NZIER INSIGHT

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Four ways to improve climate change policy and why

Climate change is becoming more apparent in the succession of major adverse weather events in recent years, with increased severity of storms, floods, landslips, droughts and wildfires and associated damage and disruption. A warming atmosphere is also raising chronic risks of sea-level rise from thermal expansion of the oceans and melting ice caps and glaciers, shifting boundaries of climate zones that create new risks for biosecurity and stranding assets in locations where they no longer function as intended.

New Zealand's policy on climate change has also recently stepped up a gear after decades of apparently minimal activity. But are the new policies the right mix to limit climate change impacts and build resilience?

Looking in turn at the nature of the climate change challenge, the economics of adaptation and mitigation and New Zealand's evolving policy responses, we apply an economic lens to the current mix of responses to climate change and consider whether New Zealand has its priorities right and what might be done to improve them. Some of this will seem familiar to those who follow the issues, but other parts are often overlooked in the common commentary. This Insight is a discussion starter on refining responses to climate change.

Changing climates pose difficult choices

Faced with risks of climate disruption, people can accept them and weather the changes by making repairs where necessary, or they can attempt to anticipate and mitigate impacts by:

- Adapting to the new conditions, building resistance to impacts and resilience to get through events and enable swifter recovery afterwards, or maybe retreat from untenable areas; or
- Reducing the cause of the problem through abatement of greenhouse gas emissions or removing carbon already in the atmosphere by creating carbon sinks in forests or other means of carbon capture and storage.

Choosing what combination of options to adopt raises economic questions about how to make the most of resources deployed for the wellbeing of those alive today and future generations. How effective and efficient are actions likely to be at making progress at home and supporting the international cooperation required for widespread mitigation? How will the impacts of climate change and its remedies be distributed? What balance of effort should be put into adaptation or emission reduction, and over what timeframe? How robust are responses to future changes, and what are the fallback options if current approaches don't work?

There is now widespread scientific agreement that human actions are exacerbating the current global warming trend by increasing emissions of greenhouse gases that accumulate in the atmosphere and trap heat that would otherwise be reflected back into space. In the context of the atmosphere, these are all trace gases, small in volume but with a disproportionate impact on the temperature on Earth. The predominant greenhouse gas, carbon dioxide, has increased from around 270 parts per million in pre-industrial times before 1750 CE to around 412 parts per million today. This has raised the global mean temperature by about 1.2°C over the same period.

This rise in atmospheric carbon and temperatures has been driven by growth in industrialisation and increasing extraction and use of carbon-based fossil fuels of coal, oil and natural gas. Combustion of such fuels releases carbon to the atmosphere that has long been out of circulation, in some cases up to 300 million years since the Carboniferous Era.

Climate change is a problem too big for New Zealand to solve alone. Accounting for just 0.17% of global greenhouse gas emissions, no amount of change in New Zealand's emissions will substantially affect the climate it receives. But demonstrating a reduction in New Zealand's emissions would show support for international agreements and could encourage other countries to contribute to more substantive international action to reduce emissions. To date, there is little evidence of that happening, and most countries are lagging their stated emission reduction targets.

Carbon is the main culprit

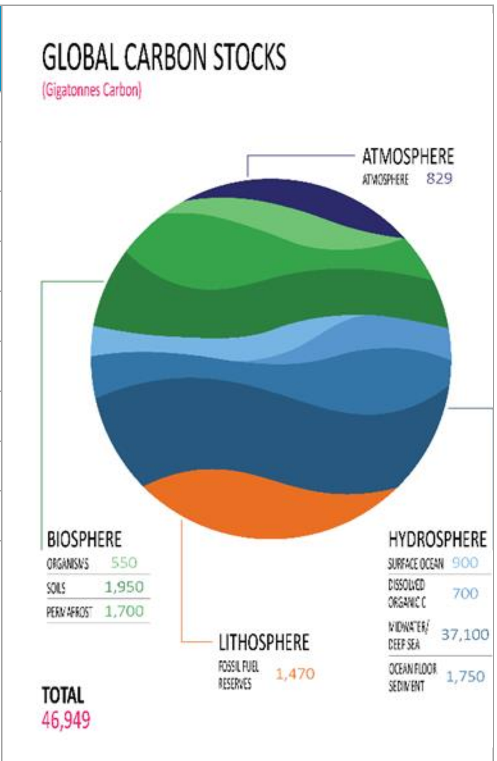
Estimates of planetary carbon stocks show that most are contained in the Earth's crust, with only small amounts released each year for uptake by organisms and the atmosphere through erosion, mineral decomposition and volcanic eruptions. Table 1 shows estimates of global carbon stocks accessible to short-term cycling through natural planetary systems. The speed at which it cycles varies with the individual stocks – relatively rapid between organisms and atmosphere, slower between the atmosphere and the sea, and very slow into the deep sea and ocean floor sediments.

The Earth's ecosystems can absorb natural rates of carbon release, with carbon storage in vegetation, soils, surface waters and the deep ocean, some of which gets buried and metamorphosed into sedimentary rocks over a much slower geological time scale. But the current rates of addition of greenhouse gases exceed the capacity of Earth systems to absorb all the carbon emitted, resulting in these trace gases accumulating in the atmosphere, warming the planet and increasing the energy and moisture in storm systems, widening their geographical range and extent of potential damage. Change in the atmosphere's composition is further exacerbated by human deforestation and other land use changes that release carbon, such as draining wetlands that increase methane emissions.

