Some reflections on Farms, forests and fossil fuels: The next great landscape transformation?

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- The title of this conference is *Shaping our low emissions future*. I'm going to share some thoughts on how to do this by drawing on my recent report *Farms, forests and fossil fuels: The next great landscape transformation*.[1] I hope these insights are complementary to those you have heard this morning from Minister Shaw. I don't agree with every element of the proposed way forward, but I absolutely support the determination he is showing to make progress. New Zealand has been good at the theory of climate policy, but not so good on implementation. The Minister is determined to change that and he has my support.

- I have organised my talk into four parts. First, I will talk about something we clearly need to do – reduce fossil carbon dioxide emissions to zero. Second, I will talk about something we need to avoid doing – rely heavily on tree planting. Third, I will talk about how we might eliminate our carbon dioxide emissions from fossil fuel combustion. Finally, I'll conclude with some comments on the policies needed to get us there.

Why fossil carbon dioxide emissions need to be reduced to zero

- So let me start with why fossil carbon dioxide emissions need to be reduced to zero.

- Carbon dioxide is the main anthropogenic driver of global warming. Due to the extremely long lifetime of carbon dioxide in the atmosphere, the Earth's average temperature will not stabilise at any level until carbon dioxide emissions reach zero. Emitting carbon dioxide is like turning up a thermostat that cannot easily be turned down.

- Without strong action to reduce carbon dioxide we will be exposed to a wide range of increasing risks – sea level rise, species extinction and ocean acidification to name a few.

- To mitigate these risks, we need to tackle carbon dioxide as our top priority. Progress on other greenhouse gases, such as methane and nitrous oxide, can help reduce peak warming, but *only if* fossil carbon dioxide emissions are on a trajectory to zero.

- In other words, action on methane and nitrous oxide must be regarded as additional to, not a substitute for, action on carbon dioxide.

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[1] Parliamentary Commissioner for the Environment, 2019. *Farms, forests and fossil fuels: The next great landscape transformation?* Parliamentary Commissioner for the Environment: Wellington.

- In IPCC pathways that are consistent with staying below 2 degrees, global carbon dioxide emissions reach net zero by around 2070.
- For pathways consistent with 1.5 degrees, global carbon dioxide emissions need to reach net zero by around 2050.[2]
- Despite the clear message coming from the science community, carbon dioxide emissions are still going in the wrong direction. Global carbon dioxide emissions from fuel combustion increased again last year, to an historic high of 33 gigatonnes.[3]
- We are part of this concerning trend. New Zealand's gross carbon dioxide emissions have increased by 42 per cent between 1990 and 2017. The main drivers were road transport and chemical and food processing.[4]
- So it is clear that we need to reduce carbon dioxide – and fast.
- This is why I recommended in my report a target of reducing emissions of fossil carbon dioxide to zero in the second half of the century. I also recommended that we should not rely on forest sinks to achieve that target.

Why we need to avoid relying heavily on tree planting

- Why? I am deeply sceptical about a net zero target for fossil carbon dioxide that allows forest offsets.
- For forests to be a legitimate offset for fossil carbon dioxide emissions there needs to be broad alignment between the warming caused by emissions and the cooling effects of the sinks that are meant to be offsetting them. The problem is that there is no such alignment.
- This is because fossil carbon dioxide emitted into the atmosphere has a warming effect that lasts for centuries to millennia. By contrast, most forests store carbon on timescales that last from decades to centuries. There is a chance their carbon could be released due to fire, disease or land use change and then not fully recovered. Furthermore, these risks may be exacerbated by climate change.
- This misalignment between the near-permanent warming effects of carbon dioxide emissions, and the likely shorter-lived climate mitigation benefits of forest sinks, highlights that using carbon sequestration by trees to offset fossil carbon dioxide emissions comes with very real risks.

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[2] IPCC. 2019. *Special report on global warming of 1.5 °C*. www.ipcc.ch/reports/sr15/.

