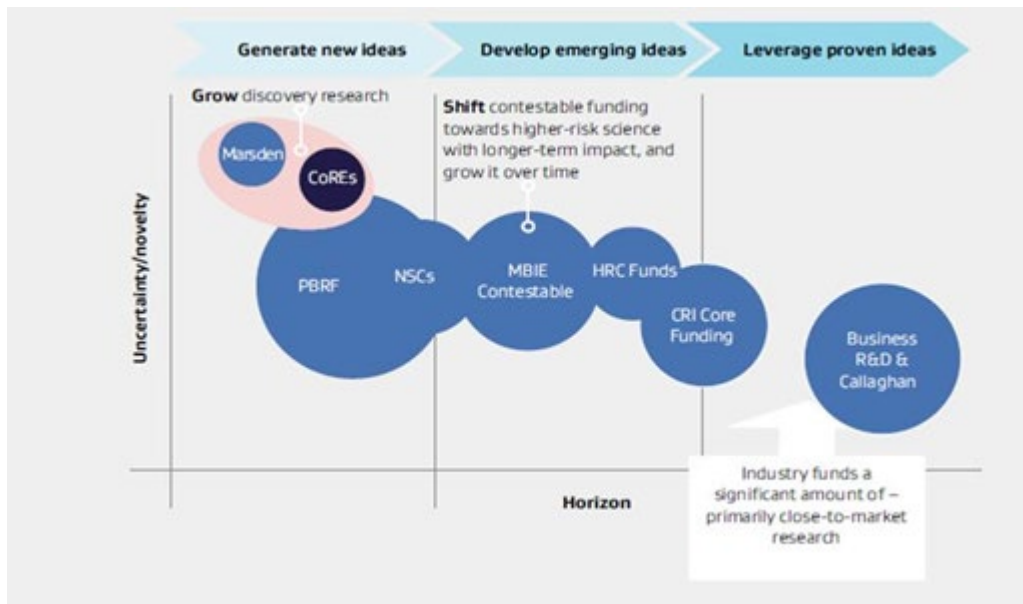
Page 18 of the Commission’s Advice states that “Meeting our proposed emissions budgets and 2050 targets requires transformational change across all sectors of the economy.” For such a massive (but essential) endeavour, a long-term, stable research platform (i.e. 10+years) is needed to enable the development of the necessary innovations, end-user relationships and delivery of outcomes. It will also require careful monitoring and coordination of relevant current research (wherever it is funded from) and identification of research gaps. Without such coordination, the transition will be more expensive and less likely to succeed.

Currently, none of New Zealand’s research funding sources supports such a platform of research and coordination.

Current research funding environment

The [National Statement of Science Investment 2015-2025](#) uses the image copied below to summarise the main research funding sources in New Zealand (p7). The vertical axis indicates the degree of novelty (‘blue skies’) desired by the funder; the horizontal axis indicates the anticipated time horizon between the innovation and implementation.

Innovation for a low-carbon future will involve the full space of this figure, from generating new ideas to the coordinated leveraging of proven ideas, with time horizons from the immediate to the long-term.



The current funding sources indicated on the figure are largely unsuited to a major platform of research and innovation for a low-carbon future. In case the Commission is unfamiliar with New Zealand’s research funding landscape, we briefly outline it below with links to relevant websites:

Marsden: funds managed by the Royal Society of NZ to support investigator-led ‘blue skies’ research in a wide range of topics. Some projects may include aspects of climate change. Projects are usually 3 years.

CoREs (Centres of Research Excellence): support research and capability development in a particular field. Only able to be led by universities, wānanga or polytechnics. While some of NZ’s 10 CoREs may fund some climate change related research, such as Ngā Pae o te Māramatanga (NZ’s Māori Centre of Research Excellence) and Te Pūnaha Matatini (complex systems), none of them are expressly focused on climate change. CoREs are funded for 7 years and most have just had a second 7-year term approved.

PBRF/Performance-Based Research Fund: provides funding to tertiary institutions based on performance of staff in research related areas, such as journal article publications. There is considerable variation in how this money is used and distributed within the institutions, and given its granular distribution it is not suited to funding a major inter-institutional programme.