Table 1 Global carbon stocks accessible to the fast carbon cycle

Excludes carbon in rocks in the Earth's crust and magma, which cycles very slowly

Zone	Domain	Gigatonnes (Gt) Carbon
Atmosphere	Atmosphere	829
Biosphere	Organisms	550
	Soils	1,950
	Permafrost	1,700
Hydrosphere	Surface ocean	900
	Dissolved Organic C	700
	Midwater/deep sea	37,100
	Ocean floor sediment	1,750
Lithosphere	Fossil fuel reserves	1,470
Total		**46,949**



Source: https://www.pmel.noaa.gov/co2/story/Carbon+Cycle

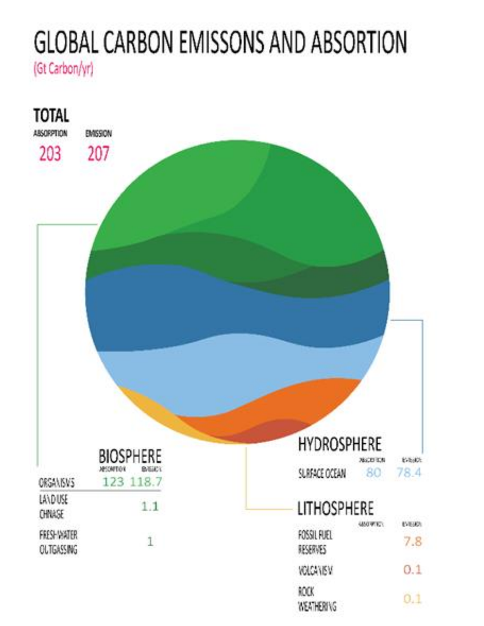
Table 2 shows the estimated global flows of carbon into and out of the respective stocks each year. Organisms and the ocean absorb more than they emit annually, with a combined net absorption of 5.9 Gt, more than enough to outweigh combined emissions of volcanism, rock weathering, freshwater degassing and land use change.

But fossil fuel emissions, virtually all of them originating from human actions, are sufficiently large to result in net gain in emissions from these combined systems of 3-4 Gt per year, resulting in more carbon accumulating in the atmosphere.

Table 2 Global carbon flows between the atmosphere and other stocks in the fast carbon cycle

Gigatonnes (Gt) Carbon per year

Zone	Domain	Absorption	Emission
Biosphere	Organisms	123	118.7
	Land use change		1.1
	Freshwater outgassing		1.0
Hydrosphere	Surface ocean	80	78.4
Lithosphere	Fossil fuel emissions		7.8
	Volcanism		0.1
	Rock weathering		0.1
Total		**203**	**207**



Source: https://www.pmel.noaa.gov/co2/story/Carbon+Cycle

Current records of human-induced greenhouse gas emissions measured in carbon dioxide equivalent units on a 100-year Global Warming Potential (GWP) to account for each gas's different warming potency and duration show that the predominant gas is carbon dioxide from fossil fuels and land use change (LULUCF). Other prominent greenhouse gases include methane, which accounts for just under 20% of total emissions; nitrous oxide, for about 6% and synthetic fluoridated gases, for about 2%, as illustrated in Figure 1.

Over half of global methane emissions are derived from fossil fuel production and use and add to atmospheric carbon. The remainder is 'biogenic' methane derived from livestock digestion and vegetation removal, sourced from carbon already in circulation through the Earth's ecosystems. Biogenic methane is carbon neutral but not warming neutral for the atmosphere (New Zealand Agricultural Greenhouse Gas Research Centre 2021).

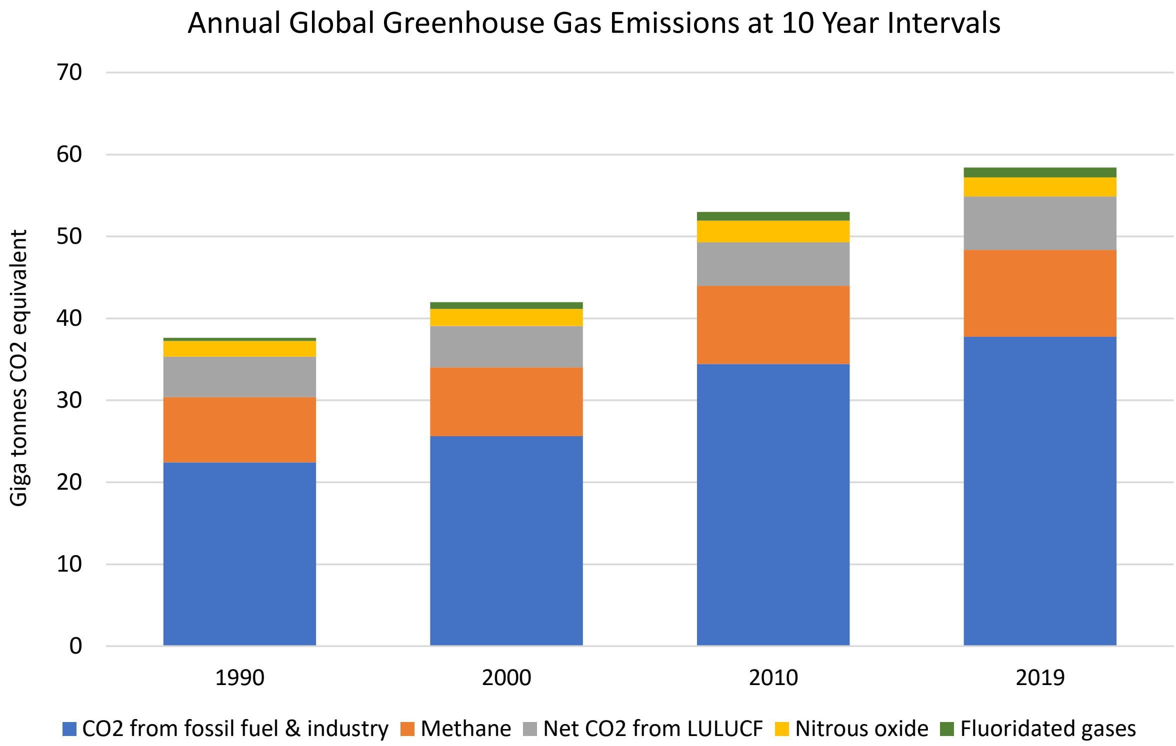
Methane has a high GWP but is a short-lived gas. This presents challenges in estimating equivalence with carbon dioxide and other long-lived gases, whose warming effect lasts indefinitely; treating all methane, both fossil-based and biogenic, in the same way risks distracting efforts by over-stating the warming effect of biogenic methane, which does not add carbon to the atmosphere.