[3] IEA. 2019. *Global energy and CO_2 status report 2018*. webstore.iea.org/global-energy-co2-status-report-2018.

[4] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990-2017*. www.mfe.govt.nz/publications/climate-change/new-zealands-greenhouse-gas-inventory-1990-2017.

- To truly offset the impact of fossil carbon dioxide emissions, forest carbon pools would need to be maintained effectively in perpetuity. We have no way of knowing if we can do that.
- Further, the climate benefits of forest sinks are uncertain. For example, converting pasture to forest can have a warming contribution due to the reduced reflectivity, or albedo, of the land. There may also be cooling contributions at work. Hence, we simply do not know the full extent of the temperature effects of forests that well.
- These issues have led me to the conclusion that reducing fossil carbon dioxide emissions by, say, half and claiming to have covered the rest by planting forests is a bad idea.
- While the short-term costs of relying heavily on forest offsets are lower, it will almost certainly be at the cost of delaying serious action on reducing gross emissions.
- Relatively cheap forest offsets can be expected to significantly suppress the emissions price under the New Zealand emissions trading scheme. Indeed, that is their attraction to those who promote this path. If this is the case, there is likely to be less investment in innovation and the deployment of new abatement technologies to reduce gross emissions.
- New Zealand is the only country to fully integrate forest carbon sinks into an ETS alongside fossil fuel emissions. Other countries are happy to count increased forest sinks towards their national targets, but none is allowing direct substitution of one for the other.
- On the other hand, I see forestry having a vital role to play in climate mitigation through the offsetting of biological emissions. This is because the durations of the warming effects of biological emissions are better aligned with the duration of the climate mitigation benefits of trees. But, even in respect of biological emissions, a limit or discount factor for forest offsets should be considered because of the risks and uncertainties I've mentioned.

How we might eliminate emissions of fossil carbon dioxide

- So how do we get to zero fossil carbon? There are three things we need to do.
- One, greatly improve the energy efficiency of our buildings, vehicles and appliances.
- Two, transition to emissions-free methods for supplying electricity, generating heat and transporting people and goods.
- Three, shift to alternative production processes for steel, aluminium, cement and other industrial products and/or substitute less emissions-intensive materials in place of these materials.
- Energy efficiency is often one of the cheapest and most effective ways to reduce carbon dioxide emissions. Saving energy minimises the amount of investment needed in new energy supply infrastructure.

- Many of our existing buildings will still be around in 2050. So we need to retrofit existing buildings in addition to putting in place more ambitious standards for new ones. This is why the New Zealand Green Building Council and Enviro-mark Solutions are currently working on a new zero carbon standard for existing buildings.[5]

- The efficiency of New Zealand's vehicle fleet is poor by international standards. Only two other OECD countries – the USA and Australia – use more energy per passenger kilometre.[6] The lack of fuel efficiency standards for vehicles means that New Zealand risks remaining a dumping ground for second-hand vehicles that cannot be sold in other countries.

- New Zealand has been a pioneer when it comes to harnessing renewable energy sources for electricity generation. But we still rely heavily on fossil fuels for transport and heating.

- Deep decarbonisation of our energy system will require us to develop a flexible system that draws on a diverse range of renewable energy sources – wind, solar, hydro, geothermal, and maybe wave and tidal power. These sources will need to work together with energy storage technologies such as pumped storage, batteries and hydrogen. All need to be integrated to meet demand.

- In the modelling I commissioned for the *Farms, forests and fossil fuels* report, by 2075 the largest contributions to electricity generation come from utility-scale solar PV, hydro, wind and geothermal. This is a result of assumptions that consider sustained technological improvements and reduced capital costs to be plausible outcomes.

- The modelling also indicates a rapid switch to electric vehicles with over 95 per cent of New Zealand's light vehicle fleet being electric by 2075. Though not included in the model we used, other energy carriers such as hydrogen might also provide a solution for heavy transport.