NSCs/National Science Challenges: these are focused on long-term, national-level problems determined by government. Some climate mitigation related research occurs in a fragmented way among the 11 NSCs, such as Resilience to Nature's Challenges and Our Land and Water. Deep South NSC address adaptation to climate change, but no NSCs are focused on climate change mitigation. Most NSCs have 10 years’ funding, and no new calls are yet on the horizon.

MBIE contestable funds: competitive funding for research focused on long-term benefits for New Zealand. The major fund is the Endeavour Fund which supports ambitious, risky and scientifically excellent research with major impacts. Some funded projects may have a climate mitigation focus. Projects generally receive 3-5 years funding. MBIE also hosts the [Strategic Science Investment Fund](#) which funds a small number of longer-term ‘science platforms’ determined by government priorities. None of these are currently focused on climate change, with the closest being the Advanced Energy Technology Platform which focuses on exportable technological innovations.

HRC/Health Research Council: funds health focused research (a small amount of climate change research is undertaken relating to this area).

CRI core funding: funding specifically for the [Crown Research Institutes](#) (such as NIWA, Scion, Manaaki Whenua Landcare Research and GNS Science), to support their own research programmes. Although some CRIs undertake some climate-related research, none is specifically focused on NZ's low-carbon transition.

Business R&D and [Callaghan](#): supports industry-led research, which is usually focused towards an economic benefit for that business.

Agriculture is the one exception to this lack of a coordinated, targeted research platform. Alongside the established funds listed above, some government agencies (e.g. MPI) distribute considerable amounts of government-directed funding. In the climate change field, the most notable is the ~\$20 million per year that has been invested into researching agricultural greenhouse gas mitigation, most of which helps fund three research centres:

- The Pastoral Greenhouse Gas Research Consortium, (PGgRC), established 2003. Works in partnership with the NZAGRC focussing on the mitigation of CH₄ and N₂O emissions.
- The New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) established 2009. Research on ways to reduce CH₄ and N₂O emissions and increase the carbon stored in soils.
- The Global Research Alliance on Agricultural Greenhouse Gases (GRA), established 2009.

Currently there is no parallel level of commitment to coordinated research on the non-agricultural aspects of the low-carbon transition. The kind of collaborative research platform needed is largely outside of the criteria for many of our larger funds. It is not suited to being funded by business. The National Science Challenge funding, with which the issue would be most closely aligned, is fully allocated to 2024 with no new calls for proposals on the horizon. The other potentially suitable funding scheme is the SSIF, but there are no new calls currently signalled for this fund.

A way forward

Two of the existing funding sources shown in the diagram above could potentially be suitable vehicles for a coordinated research platform for a low-carbon future, or at least indicate the kind of platform required:

- (a) a new call for a National Science Challenge (or similar arrangement) on the low-carbon transition, or
- (b) a new programme under the Strategic Science Investment Fund.

Alternatively (or in addition), a new type of research platform could be developed, independent from but aligned with the Climate Change Commission's functions, to help develop the independent evidence that the Commission will require.

Conclusion

Although there is a large body of evidence already available that can help inform the transition to a low-carbon economy, there are many gaps in knowledge. The low-carbon transition will require sector-specific technological innovations, new understandings of emissions and capture, and system-wide socio-technical transformations, and – importantly - coordination between all of these. New Zealand does not yet have the long-term, climate change focused research platform that is needed to underpin the transition.

We request that, in its final Advice, the Climate Change Commission includes a discussion of the need for a targeted, coordinated, interdisciplinary and pan-institutional research platform, and recommends that the government establishes such a platform.

The Six Big Issues

Issue 1. Do you agree that the emissions budgets we have proposed would put Aotearoa on course to meet the 2050 emissions targets?

Do not know. It is not the budgets, but the policies and commitments to change that will determine whether we are on course.

Issue 2: Future generations: Do you agree we have struck a fair balance between requiring the current generation to take action, and leaving future generations to do more work to meet the 2050 target and beyond?

Disagree. We believe that the budget is not aspirational enough.

Firstly, agricultural emission reductions should be greater than recommended, and more aligned with international expectations (as per Biogenic methane recommendation 1).