A recent report extrapolated recent livestock farming growth rates into the future to conclude that extreme heating from methane was possible in the absence of fossil fuel emissions, but without examining whether that expansion is economically or technically feasible (Clark et al. 2020).

Another highlights the lack of focus on agricultural emissions in most countries and suggests applying a 20-year GWP to lift the weighting on methane emissions to accelerate the achievement of short-term emission reduction (IATP 2022).

Such results may be possible but are not probable and distract from a more likely route to a reduction in global warming, in deeply cutting fossil fuel emissions where substitute non-fossil energy sources and activities are available.

Figure 1 Global greenhouse gas emissions rising over time



Source: NZIER, drawing from IPCC Assessment Report 6

New Zealand is challenged by its peculiar mix of greenhouse gas emissions

As shown in Figure 2, New Zealand has a distinctive greenhouse gas emission profile, with carbon dioxide and methane having roughly the same share of annual emissions (about 44%). Its large share of agricultural emissions of predominantly methane (CH_4) and nitrous oxide (N_2O) gives it a unique emission profile among OECD countries. Around 80% of New Zealand's methane emissions are derived from livestock farming, causing a skewed perception among some commentators and the wider public that farming is New Zealand's principal greenhouse gas polluter and should face deep emission cuts. But these emissions are biogenic in origin and do not add to the carbon circulating in the biosphere. They are also difficult to reduce with current farming practices without reducing production, which would cause associated revenue losses to farmers, upstream supply industries and downstream processing industries.

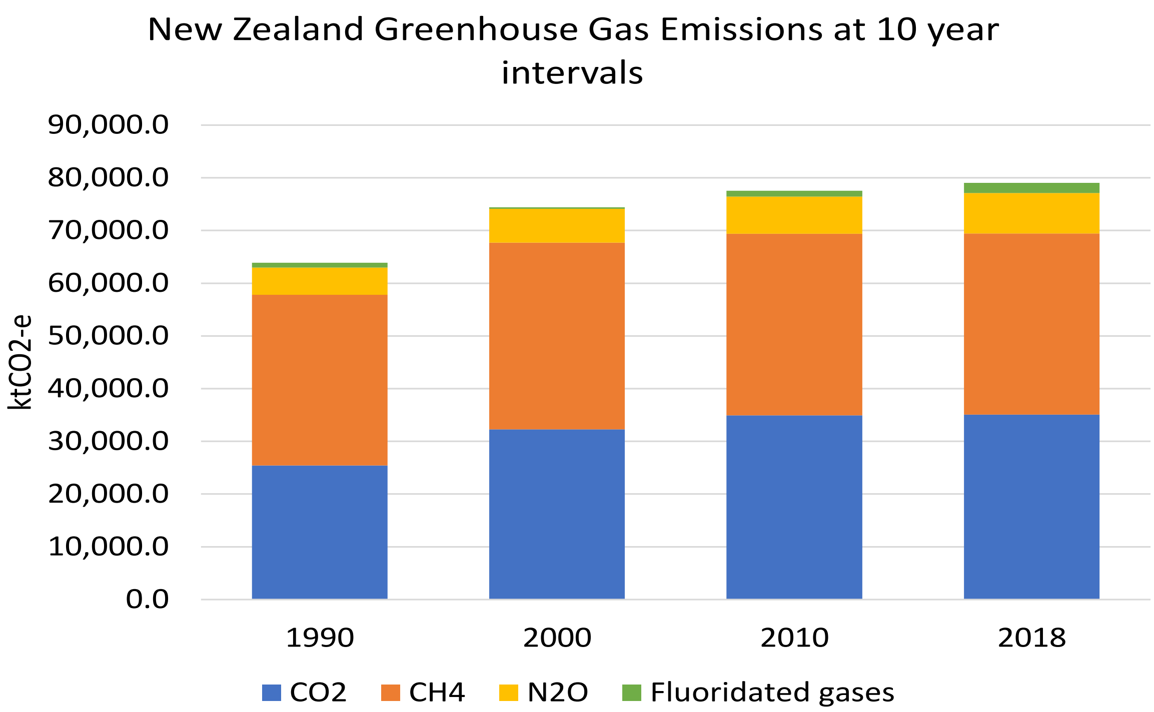
Calls to cut New Zealand's livestock numbers often conflate their impact on climate change (which is negligible on a global scale) with their local environmental effects, such as deteriorating water quality and biodiversity loss. As a single instrument can best handle a single issue (Tinbergen 1952), local effects are more efficiently dealt with through mechanisms tailored to local conditions by regional councils than by using global emission policies with more widespread implications.

