

# “Our Climate Your Say” Input to Ministry for the Environment

Good afternoon and thank you for taking the time to read this. I shall try to be brief and concise however this is an expansive issue and one which in my view needs a holistic approach. My background is as a Mechanical Engineer so I focus on efficiency and effectiveness as key outcomes of reaching a given goal.

Firstly to state my goal: My intentions and plans are focused on making New Zealand one of the world's first fossil fuel free nations, and carbon neutral. To this end I have read and refer to Net Zero in New Zealand Summary Report by Vivid Economics (March 2017). I believe this can be done at the same time as tackling the housing crisis, in fact I view it as essential in reaching our stated Paris Agreement goals that we handle the housing crisis appropriately.

## Summary

Although I have only recently returned home, I have long viewed New Zealand as one of the nations of the world best positioned to demonstrate best practise in terms of freeing ourselves of our dangerous addiction to fossil fuels. I believe it is entirely technically possible to achieve this by 2050 if appropriate steps are taken.

I think the first step to making New Zealand Carbon Neutral and more sustainable is to improve the housing stock. I know statistics from the UK and there is better insulation etc there, but even there around 50% of energy is spent heating space and water. A large portion of this is in the domestic building sector. If we can set strong building regulation in place, similar to The Code for Sustainable Homes (which was abandoned by the UK when the Conservatives took office under David Cameron), whereby new build houses are as close to net zero carbon/ Passivhaus as possible, it will free up a huge amount of electricity which is centrally generated to be used for powering transport. I imagine these 2 processes need to happen in a synchronised manner to prevent economic instability in electricity pricing. We can then switch to either a hydrogen economy or an electrified one in terms of vehicle fuelling for the most part.

There are a multitude of benefits to achieving a hydrogen economy with prefab houses, which in my view make it an easy sell to the population:

1. Higher air quality and lower incidence of respiratory illnesses (“Breath Easy” or some logo could be used for this aspect)
2. Better quality homes, better insulation, lower life cycle costs for occupants
3. Quicker build (pre-fab) allowing swift construction and housing of people, this is especially useful for rehousing after natural disasters
4. Lower running costs for transport once electrified or converted to hydrogen for energy storage
5. Far lower environmental impacts both on a local and global level
6. Demonstrate New Zealand as a world leader in tackling climate change and moving towards sustainability
7. Less trade based conflicts of interest (energy based conflicts are likely to become more frequent and conflicts over fossil fuels are clearly evident)

## Step 1: Housing

For housing to be sustainable the entire life cycle must be considered, from “cradle to grave”, and the most immediate concern would be establishing a suitable supply chain of materials, in particular timber, for building a large amount of new housing.

### Cradle to Gate

Some timber can be imported from nations which have (accredited) sustainable forestry practises. Ideally not monoculture intensive plantations with clear fell (as I see in many parts of New Zealand- hopefully this practice can also be improved upon). However as in the Net Zero in New Zealand pathway set out, agricultural reform is one key area to address to meet our 2050 targets. 2 particularly good forms of repurposing the land would be afforestation and hemp plantations. Both are excellent materials and could then be utilised in prefab building as well as other industries. It would also be important to ensure the right kinds of timber were grown so we’d not end up in the situation the UK is in with Sitka Spruce which is a relatively low quality building material compared with those grown in Germany and Nordic countries.

I believe repurposing land from cattle farming to afforestation would be a perfect means of reaching the stated goals. This is particularly useful along water ways prone to flooding as forestry helps to limit flood risks, and would help alleviate many of the water quality issues we’re facing as a result of intensive dairy/cattle farming. Economically I am unsure how we should best go about achieving this, perhaps grants and tax system reforms to provide an incentive farmers to switch- also potential courses to train people in ‘best practise’ when it comes to sustainable forestry.