Secondly, the rate of change over the first budget period is far too low. The trajectory should recognise that the earlier changes will be much easier than the later changes given the earlier ones are using known technologies and practice changes, and many are essentially cost-neutral or even cost-saving (not to mention the co-benefits). Indicating that we essentially have a free ride for the first 4 years before starting to take serious action in Budget 2 is tantamount to saying nothing has to change. That sets the wrong mindset. We believe there must be a greater focus on making significant changes from the outset.

Issue 3: Our contribution: Do you agree with the changes we have suggested to make the NDC compatible with the 1.5°C goal?

Strongly agree

Issue 4: Role and type of forests: Do you agree with our approach to meet the 2050 target that prioritises growing new native forests to provide a long-term store of carbon?

Strongly agree, with the proviso that (a) even native forests have finite storage capacity, and (b) other sinks/offsetting besides forest planting must also be prioritised.

Issue 5: Policy priorities to reduce emissions: What are the most urgent policy interventions needed to help meet our emissions budgets?

All of these interventions are important. Firstly, ETS alone has shown itself to be ineffective in shifting NZ's emissions trajectory and would require (as the CCC notes) a huge hike in the value of carbon to be effective within the sectors it applies to. It is essential to shift as rapidly as possible to reach the carbon prices indicated as being necessary by this report.

Alongside this, it is critical to develop complementary policy to the Emissions Trading Scheme. It is well established that price signals alone are usually ineffective in changing behaviour – price is only

one of many factors that drive decision-making in businesses and households. Given we need to bring about rapid transformative change, which will include identifying where in the system interventions are needed to reduce barriers to change; ensuring all actors have an understanding of carbon as an invisible but critical flow through all parts of production and consumption; investing in infrastructure that makes low-carbon living easy and convenient; developing pride in a 'kiwi' way of becoming low-carbon; and ensuring the transition does not exacerbate inequities and ideally reduces them.

Investment to spur innovation and system transformation is also important and research is a critical part of that. However the CCC advice is very light on any discussion or recommendations on how NZ will build the research capacity and capability for a low-carbon transition, and on how a programme of research could/should be enabled. It talks about targeted R&D to reduce agricultural emissions (p12) and the potential for research in hard-to-abate industrial processes (p116) and waste reduction (p125). But the problem of lack of any targeted and comprehensive programme of research is under-discussed and not considered by the CCC in light of the current research funding landscape.

See our 'one big idea' for our discussion on the need for a coordinated, targeted research platform focused on the low-carbon transition.

Issue 6: Technology and behaviour change: Do you think our proposed emissions budgets and path to 2035 are both ambitious and achievable considering the potential for future behaviour and technology changes in the next 15 years?

As noted earlier we don't believe it is ambitious enough. Whether it is achievable depends on what expertise can be brought to bear on the complex question of behaviour change.

The emissions path is strongly dependent on behavioural/cultural/institutional change. Adopting new technologies is a behaviour change in its own right. And many of the actions needed for a low emissions future also require the adoption of new/different behaviours and expectations. As a researcher in energy cultures and behaviour change, our researcher Prof Janet Stephenson says that there is not enough known about what is possible to achieve, because relatively little behaviour-related research has been undertaken in New Zealand in this field – compared to technology-focused research.

There is strong support amongst many businesses, communities, iwi, councils and NGOs for ambitious action on climate change, but whether they will be able and willing to make change depends on many factors that we don't well understand. And those factors will be different with different contexts.

Our position is that there needs to be an extensive programme of interdisciplinary research that underpins New Zealand's low-carbon transition (see 'our one big idea') including social scientists who are seeking answers to the potential for future behaviour change and what might enable this.

Responses to specific consultation questions

1. Do you support the principles we have used to guide our analysis?

We fully support the Principles but consider that a further Principle should be added.

We note the seven Principles listed on page 29-30 are intended “to help guide our advice and the transition to a thriving, climate-resilient and low emissions Aotearoa”. That implies two functions for the principles: ‘Guide our advice’ is one function which is the CCC’s own task, but “the transition” is a separate (albeit linked) function which must be led by the government. In this light, given the government’s role as the Treaty partner, the glaring omission from the Principles is that the transition must accord with Te Tiriti o Waitangi.