New Zealand's pasture-based farming has been shown to have a low carbon footprint compared to many other countries' livestock production.

Lincoln University researchers demonstrated that New Zealand apples, beef, lamb and dairy products delivered to the UK market all had lower costs and environmental footprints than their British-produced counterparts, despite their greater 'food miles' (Saunders, Barber, and Taylor 2006). A recent AgResearch review found New Zealand dairying had the lowest emissions of all the countries studied (DairyNZ 2022). So, a reduction in New Zealand's farm production and exports could result in other countries with higher emitting systems increasing their livestock production, causing what's known as 'carbon leakage'. Such a result would be economically damaging for New Zealand and counter-productive to the international aim of reducing emissions. So, a 'split-gas' approach that treats biogenic methane differently from long-lived gases like carbon dioxide is rational on both carbon accounting and economic grounds.

Targeting farm production to lower emissions also undermines New Zealand's competitive advantage in having the space to convert cheap inputs of sun and rain to grass and hence to valuable animal protein. Land use capability mapping indicates only 15% of New Zealand's land area is flat enough to be practically used for cropping. Land released by farm production could be taken up by afforestation which sequesters carbon for offsetting, but the risk that forest fires or other land disturbance could re-emit CO_2 means such land use change does not provide secure or permanent removal of carbon from the atmosphere.

Figure 2 Emissions recorded in the New Zealand Greenhouse Gas Inventory



Source: NZIER, drawing from New Zealand's Greenhouse Gas Inventory

Table 3 shows the emissions attributable to different production sectors and households in New Zealand in 2020. Agriculture accounts for about half the emissions, manufacturing for 13%, service industries for about 9% (of which over half is due to transport), electricity and gas supply for 7% and waste and water services for just under 4%. Household consumption accounts for nearly 10%, of which nearly 90% is attributable to transport.

While it would be simple to suggest making pro rata cuts in emissions across all sectors, that would be an economically costly way of reducing emissions. It would be more efficient to focus on emission sources offering greater emission reduction per unit cost.

Livestock farming and processing industries account for about 8% of New Zealand's GDP and about 40% of its exports, so deep cuts in production to reduce emissions would have a noticeable adverse economic impact. There are currently limited ways to cut livestock emissions other than by reducing livestock numbers and production.

Around 10% of methane emissions could be avoided by the least efficient farmers fine-tuning their practices towards those of the most efficient farmers, and more emission reductions found from measures such as methane-inhibiting feed supplements applied to dairy cows during daily milking. But there are no easy options for large emission reductions from pastoral livestock production that are not already being taken up.[1]

Table 3 New Zealand emissions appear agriculture-heavy

Sector	Gross emissions 2020	
Agriculture share of total emissions		**52.0%**
In which: beef, sheep and grain farming	*27.7%*	
Dairy cattle farming	*21.6%*	
Poultry, deer and other livestock production	*1.4%*	
Horticulture and vegetable farming	*0.7%*	
Forestry share of total emissions		**0.7%**
Fishing, aquaculture and support industry share of total emissions		**0.7%**
Mining share of total emissions		**1.5%**
Manufacturing share of total emissions		**13.2%**
Construction share of total emissions		**1.8%**
Electricity and gas supply share of total emissions		**7.0%**
Water, sewerage and waste services share of total emissions		**3.7%**
Service industries share of total emissions		**9.4%**
In which: road transport	*2.9%*	
Rail, water, air and other transport	*3.2%*	
Households' share of total emissions		**9.9%**
In which: transport	*8.7%*	
Heating/cooling	*0.9%*	
Other	*0.3%*	

Source: Statistics New Zealand Greenhouse Gas Emissions by Industry and Household

1 https://www.agmatters.nz/goals/reduce-methane-emissions/

In search of an economic response…

Economic capacity governs countries' ability to respond to climate change through adaptation and emissions abatement. Economics provides a range of guiding considerations for devising responses.

It is efficient to pursue measures to counter climate change to the point where the marginal cost of the measures equals the marginal benefit obtained. This minimises the combined cost of mitigation actions and damage caused by climate change.

That applies to both adaptation and abatement, so in principle, there is an optimal mix of each approach.

Climate change is defined by externalities

However, controlling emissions of greenhouse gases is complicated by externalities that land on unwitting third parties. A tonne of greenhouse gas emitted will mix and circulate in the atmosphere and contribute to adverse effects potentially anywhere in the world. This causes a negative externality as the emitter does not face the full cost of the emissions. Similarly, someone reducing emissions will not receive the full benefits of such restraint, the averted cost of emissions worldwide. These externalities fall beyond the jurisdiction of local or national governments. If they remain unrecognised and unaccounted for, negative externalities of climate damage will be oversupplied, and positive externalities of emission abatement will be undersupplied relative to the economically efficient situation of equalised marginal costs and benefits.

Greenhouse gas emissions create a global externality with implications for the distribution of causes and effects across countries and also across time periods, as the accumulation of greenhouse gases builds up the potential for future disruptive outcomes. Historically, most greenhouse gas emissions have been released by activities in the now rich developed countries, but global warming may be most disruptive in countries that contribute little to the problem (e.g. low-lying island states).