There are enormous benefits to repurposing the land in this way, and if it is handled correctly will benefit ecosystems, water ways, soil quality (which is often forgotten as a very important factor) and myriad other issues. The main obstacle will be (dairy) farming bodies and others with vested interests in maintaining this industry, but if we can reward farmers who convert and offer them a good economic future then hopefully this can be achieved.

I am unsure of the life cycle of the appropriate kinds of timber to grow in NZ, I know hemp is relatively quick to mature and would be a better short term transition with perhaps some land (like with “set aside” systems in the UK) dedicated to early forestry as a long term investment. It would take a while for the timber to come online to help with the materials supply chain for the prefab house building.

### Gate to Gate

Once we have the materials (whether import or locally produced) we need to establish appropriate factories for building the housing elements which are then assembled to produce the houses. Hopefully we could learn from best practise, I am aware there is some prefab in NZ but it would need to be expanded rapidly to help handle the housing crisis and replace existing housing stock of poor quality. Looking at how this industry is operated in Germany and Sweden etc would be a good step to take to see how we could best adapt it to New Zealand.

Another issue which would be of concern to many kiwis is having ‘copy paste’ houses, this is easily managed by the following method:

Using Computer Aided design programs, have several pre-set variations for different houses, with varying numbers of rooms, footprints etc. Band them by size, cost etc. Allow people to design their own homes with the program ensuring they are feasible, perhaps have engineers/architects review plans and provide feedback on them (for a fee). Each house is made of the building elements

produced and so when a design is finalised, a parts list is automatically generated and forwarded to the factory/warehouse for production and sending to the construction site. This allows personalisation of the buildings. It would be important to ensure all designs were feasible, safe etc. When designs are approved they can then be shared much like with 3D printing. People could submit their designs for sharing and competitions could be held in different categories (affordable housing, deluxe, high capacity etc).

By combining expertise, CAD programs, and proper production and storage facilities for materials, houses can be designed and materials can be ready to go out of the gate in a matter of days.

The benefits of building houses in a prefab factory are:

1. Far better quality control over building elements (higher quality elements, less flaws in parts)
2. Lower (or no) material waste (offcuts can be reused or in the worst case chipped and used in a CHP generator to power and heat the facility)
3. Significantly reduced labour time/house, allowing far faster construction of houses
4. Potential for 'emergency housing/shelter' to be assembled quickly from stored materials in event of natural disasters.
5. Materials are stored in a secure environment meaning wood doesn't warp or waste in 'the elements'
6. Timber frame housing is some of the best for resilience to earthquakes and the most appropriate for many areas of New Zealand
7. Houses built this way will have better insulation (U values) than any other mass produced
8. Houses built this way will last longer than most others mass produced (assuming similar conditions and appropriate designs)

### Gate to site

When I worked at BRE, I saw a prefab house go up in 3 days, after foundations had been dug, laid and set (which took another week). It was weather tight within this time and ready for electricians, plumbers etc to do their work inside. I believe any new build house should be as water and energy efficient as possible, so I am assuming (ground source) heat pumps, solar water heating and PVC solar panels would all be installed where appropriate, along with water conserving and collection features. All of this can be done more affordably due to all the time saved using these construction methods, helping lower house prices while also improving home quality for as many kiwis as possible (if executed properly, this could be the future for almost all of us). With well organised production houses can go up and be ready to move into within around 3-4 weeks, allowing us to help alleviate the housing crisis while also meeting our Paris Climate commitments. Overall a campaign could be organised titled "Building a Better New Zealand" or something similar. I believe this is a project which we could get most kiwis to buy into and rally around. It is something aimed at benefiting literally every single person in this country and their children and future generations.

### Site to Grave

My hope is that these buildings would last a long time. When requiring maintenance occupiers can either do it themselves or even feasibly order in replacement parts (houses could be designed in a modular fashion and also ready for extensions which could also be ordered in the same fashion). As the elements would largely be timber, the timber could hopefully be reused, repurposed or recycled. If not, energy can be recovered from it in wood or co-fired CHP plants.