The current Principle 5: “Transition in an equitable and inclusive way” in no way stands for nor implies Te Tiriti.

We note that later on in section 5.2 (on creating a fair, equitable and inclusive transition) has a bullet point list of important criteria, the first of which is ‘Honouring the principles of Te Tiriti o Waitangi’.

We believe that it is inappropriate to subsume Te Tiriti to a bullet point in this section – it has much broader implications for the transition than just fairness and equity - it is about rangatiratanga and the building of strong partnerships for the transition. This point is actually made in Figure 6.1 on page 105 “Elements of an effective climate policy package” which has ‘Partnership approach with iwi/Māori at the top of the diagram, relating to everything.

It seems that the CCC does recognise the importance of Te Tiriti in other parts of the Advice, but has not elevated to the critical place and that is in the opening Principles. We believe that a further Principle needs to be added, to the effect that ***the transition must accord with Te Tiriti o Waitangi and its principles.***

4. Do you support budget recommendation 4? Is there anything we should change, and why?

We fully support this recommendation and the rationale for it.

5. Do you support enabling recommendation 1 on cross-party support for emissions budgets? Is there anything we should change and why?

Fully support. Cross-party support is critical to ensure that there is long-term political buy-in to such important action. However it is only a point in time: there’s always the chance that a future government would renege on this. It would be even better if there was a category of parliamentary action which, once agreed at a cross-party level, could continue without the possibility of it being dropped by a future government (with stringent provisos for any ‘out’ clause).

See for example the Finnish Committee for the Future, as critically discussed in this article: Vesa Koskimaa & Tapio Raunio (2020) Encouraging a longer time horizon: the Committee for the Future in the Finnish Eduskunta, *The Journal of Legislative Studies*, 26:2, 159-179. https://www.tandfonline.com/doi/full/10.1080/13572334.2020.1738670?casa_token=iljW77zHBXsAAAAA%3AJV7nVwiWoX3oLQYfY3NXqXwuRCGYRwp4wELAwivqt1xnvihAUwEAYzjCltlFeXym2BYaskEveSJJYZc

6. Do you support enabling recommendation 2 on coordinating efforts to address climate change across Government? Is there anything we should change and why?

We fully support this recommendation.

7. Do you support enabling recommendation 3 on creating a genuine, active and enduring partnership with iwi/Māori? Is there anything we should change and why?

We fully support these recommendations, but also we would add that there should be an additional requirement that policy seeks to redress past inequities as part of the transition. For example, Māori land is often the most marginal because of the pattern of land losses. Focus should be on assisting Māori owners to utilise their land in ways which create mutual benefits to the owners and to carbon mitigation – this may involve positive action to help rebalance this disadvantage such as land use mapping, targeted advice and capability building.

8. Do you support enabling recommendation 4 on central and local government working in partnership? Is there anything we should change and why?

Fully support.

9. Do you support enabling recommendation 5 on establishing processes for incorporating the views of all New Zealanders? Is there anything we should change and why?

We fully support these recommendations and in particular the notion of a citizens' assembly or similar forum. The scale of the societal changes required to achieve a low-carbon future is massive, and because it has the potential to impact on people's expectations about how they want to live their lives, there is a huge potential for lack of acceptance, backlash and civic unrest. The more that everyday Kiwis can be engaged in why, what and how the changes will occur, the better, especially at the early stages.

11. Do you support our approach to focus on growing new native forests to create a long-lived source of carbon removals? Is there anything we should change and why?

Fully support. However, there should also be the ability to account for removals from existing (pre 1990) native forests. This is particularly an issue for Māori land which may have regrowth forests due to the difficulties of farming marginal country. Being able to include these within the ETS would be one small way of redressing the inequitable situation that many Māori landowners are in. Additionally there also needs to be a focus on non-forestry carbon removals more generally such as building up soil carbon, restoring freshwater and marine wetlands (the latter more likely as sea levels rise over flat plains close to the sea). At the very least the Commission should indicate that more research is needed to explore all of these potentials.