There is also an inter-temporal externality in that actions taken today are affecting the prospects for future generations, depriving them of the relatively equable climates known in the past and conferring more extreme and disruptive climate conditions.

The value of everything and the price of nothing

Climate stability is a conditionally renewable natural resource, which can be sustained given the maintenance of atmospheric balances within bounds. Influences like solar inflow are outside of human control, but human activities have been violating these sustainability conditions for the past 250 years, destabilising the balance of atmospheric composition, principally by increases in fossil fuel combustion since the industrial revolution.

Emitting long-lived gases like carbon dioxide that change critical balances in atmospheric composition with outsized effects on warming and climate change have long-term externality effects that create a 'user cost' that is not reflected in the costs of extracting and supplying fossil fuels. That is part of the social cost of fossil carbon emissions that is not shared by biogenic emissions and a reason for the latter to face a lower carbon cost than fossil emissions and a split gas approach that treats biogenic and long-lived gases separately.

Dealing with emission externalities by correcting their prices is one response to climate change. Carbon taxes and emissions trading leave emitters to find their least costly options between reducing emissions or paying their price. Other financial instruments, such as electric vehicle subsidies or providing public transport free to users, will be incomplete if they do not correct the mispricing of emissions, as under-pricing leads to excessive emission levels.

Under-pricing of emissions is a symptom of externalities, resulting in emitters not facing the full costs of their decisions to emit or abate. A wide range of activities are potentially 'distorted' by this mispricing of externalities – for instance, transport-related activities will be excessively transport-intensive in economic terms as fossil fuels have been under-priced over the past century and face substantial adjustment to a world in which transport use reflects full social cost of emissions.

Climate-friendly transport in the future may mean not just replacing current vehicles with low-emission vehicles but also covering the cost of new externalities such as replacing and recycling batteries.

Emission prices have been too low

There are various methods of putting a monetary value on emissions, the principal ones being:

- Carbon prices in Emission Trading Schemes (ETS): these are a clearing price in a controlled market for access to the restricted stock of emission units
- Abatement cost, also known as the 'shadow price of carbon', measures the opportunity costs to an economy of reducing emissions by one tonne
- Social Cost of Carbon (SCC) is the global cost attributable to a tonne of GHG emission (i.e. the damage done to global wellbeing by an additional tonne of emissions) – this needs bespoke estimation and varies widely with estimation process and assumptions about damage coverage, attribution to climate change, discount rates applied to future damage from accumulating emissions etc
- Public willingness to pay for carbon emission reductions, inferred through stated preference surveys.

The price of carbon revealed through emissions trading schemes does not represent the full social cost of carbon reflecting the damage caused worldwide per additional tonne of carbon emitted, as it is a clearing price in a market that can be manipulated to affect prices faced in the market. This is evident in the widely varying prices for carbon in different emissions trading or carbon pricing schemes around the world. An article in *The Economist* magazine shows that at the end of 2021, more than 21% of global emissions were covered by some form of carbon pricing, but only a handful of schemes, covering 3.8% of emissions, priced emission units above US$40/tonne CO_2-e (NZ$58) recommended as the minimum value of the social cost of carbon (The Economist 2022).

With prices edging NZ$70/tonne at that time, New Zealand's ETS was one that did, but only relatively recently. Up to 2015, the New Zealand ETS allowed foreign carbon credits of sometimes dubious validity to be used to cover emission obligations, driving the market price in New Zealand below $10 per tonne, too low to encourage much emission reduction or carbon credit creation.

Some other schemes sold units too cheaply to reduce emissions. The world's largest ETS in China had a price of US$9/tonne (NZ$13.26), while the EU ETS had a unit price of US$97/tonne (NZ$143). Studies suggest the emission unit price should be US$200 (NZ$294) or more (Rennert et al. 2022). As a global externality, an efficient price would be the same in all countries, so the current global response to emission reduction is economically inefficient.

Mitigation options vary in effectiveness and potential

Table 4 outlines some options for emission reduction from the IPCC's 6th Assessment Report (IPCC 2022), which distinguishes options by their net lifetime cost per tonne of emissions averted and by the size of the opportunity to apply them worldwide, from the highest at the top of the table to the lowest at the bottom. Thus, solar and wind energy have low net lifetime cost and potentially extensive potential application, whereas a shift to bikes and e-bikes, although low cost, has very limited potential to displace higher emitting modes from transport because they are slow and of limited range and only provide a substitute for a small fraction of modern urban transport needs.

Table 4 Mitigation options in descending order of potential emission reduction

Low Net Lifetime Cost	High Net Lifetime Cost
Solar Energy	Reduced forest conversion
Wind Energy	Carbon sequestration in agriculture
Efficient lighting & equipment	Ecosystem restoration, reforestation
Avert demand for energy services	Fuel switching
Fuel efficient light vehicles	Improved sustainable forest management
Shift to public transport	High energy performance new buildings
Shipping - efficiency/optimisation	Energy efficiency
Fuel efficient heavy vehicles	Material efficiency
Reduce methane from solid waste	Bioelectricity
Reduce methane from oil & gas	Biofuels
Reduce fluoridated gas emissions	Enhanced recycling
Aviation - energy efficiency	Reduce agricultural CH4 & N2O
Shift to bikes and e-bikes	Carbon capture and storage
Nuclear energy	On-site renewable building production

Source: IPCC Assessment Report 6 SPM7 (IPCC 2022)

Conversely, reducing forest conversion or reforestation has wide potential applicability worldwide but comes at a high lifetime cost because most of the new sequestration benefit occurs in the span of the first rotation of new (or restored) forest, whereas the opportunity cost of alternative uses of land recurs every year and accumulates over time. Other current processes and technologies available for carbon capture and storage have both high costs and applications limited to certain locations with the right geological conditions for storing carbon where it cannot escape back into the atmosphere.