## Labour

All of this work will require skilled tradespeople to be on board. Either less would be needed or more could be done with the roughly the same numbers if using the above methods, as work could be organised much more efficiently in particular with the builders and carpenters. I believe that under the umbrella campaign of “building a better New Zealand” apprenticeship programs and retraining programs could be set up to encourage and help people into the trades generally. This can be done with the help of the private sector and public sector, and help move many people back into fulfilling work. The work at the prefab factories and warehouses wouldn't be too complex, and could be overseen with quality control and regular work shifts. I believe trades are hugely undervalued and hopefully they would will receive the additional support they need, in particular to help produce the workers we need to meet the challenges of climate change and the housing crisis, as well as the ‘business as usual’ of the country.

## Outreach

I believe this is an issue that the whole nation can get behind, both on a large scale and at a community level. Well run community outreach programs (or school/college trips) could be organised to help with land repurposing (afforestation, conservation etc). It may also be possible to get business to buy into it with a voluntary corporate sign up program, perhaps with bronze/silver/gold awards for companies demonstrating best practise. There are enormous possibilities with this challenge for it to be something that brings people closer together with a unified purpose.

## Energy Sector

New Zealand sits in a very promising position with so much of its energy already derived from renewable sources. So long as further energy generation and storage is pursued in the most sustainable way possible, I believe we can become net zero carbon by 2050.

## Energy Conservation

Energy conservation is often the first target for achieving emissions reductions. The above steps in domestic housing should significantly reduce energy demand for space heating/cooling. Good natural lighting and design can help with both the natural heating/ventilation and reduce energy demand there too. Energy saving light bulbs and ‘smart house’ features can also limit energy waste for other purposes within the house.

## Energy Generation

I believe we have more or less saturated hydroelectric possibilities in New Zealand in terms of dams, but there are many other technologies we can use in suitable combinations to help meet current and future energy needs sustainably.

## Geothermal

I went to a talk while working at Lancaster University on a new development in Geothermal energy where they dug deep to a magma chamber and got 10x the energy output than from a typical well. With practises like this we can explore appropriate expansion of geothermal sites, meeting local and national energy needs so long as the impacts to water table level and emissions are carefully handled.

## Solar PVC

With the price of PVC having halved in recent years this is perhaps the best option for generating significant portions of energy. Ideally this should be integrated with new builds and also rolled out to

the existing housing stock as much as possible. When people are able to fuel their own cars through their own solar panels the benefits may become even more apparent! Building roofs are in my opinion one of the greatest potential spaces to develop. They are often not utilised at all, and rather than using fields to house solar panels I think it should be done on roofs as much as possible, and have the fields used in better ways.

### Combined Heat and Power (CHP) Generation

Traditional centralised energy generation wasted enormous amounts of energy in terms of the heat which is 'waste'. This is most evident in the steam tower stacks in places like the midlands of the UK. Increasingly power stations are designed to reuse or utilise this heat in steam cycles amongst other methods, however the best adaptation is to have the energy generated as near the point of use as possible, where the heat generated can also be used. CHP plants can be run on wood pellets and other fuel sources, and can be set up in a municipal manner (as done in some Nordic countries) or for large buildings such as Hospitals, University campus' etc.

Fuel transport to CHP generation is one of the difficulties, however a decent infrastructure to do so isn't too hard to set up and much waste can be redirected from landfill to combustion at CHP sites.

### Wind

I am aware wind energy generation is a contentious issue for many people. I agree it's important to preserve the natural beauty of the country and they shouldn't be rolled out everywhere. However appropriate developments can be enormously useful, and there is significant potential for offshore wind developments as well.

### Tidal and Wave

Tidal and wave energy technologies have come a long way and can be combined in some cases with offshore wind to generate significant amounts of energy. Tidal barrages can have significant impacts on local ecology though so implementing these technologies appropriately is very important.

### Other Microgeneration Technologies

Solar water heating is a cheap and efficient technology that can help preheat water and significantly reduce the energy needed.