13. Do you support the package of recommendations and actions we have proposed to increase the likelihood of an equitable, inclusive and well-planned climate transition? Is there anything we should change, and why?

We fully support this package but would add that the low-carbon transition is very much a socio-technical one in that it will involve both social change, technical change, and change that arises from the interactions of both. And by 'social' we don't just mean individuals and their families/whanau, but also Māori collectives, businesses, organisations and communities. So when you're looking at equity and inclusivity it has to be considered across all of these.

In addition, the transition is thus immensely complex and will involve cultural change – i.e. in how people think and act, and their everyday consumption decisions. Any policy work needs to be well supported by research-informed insights.

For example, see

Stephenson, J., Barton, B., Carrington, G., Hopkins, D., Lavelle, M.J., Lawson, R., Rees, D., Scott, M., Thorsnes, P., Walton, S., Wooliscroft, B. (2016). Energy Cultures Policy Briefs. Centre for Sustainability, University of Otago. <https://ourarchive.otago.ac.nz/handle/10523/7104>

Barton, B., Blackwell, S., Carrington, G., Ford, R., Lawson, R., Stephenson, J., Thorsnes, P., Williams, J. (2013) Energy Cultures: Implications for Policymakers. Research Report, Centre for Sustainability, University of Otago, Dunedin, New Zealand. ISBN: 978-0-473-23717-2 <https://ourarchive.otago.ac.nz/handle/10523/3747>

14. Do you support the package of recommendations and actions for the transport sector? Is there anything we should change and why?

We support the actions but consider there needs to be more focus on distant and deprived communities who may otherwise be inequitably affected. Rural and remote communities are not mentioned in the recommendations and they require tailored solutions. Some communities traditionally use shared transport (see reference below) and finding ways to support the continuation of this with low-carbon vehicles could be one solution.

See: Ngarangi, H., Stephenson, J., & Hopkins, D. (2018). Shared mobility in a Maori community. *Kotuitui: New Zealand Journal of Social Science Online*.

<https://www.tandfonline.com/doi/full/10.1080/1177083X.2018.1469516>

Also the Commission's focus on electric vehicles is problematic. There are many other transport modes and one of the more interesting from a low-carbon perspective is the huge uptake already in NZ of ebikes. Also the Commission could look to build on the cultural shift already evident amongst younger people to abstain from car ownership and instead use multi-modal transport.

See

Hopkins, D., & **Stephenson, J.** (2014). Generation Y mobilities through the lens of energy cultures: a preliminary exploration of mobility cultures. *Journal of Transport Geography*, 38, 88-

91. <https://ourarchive.otago.ac.nz/handle/10523/5318>

Hopkins, D., & **Stephenson, J.** (2016). The replication and reduction of automobility: findings from Aotearoa New Zealand. *Journal of Transport Geography*, 56, 92-101.

<https://ourarchive.otago.ac.nz/handle/10523/6975>

Furthermore, shifting to low-carbon transport requires systemic change – that is, it's not just a matter of replacing like with like, or simply investing in new technologies – it requires simultaneous change in many parts of the transport system including within decision-making institutions, expert knowledge, funding sources, funding criteria, as well as addressing the lag that

will otherwise exist from transport infrastructure projects that are still in the approval pipeline. Many of these matters are covered in this paper:

Stephenson, J., Spector, S., Hopkins, D., & McCarthy, A. (2018). Deep interventions for a sustainable transport future. *Transportation Research Part D: Transport and Environment*, 61, 356-372.