Cross-border issues complicate matters

Because greenhouse gas emissions cause global externalities, international agreements have been negotiated to guide concerted action on global emissions abatement, with high points in:

- The formation of the United Nations Framework Convention on Climate Change in 1992, which established the protocols for measuring and reporting greenhouse gas emissions and removals (sequestration).
- The Kyoto Protocol in 1997, which set a framework for international emissions trading, enabling countries that could achieve emission reductions easily to create emission reduction credits that they could sell to other countries that needed them so as to find the least cost way to global emission reduction; but the Protocol failed to gain traction, with major countries not ratifying and other countries wary of the validity and verification of cross-border trading.
- The Paris Agreement in 2015, whereby each signatory state made commitments to a nationally determined contribution to reducing net greenhouse gas emissions to levels that aimed collectively to restrain global warming to 1.5°C above pre-industrial levels by the end of the century.

The COP27 (Conference of Parties) in 2022 issued an agreement on setting up a remediation and compensation fund that poor countries can draw on to assist their climate change adaptation, and to which richer developed countries contribute due to their responsibility for historic emissions that have contributed to global warming to date. As with earlier international agreements, it remains to be seen how far countries' subsequent actions match their stated commitments.

All countries rely on concerted global action to curb greenhouse gas emissions but can free-ride on others' actions. However, doing so may expose them to consumer backlash or border carbon tariffs in key markets, so there is a reputational value in countries complying with joint efforts.

The international community of nations has been likened to a club in which no one can enforce compliance unless there is cooperation from a sufficient number of countries that they can ostracise the non-compliant into submission (Nordhaus 2015). Membership of the club and adherence to rules is voluntary, and countries will join if they see a tangible benefit that is not disproportionately small compared to their costs.

New Zealand's response has shown initiative at times…

New Zealand's response over time has been supportive of international action on climate change but wary of incurring costs in doing so. Prominent features have been:

- Early establishment of an emissions reporting structure and instigation of a Working Group on Carbon dioxide Policy (WOGOCOP) which, although making no firm recommendations, did point officials towards favouring emissions trading over a carbon tax, because, with a quantity restriction and a market determining emissions price, it appeared more likely to achieve the intended emission reduction than a government trying to set the right tax rate to achieve the same end (WOGOCOP 1996).
- Design of an emissions trading scheme for the Kyoto Protocol's 2008-2012 commitment period, with various refinements and concessions to lower the cost of emissions for industries deemed at risk of competition from foreign suppliers not subject to emissions restraints – New Zealand's ETS had no international trading other than access to foreign carbon credits that drove emission prices down; the ETS was retained in operation after the end of the Kyoto commitment period, and in 2015 the concessions and access for foreign credits were curtailed – the ETS remains central to New Zealand climate policy, although its price likely understates the long-term global social cost of carbon.
- In 2019 New Zealand passed its Climate Change Response (Zero Carbon) Act to set the framework for New Zealand to meet its Nationally Determined Contribution target in line with the 2015 Paris Agreement. It adopted a split gas approach, seeking by 2050 a reduction of biogenic methane emissions by 24% to 47% below 2017 levels, whereas other long lived gases (CO_2, N_2O and synthetic gases) were required to meet Net Zero Carbon, i.e. Gross Emissions would be matched by Removals by new forest growth. It also established the Climate Change Commission (CCC) to provide a road map for emission reductions across sectors and the He Waka Eke Noa (HWEN) consultative group to consider how to reduce agricultural emissions without reducing production.

…and research has followed suit…

In 2018 the New Zealand Productivity Commission reviewed what it would take to transition to a low-emissions economy by 2050, identifying three principal tasks: stop burning fossil fuels and switch to lower emission power; invest in substantial new afforestation; and change agriculture's structure and methods (Productivity Commission 2018).

It concluded that emissions pricing is essential as price pervades the whole economy, but the carbon price needed to rise to around $75/tCO2-e in the near term, and to around $200 in the decades ahead. It recommended a 'split gas' approach with an alternative emissions pricing system for agricultural methane outside the ETS, recognising its distinctive characteristics. It called adopting electric vehicles (EVs) New Zealand's most significant opportunity to reduce transport emissions.

In 2020, the Government issued a consultants' report on marginal abatement cost curves (MACCs), which estimated the size of emission reduction available from different activities for a given cost (Ministry for the Environment 2020). Although widely touted for guiding choices of abatement effort, such MACCs are challenging to prepare in practice and use sector averages that lack nuance across different types of enterprise within industries and are not tied to inter-industry economic impacts. This report found that land-use change to forestry had a low abatement cost across most of the sheep and beef sector and even some dairy farming; but it did acknowledge some major caveats on the modelling, including no constraint on land-use conversion, which made its results unrealistic for short term outcomes.

In 2021 the CCC produced a report and quantified model estimates on achieving a low emissions future within the framework of national emission budgets in which total emissions step down to 2050 (Climate Change Commission 2021). The CCC focused on near term budget steps to 2035, provided recommendations on policies and strategies needed in a national emission reduction plan to achieve such budget reductions, and also commented on the Nationally Determined Contribution and the reduction in biogenic methane.