Ground Source Heat pumps perform a similar role to solar thermal panels, taking latent heat from the upper layers of soil and using it to preheat water or spaces.

I don't personally think micro-wind technology is that useful, but when used appropriately it can help. I generally think bigger turbines are far more effective and efficient.

"River pods" and micro hydroelectric generation technologies (water wheels etc) are feasible but not that many people have rivers etc nearby to utilise them.

### Energy Storage

One of the main criticisms of renewables is that the wind doesn't always blow and the sun doesn't always shine. Many people seem to not understand matching supply to demand is difficult using any form of energy generation and energy storage is needed in all cases. We have hydroelectric facilities which can be used for energy storage, but additionally I think a decentralised energy storage system is more beneficial and efficient. Making use of home batteries, electric vehicles (which can serve the same purpose) and converting water to hydrogen for energy storage as all possible and often more efficient than pumping water up and down dams.

### Energy repurposing and economic stability

The changes needed in our energy sector to meet our Paris Climate targets will be demanding and may be very difficult with the industry set up as it is. To implement a hydrogen economy we need an excess supply over demand of renewable energy or it is not zero carbon. Doing this requires a demand to be in place for the excess energy or prices will drop and there'll be huge conflicts of interest. Helping to establish the infrastructure for electric and hydrogen vehicles is imperative to allowing this transition to happen, and will be one of the most challenging tasks in becoming net zero carbon. In my opinion it would be most easily achieved by renationalising the energy sector generally, but hopefully other means can be found too as I believe this to be incredibly unlikely an outcome.

Having large amounts of renewable energy could also be used as a means of attracting other energy intensive industries such as data storage facilities or manufacturing companies keen to use 'green' energy for production. It could be a key selling point to attract businesses which want green credentials and allow for more economic growth in general as a country.

### Distributed Energy generation and storage

A promising possibility is to rethink how the energy infrastructure is designed entirely. Rather than centralised energy generation exporting energy to the users, sort of like the way lungs breathe in. We could have a net, or web, of energy trading and distribution and storage. If as many people as possible are generating electricity, and storing it, there are smart metres that can be used to trade energy at local and national (or international) levels.

With the right kind of implementation, this could make communities far more resilient to natural disasters, by allowing them to store additional energy if warned of storms or other events being likely (such as the recent storms that hit Auckland). I wrote a PhD proposal on setting something like this up and I am happy send that along if anyone is interested, though it was written when I was living in Lancaster, England, and addressing floods they had experienced there which also caused power cuts.

In short, this would allow more efficient and effective management of energy as it would be generated and stored as close to the point of use as possible. It would make communities more resilient to severe weather patterns which will become more frequent with climate change. It will also mean that after the initial capital investments, energy will essentially be 'free' or at least very low cost for running transport and homes and that will free up significant disposable income (assuming it didn't just contribute to further house price inflation).

## Transport

Auckland has a dangerous addiction to the car and unfortunately many historic opportunities to develop a better infrastructure for public transport were lost, however many good efforts have since been made to mitigate the problems.

The potential of self-driving and an electrified system is that we could look to have car sharing in a system much like Uber, but with self-driving cars servicing communities, either in a public or private model (thinking of hospital discharge patients etc as one example).

Beyond this it is perfectly possible to run almost all transport in cities with a zero carbon model. The 2 most difficult to tackle are ships and planes. Plane fuel can be synthesised and be net zero carbon, likewise ship fuel, both could also be fuelled by hydrogen if we are able to safely and effectively store it (research is moving forward with this). However overall I feel this will be something that

needs to be addressed further down the line and is an international issue rather than one that NZ should seek to solve in isolation.

## Conclusion

I have run out of time to write more and have cut many corners in explaining my overall vision of how I think NZ can meet its goals. I may also have stated the obvious in many parts but I wrote this partly in the style I was trained to at university where everything needs to be stated. I hope my input is helpful and I am more than happy to discuss these matters further should that be wanted. My contact details are in the overall submission data.