<https://www.sciencedirect.com/science/article/abs/pii/S1361920917300184>

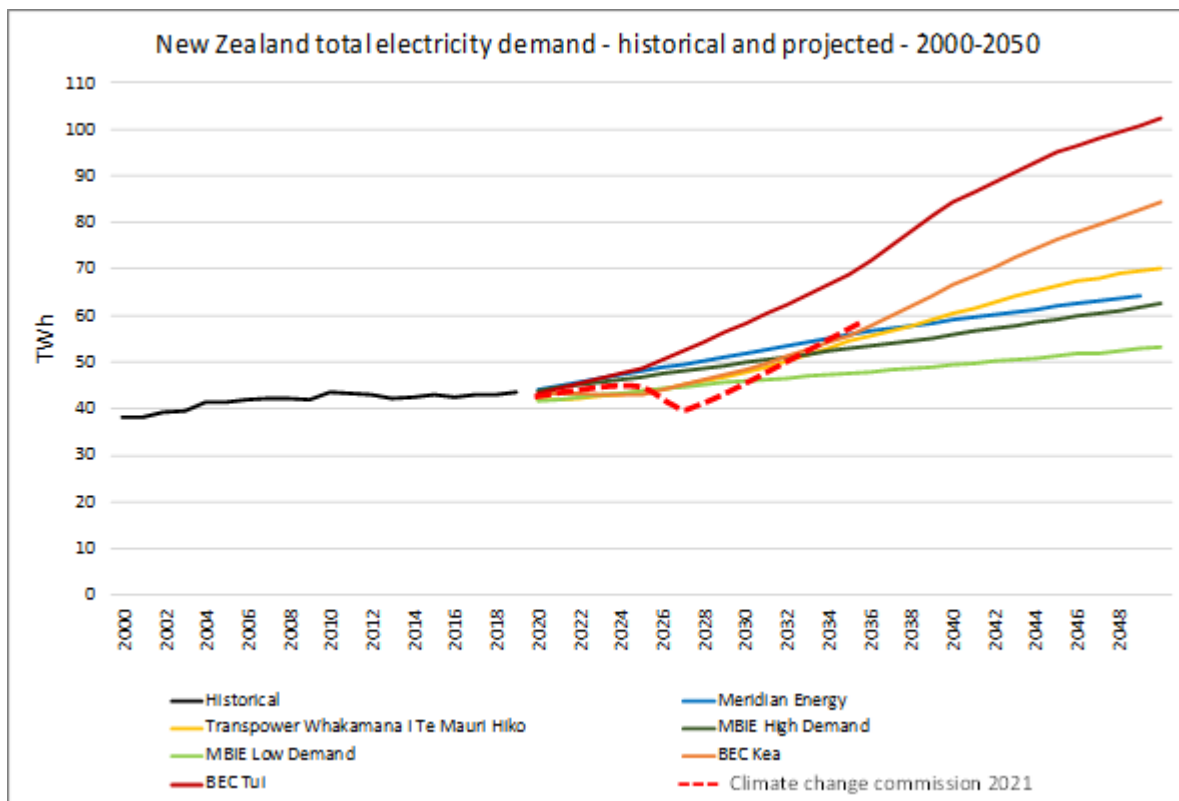
15. Do you support the package of recommendations and actions for the heat, industry and power sectors? Is there anything we should change and why?

We support all the actions.

The national electricity market modelling we undertake at the Centre for Sustainability (as yet unpublished) examines scenarios of the path to 2050 for the NZ electricity system, on a fine spatial and temporal scale. It is good to see that the CCC's focus is not just on the growing demand and consequent increases needed in the supply side of the electricity system, but also focuses on demand side management too. Our modelling shows that a 100% renewable electricity system can be achieved in a variety of ways, with different speeds of transition, and the differences in cost to the country from these different pathways are very significant. The right balance of 99% vs 100% renewable electricity, electrification vs other low emissions energy forms, and demand side management vs supply side growth, is crucial. We feel the CCC generally treads a good path through the midst of these variables, with some caveats.

We strongly feel that the country should NOT be aiming for 100% renewable electricity by 2030 (current government policy). The cost of trying to cover dry year risk by this date will be considerable, and will result in less total emissions reductions than a 99% renewable target (ICCC, 2019). The CCC says that "100% renewable electricity target should be treated as aspirational". We urge the CCC to take a stronger stance, and to advise the government to make the target "maximise emissions reductions", or even "100% renewable electricity by 2040". Our modelling shows that these targets result in a more orderly and cheaper transition towards low emissions, and are far more likely to result in an optimum mix of solutions, including much new grid scale wind, solar, and geothermal generating plant, a significant network of distributed generation and batteries, energy efficiency and demand side management measures (reducing the need for overbuild to cover dry winter risk), and PERHAPS a small pumped hydro scheme. Pushing for 100% renewable by 2030 will almost certainly result in expensive solutions to dry year risk, with greater negative environmental consequences than a 99% renewable target. In particular, we comment on the following specific points from the text.