But it also stepped back from reliance on forestry carbon removals, arguing it might potentially slow the drive to lower gross emissions. The CCC's expectations were for little change in exotic production forest from that forecast under current policy settings, but also a substantial increase in area of planted indigenous forests, which grow slower but live longer and store more carbon per hectare than exotic plantings, but provide less value from harvesting, replanting and supply of forest products, which are expected to increase to supply more timber to substitute for steel and concrete.

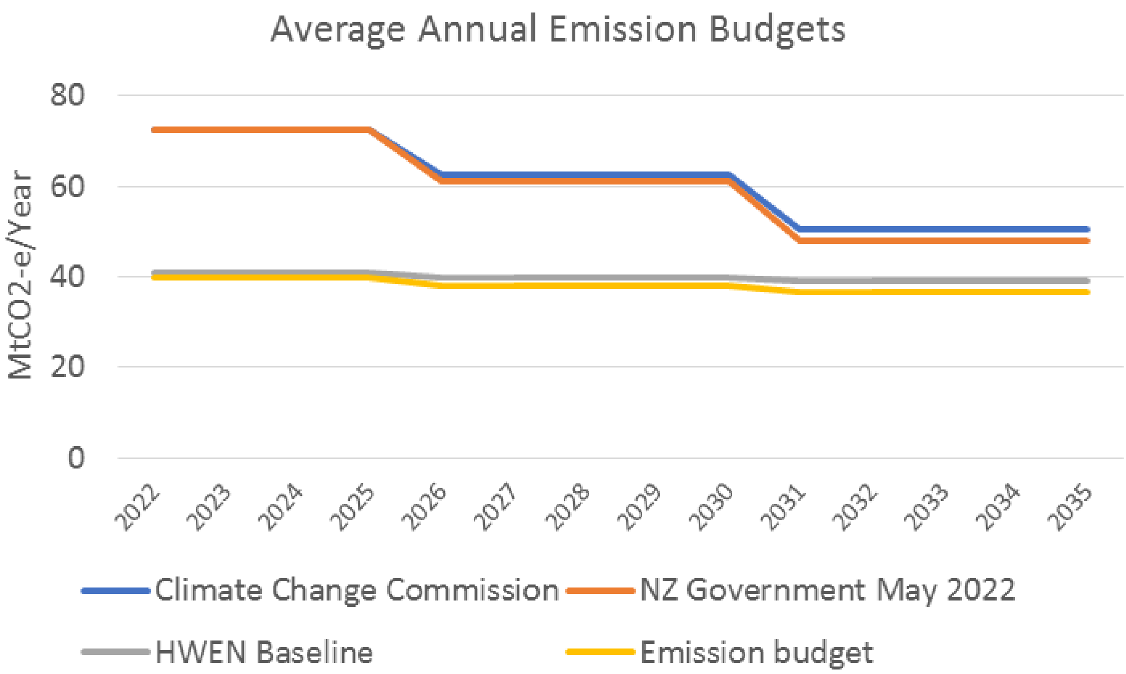
…but policy's pointy end is not as sharp…

In 2022 Government issued a three-part action plan to tackle climate change. These include an Emission Reduction Plan (ERP) to help New Zealand meet its emission reduction commitments under the Paris Agreement; recommendations from the HWEN consultative group about reducing agricultural emissions without reducing production; and a National Adaptation Plan (NAP) to improve adaptation to climate change:

- The ERP traverses over 300 actions for general emission reductions and covers familiar directions – decarbonise transport and industrial heating and electricity generation; control the flow of ETS units on the market to raise prices and incentivise emission abatement; budgetary spending to subsidise EVs, replace fossil fuel heating with renewable energy; adjust regulations on land use planning to aid urban densification and reduce transport emissions (Ministry for the Environment 2022b); but the budgetary allocations imply a wide variation in subsidised cost per tonne of emissions averted across the mix of measures, and some highly publicised measures such as the clean car rebate have limited effectiveness at emissions reduction and are not efficient uses of resources.
- The NAP, at the time of writing, has virtually no quantification of what it aims to achieve (Ministry for the Environment 2022c). It has no information on its funding and who pays for it: it is largely focused on improving processes in local and national government agencies rather than the expected outcomes and implications for future climate disruption; some of it relies on the replacement of the resource management legislation, but of the three new Acts, the Climate Change Adaptation Act been a low priority and has yet to be drafted.
- The Government's consultation document on farming emissions (Ministry for the Environment 2022a) has followed some recommendations from HWEN but rejected others and is supported by modelling suggesting the levy on farm emissions used to fund research into farm emission reduction would result in a 20% reduction in beef and lamb production, but it has limited commentary on the effects on wider socio-economic conditions and wellbeing of such a landscape change.

The Government's emission reduction budgets, and those used by the CCC and HWEN, are summarised in Figure 3. This shows the Government's emission reductions are slightly more ambitious than those that both CCC and HWEN were using.

Figure 3 New Zealand's emission reduction budgets to 2035



Source: NZIER, drawing from Climate Change Commission, NZ Government, He Waka Eke Noa (HWEN)

Firm direction but little sign of efficiency

Table 5 outlines what the Ministry for the Environment expects to be the top five contributors to emission reductions in the Emission Reduction Plan,[2] showing low and high emission reduction estimates and pairing them with the Government's Budget announcements around the Plan. Combined, these five initiatives could deliver between 43% and 98% of the 9.1 million tonnes of CO_2-e reduction in emissions the Government is aiming to achieve in the first phase of the ERP between 2023 and 2025 (inclusive).