- Turning to industry, direct emissions from industrial processes make up roughly 15 per cent of New Zealand's gross carbon dioxide emissions.[7]

- New Zealand's heavy industrial emitters are unlikely to find solutions by themselves, but they are part of global industries that are taking the search for solutions seriously.

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[5] NZGBC and Enviro-mark Solutions. 2019. *New Zealand Net Zero Carbon Buildings Standard Consultation Paper.* www.nzgbc.org.nz/Attachment?Action=Download&Attachment_id=2108.

[6] IEA. 2018. *Energy Efficiency Statistics*. www.iea.org/statistics/efficiency/.

[7] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990-2017*. www.mfe.govt.nz/publications/climate-change/new-zealands-greenhouse-gas-inventory-1990-2017.

- For example, Rio Tinto, Alcoa and Apple are working together on an alternative method for producing aluminium that uses inert anodes and cathodes instead of graphite ones. This technology could essentially eliminate direct carbon emissions from aluminium plants.[8]

- In the case of steel, a new pilot facility under construction in Sweden will produce steel using hydrogen from renewable electricity. The only emissions will be water vapour.[9]

- If there is a need for any ongoing carbon dioxide emissions, these will need to be compensated for by carbon capture, utilisation and storage technologies that remove an equivalent amount of carbon dioxide out of the atmosphere permanently.

- Broadly speaking, carbon capture can be split into two main approaches. Firstly there are those that seek to capture carbon that is being emitted in high concentration from the chimney or exhaust of some process or power station. Secondly, there are those that seek to capture carbon directly from the air – in some ways artificially replicating what plants do as they photosynthesise.

- Regardless of how the carbon is captured, it needs to be stored in a permanent way. Some approaches are looking to pump carbon dioxide deep underground, where it is either trapped by rock layers or even reacts with them to form carbon-containing rock.

- Some of these technologies for capture and storage are still at the early stages of development, with pilot or demonstration plants in operation. But if new methods to sequester carbon become commercially viable and deployable at scale, then they should be included in fossil carbon dioxide emissions targets providing they can demonstrate a more permanent and reliable method of storing carbon than trees, soils and other terrestrial ecosystems.

What types of policies might help us get there

- Finally, what types of policies are needed to shift our economy – and indeed all economies – onto a low emissions trajectory?

- Emissions pricing should be an indispensable element of climate policy packages. Emissions pricing can work, provided the prices make a meaningful difference. Unfortunately they often don't. New Zealand is a case in point.

- The emissions price created by the New Zealand Emissions Trading Scheme is currently around $25 per tonne of carbon dioxide. At that level, the price of a litre of petrol at the pump is about six cents higher than it would be without the emissions price. That's not really enough to change driver behaviour.

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[8] Rio Tinto. 2018. *Rio Tinto and Alcoa announce world's first carbon-free aluminium smelting process.* www.riotinto.com/documents/180511_Rio_Tinto_announces_worlds_first_carbon_free_aluminium.pdf.

[9] Reuters. 2018. *Swedish steel plant to run on hydrogen.* af.reuters.com/article/africaTech/idAFL8N1PR4R2.

- It has been estimated that in the short run, average global emissions prices would need to rise to between 40 and 80 US dollars per tonne of carbon dioxide by 2020 if we're to be on track to achieve the objectives of the Paris Agreement. And even higher prices will be needed beyond that.[10]

- Not only are emissions prices currently too low in New Zealand and the rest of the world, the coverage of emissions pricing is often limited. Eighty five per cent of global emissions are not currently priced and about three quarters of the emissions that *are* covered by an emissions price are priced below ten US dollars per tonne of carbon dioxide.[11]

- The modelling commissioned for *Farms, forests and fossil fuels* that I referred to earlier saw prices rising to $350 per tonne of carbon dioxide by 2075 to reach a zero fossil emissions goal.