We agree with the time-critical necessary action 3 target of 60% renewable energy no later than 2035, and our research shows this should be achievable. We strongly support the development of a national energy strategy, as bipartisan support for policy and targets, and certainty around the big uncertainties facing the energy system, are essential for infrastructure investment to progress in a timely manner. Certainty is particularly required around the two large game changers of Tiwai point and Lake Onslow pumped storage (and to a lesser extent grid scale batteries, as these can be developed in smaller amounts, over time), for meaningful investment in infrastructure to begin. Our projections of demand broadly agree with the CCC's, and examination of the spread of demand projections from various agencies show that between 10 and 60TWh of new generation plant will be needed by 2050.



Source: jen.purdie@otago.ac.nz, 2021 – spreadsheet of data and sources available upon request

We agree (pg. 113) that a regulatory regime must adapt to support and encourage the development of distributed generation, micro grids, peer-to-peer trading, and demand response. Our work shows that all of these are needed to enable high levels of renewable electricity, whilst avoiding over-building to supply dry winter peaks, and all have long lead times to achieve widespread adoption. We agree with necessary action 5 (maximise use of electricity as a low emissions fuel), and our modelling shows that the electricity system can adapt to high levels of electrification. We agree with clause c), in that we believe that the levels of new build of infrastructure needed will require the introduction of a disclosure regime or other scheme to encourage new investment. Encouragement and certainty from government are needed for investment in both generation and transmission, particularly bi-partisan support for policy and targets (for long term certainty) and RMA reforms underway following the Randerson report (2020) need to be undertaken to assist in faster build times of new infrastructure.

We also comment on necessary action 5, clauses d) & e), that the government should ensure that remote and distributed generation are not discouraged or penalised with high local lines charges, as this will be a dissuading factor in their adoption.

With regard to necessary action point f), our modelling shows that although wholesale prices are projected to not increase significantly, wholesale price volatility increases greatly with higher levels of intermittent renewables in the system, which is likely to lead to increased retail prices. We show that significant levels of demand response are essential within a decade to moderate this price volatility, with the highest prices usually coinciding with peak dry winter demand periods. In this regard we encourage the CCC to press the government to set in place requirements for smart meters and smart appliances in every house, in preparation for a significant uptake of demand response in the next decade. In particular we encourage the NZ government to adopt the requirements similar to the COAG Energy Council (2019), to require demand response capability in

new NZ appliances. Once again, the long life cycles of these appliances requires urgent action on this matter.

We agree with necessary action 6, and in fact our modelling shows that hydrogen and biofuels have a significant part to play in the decarbonisation of heavy transport and high temperature industrial processes, respectively. These two industries should receive encouragement from government as part of a national energy strategy.

We agree with necessary action 7 which states that government should act to ensure no new coal boilers are installed, given their long life cycles. We particularly agree with points c) and d), and note that energy efficiency measures, in particular, are often the most economic way to reduce emissions in industry, and conversions of thermal energy in industrial processes may require some government incentive to progress at the pace required. We in particular stress that energy efficiency should perhaps be mentioned more strongly throughout the advice report, and should be a cornerstone of any national energy strategy.

We agree with necessary action 9, and part a) in particular, and note that half of NZ houses lack adequate insulation (<https://www.branz.co.nz/pubs/research-now/hcs-2015/>). Continuing to improve energy efficiency standards for all buildings will make a significant impact to energy emissions, off-setting significant generation build costs, and will also have co-benefits with health and economic outcomes for lower socio-economic groups.

As an example of the potential impact of energy efficient lights alone, see: Dortans, C., Jack, M. W., Anderson, B., & Stephenson, J. (2020). Lightening the load: quantifying the potential for energy-efficient lighting to reduce peaks in electricity demand. *Energy Efficiency*, 13, 1105-1118. <https://link.springer.com/article/10.1007/s12053-020-09870-8>

And most of all, we urge the CCC to note strongly to government the urgency of the action required if the significant transition outlined is to be achieved.

16. Do you support the package of recommendations and actions for the agriculture sector? Is there anything we should change and why?

We support all the actions but believe more can be done.

We think the suggestions being made regarding the agriculture sector do not reflect the possible opportunities available for making meaningful transitions toward a more climate-friendly and climate-resilient agriculture and food system (agrifood system). Noticing and acting on these opportunities will require taking the agrifood system as a whole into account, this includes the complex and interconnected social and material relations that make up this system.

While we support emission reductions and the planting of trees on marginal lands, we argue that much more needs to be done to support farmers who currently want to engage in farming practices that lower emissions, do not produce extensive emissions and are resilient to climate change. At this point, most of the agriculture targets are focused on the supply side, suggesting changes which focus on maintaining levels of production while slightly lowering emissions. While it is a good starting point for reducing emissions within high-emission operations, this focus greatly overlooks the potential climate reductions possible (and already happening) throughout the wider agrifood system.

In a changing climate, reducing emissions on large-scale exports is not enough. The goal should not only be to lower emissions, but to encourage the growth of a diverse and climate-resilient agrifood system. On the supply-side, regenerative farming and other farming practices that focus on carbon sequestration, reducing topsoil loss and protecting the health of waterways are showing great promise in this area and deserves much more policy attention and investment. A recent white paper by Landcare Research outlines some of these promising trends, particularly in the field of regenerative agriculture (<https://www.landcareresearch.co.nz/publications/regenag/regenerative-agriculture-white-paper-sets-out-pressing-research-priorities/>).

While the supply side is important to climate discussions on agriculture and food, it is not the only place where opportunities exist for meaningful climate interventions. With high numbers of people suffering from food insecurity in New Zealand, there are opportunities to feed people, or give people opportunities to participate in the growing and distribution of, climate-friendly options. These kinds of creative policy solutions can work to support the health and wellbeing of our communities, while also supporting a transition to a lower-emission, climate-resilient agrifood system.

17. Do you support the package of recommendations and actions for the forestry sector? Is there anything we should change and why?

We support the actions but also would like to see a recommendation for a review of emissions accounting approaches to include pre-1990 indigenous forests, smaller stands of trees and other land-based sources of carbon sinks as outlined under our response to Question 11. Where current data is insufficient to support inclusion, recommend further research on the potential for other land-based sources to contribute to carbon storage.

18. Do you support the package of recommendations and actions for the waste sector? Is there anything we should change and why?

We support all the actions, but as well as the emphasis on recycling and keeping waste out of landfill, we would encourage the CCC to encourage government to place a much stronger emphasis on creating less waste in the first place. This will require a 'polluter pays' approach such that manufacturers of products with excessive or unnecessary packaging are forced to take responsibility for the recycling, reusing or repurposing of their products. Waste systems must move towards a circular economy approach, and this can only be achieved through reducing waste generation at the source.

19. Do you support the package of recommendations and actions to create a multisector strategy, and is there anything we should change?

We support all the actions but would add:

Government agencies undertake a host of responsibilities that are required under various regulations and policy instruments. Part of the problem with getting to a low carbon future is that they are still acting in many cases under legislation what was developed up to 30 years ago, well before any idea of the urgency of climate action was realised.

It is certainly important to look to develop new legislation and policy, but existing law and policy will keep guiding decisions for some time yet.

We believe that in order to avoid ongoing decisions being made by government agencies that are at odds with the transition, it is critical that there is a review of all legislation and policy to identify where it would result in GHG-increasing outcomes (e.g. criteria for infrastructure investments). From the review, there should then be a broadscale set of changes to bring all legal instruments into alignment with a low-carbon trajectory.

For an example of a holistic multi-sector approach in the Transport sector, see this paper:
Stephenson, J., Spector, S., Hopkins, D., & McCarthy, A. (2018). Deep interventions for a sustainable transport future. *Transportation Research Part D: Transport and Environment*, 61, 356-372.
<https://www.sciencedirect.com/science/article/abs/pii/S1361920917300184>