- The reality, of course, is that many opportunities to switch away from fossil fuel consumption will present themselves long before prices reach anything like $350 per tonne of carbon dioxide.

- The real issue is how that price evolves from its current level. It needs to rise steadily and consistently to send an unequivocal signal that fossil emissions will only become more expensive.

- Many of the relatively cheap options in other countries for mitigating fossil emissions from the energy sector, such as substituting renewable energy for fossil fuel combustion, have already been adopted in New Zealand. However, fossil emissions from transport, industry and the built environment are still significant and rising. Strong action to reduce these emissions remains a priority.

- In many sectors – such as transport – technologies are rapidly developing that any half-decent emissions price will bring forward. But there are always hard cases. Steadily rising emissions prices could soon compromise the competitiveness of some emissions-intensive sectors, such as steel, aluminium, cement and aviation. The temptation is to delay a credible and rising economy-wide fossil emissions price to protect these emitters.

- I don't think it makes sense to have the hard cases dictate our path forwards. While we're waiting for some of those technological breakthroughs I mentioned earlier, it might be better to explore some pragmatic sectoral solutions where needed and let the emissions price for the rest of the economy continue to rise. For instance, my report suggested limited access to international units of high environmental integrity.

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[10] High-Level Commission on Carbon Prices. 2017. *Report of the High-Level commission on Carbon Prices.* www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices

[11] World Bank, Ecofys and Vivid Economics. 2016. *State and Trends of Carbon Pricing 2016*. World Bank, Washington DC: World Bank.

- Transitional policies should aim to enable a steady transition – one in which industrial emitters are neither overly disrupted nor so protected that there is no incentive to switch to less emissions-intensive materials.

- For decades now, economists and policymakers alike have argued that the 'least cost' way to reduce fossil emissions is to develop emissions pricing. Unsurprisingly, governments around the world, including New Zealand have followed this advice.

- But other policies can also address the need to reduce our path dependency on fossil fuels and divert capital to cleaner technologies. For instance, directly limiting the supply of fossil fuels.[12] Last year, New Zealand embarked on one such climate policy through the amendment of the Crown Mineral Act to prohibit any new exploration of fossil fuels either offshore or onshore outside the Taranaki region.

- New Zealand is not alone in adopting these complementary climate policies. Several other countries have also recently adopted such policies, including France, Denmark and Costa Rica.[13]

- In an effort to tackle climate change effectively we need both emissions pricing and complementary policies such as energy efficiency standards, research and development incentives, and policies to limit the supply of fossil fuels.

- Deep decarbonisation of our energy, transport and industry sectors is necessary to mitigate the major risks that climate change poses to our environment, our financial systems and our communities. This transition needs to happen sooner rather than later.

- It also needs to happen globally. New Zealand is a small developed economy. We need large economies – developed and developing – to take the issue as seriously as we do. To demand that they do, we have to play our part in tackling carbon dioxide emissions. We are likely to be a technology taker in most cases, but some diversion of auction revenues to promote technological innovation could be warranted. By contrast, encouraging industrial emitters to plant trees will achieve little in the way of permanent emissions reductions.

- On the other hand, we need to demonstrate leadership in the one area where we are, plausibly, a leader – agricultural emissions. Tree planting makes better sense in that context. But emissions also have to fall. This should be where much of our innovation and research and development should focus. If any country can point the way to climate friendly food production systems it should be New Zealand.

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[12] These policies are also likely to have relatively low administrative and transaction costs. See Green, F and Denniss, R. 2018. Cutting with both arms of the scissors: the economic and political case for restrictive supply-side climate policies. *Climate Change*, 150: 73-87.

[13] Erickson, P, Lazarus, M and Piggot, G. 2018. Limiting fossil fuel production as the next big step in climate policy. *Nature Climate Change*, 8: 1037-1043.

- The ‘shape’ of a low emissions future in New Zealand will involve costs. But it also holds opportunities. Getting our policy settings right will determine whether we minimise the former and maximise the latter.