Two initiatives – raising the price of ETS units and mandatory biofuel blending with petroleum fuels – involve no budgetary cost for Government, as they place all costs on industry players who can be expected to pass most of any extra cost through wholesale and retail prices to consumers. Together they account for about half the emission reductions in the table (although the biofuel mandate has since been abandoned). For the three initiatives with Government budgetary implications, the mean budgetary cost per tonne of CO_2-e emissions reduction ranges from \$100 per tonne to \$269 per tonne, markedly higher than current ETS unit values. The lower value is for extending an existing funding scheme for scrapping fossil fuel boilers in industry; the upper value is for a new extended funding scheme for scrapping fossil fuel boilers. In the early stages of the Plan, at least, the heavy lifting in emission reduction is expected from just a handful of initiatives.

2 As reported by Stuff's Olivia Wannan on June 15 2022 https://www.stuff.co.nz/environment/climate-news/128922386/by-the-numbers-the-governments-crunchiest-carboncutting-policies

Table 5 Varied outcomes from current Emission Reduction Plan initiatives

Expected emission reduction ranges from initiatives over 2023-2025

Modelled emission reductions	Low	High	*Budget*	Mean cost
Initiatives	*$MtCO_2$-e*	*$MtCO_2$-e*	***$m***	*$/$tCO_2$-e*
Raising price of ETS units	0.94	3.50	*0.0*	Na
New agricultural research	0.00	2.33	*399.0*	$171.24
New funding to scrap fossil fuel boilers	1.30	1.30	*350.0*	$269.23
Biofuels mandate on oil suppliers	1.00	1.10	*0.0*	Na
Current funding to scrap fossil fuel boilers	0.70	0.70	*70.0*	$100.00
Total expected outcome	**3.94**	**8.93**	***819.0***	**$91.71**

Source: Wannan (2022)

Policies with a higher public profile, such as the Clean Car Rebate, for which $300 million has been budgeted to lift the uptake of low-emission light vehicles, are not on the list of heavy lifters in the ERP. Compared to similar schemes in other countries, the rebates are not particularly generous against the cost of new EVs, which are sold at a price premium over petroleum-fuelled vehicles and will be picked up mostly by the better-off buyers. The Government has also budgeted $569 million for a scrap and replace grant aimed at low to middle income households to trade in their old bangers and replace them with more modern, lower-emitting vehicles. This seems more likely to remove high-emitting vehicles from the market, but it is currently described as a pilot covering 2,500 vehicles and details of how a fully developed scheme would be applied across the country have yet to be released.

Beyond the quantified actions in the ERP, there are also unquantified measures to enable urban densification and support public transport and active transport. The National Policy Statement on Urban Development, which enables high-density residential buildings around public transport arteries and nodes, has a logic in supporting alternatives to private car use along those corridors. But the subsequent legislative change to introduce medium-density residential standards that allow subdivision anywhere in residentially zoned areas on the initiative of private landholders risks the proliferation of intensified pockets scattered across city suburbs, still dependent on individual vehicle use for all journeys.

And pricing is under-done

Other than controlling the flow of ETS units, the ERP is longer on regulation and/or potential infrastructure builds than on adjusting prices to change behaviour and choices. Incentives count, including prices, not just subsidies. As the ETS price is an incomplete measure of the social cost of carbon, it can be supplemented by pricing elements for other externalities that affect emissions.

Most evident is congestion pricing on New Zealand roads, which are generally open to all traffic regardless of additional cars' effect on slowing down other traffic on the road network. In 2017 NZIER estimated congestion in the Auckland urban area cost about $2 billion a year, and measures to decongest the city's roads could save between $0.9 billion and $1.3 billion a year (NZIER 2017). Drivers joining roads at congestion-prone times do not face the cost that their adding another vehicle imposes on all other drivers on the network. This is an externality addressed by pricing in other countries, incentivising travel mode switch and providing revenue to support alternative transport as well as co-benefits of reducing emissions (for air quality and greenhouse gas emissions) along with improvements in travel time and reliability.

The ERP mentions consideration of congestion charging some years ahead, but it is not alone in having this blind spot. In a multi-criteria analysis of 26 urban transport policy options for climate change from interviews with experts from central government, local government, non-government organisations and academics, congestion charging is conspicuous by its absence (Chapman 2022). All externality pricing that brings down emissions and shows support for international efforts towards emission abatement could be used as part of the armoury of climate change responses.

Right direction or left behind?

"Think globally, act locally" is a slogan favoured by environmentalists, but in public discourse on climate change, it sometimes seems inverted in New Zealand, with not enough thinking locally about how to translate global issues or solutions parroted from overseas into actions appropriate for New Zealand's distinctive emissions conditions.

Thus, those who target New Zealand's agricultural emissions and demand a halving of its cow numbers are not only advocating the disruption of the livelihoods and lives of their rural compatriots and others' wellbeing through the contraction of an industry that provides 40% of New Zealand's exports. They are also creating opportunities for other countries to expand their livestock production to fill the gaps left by reduced New Zealand exports, using farm systems with higher carbon footprints than New Zealand's: an own goal for the cause of planetary emissions restraint.

New Zealand may appear a laggard in addressing climate change, relying too long on an emissions trading scheme with a carbon price too low to induce much emission reduction. There has been even less attention to climate change adaptation, leaving local councils to do what they can with little resourcing or legal support for dealing with issues like managed retreat of flood-risk areas that have a material impact on their ratepayers' properties.

But there are some bright signs, albeit with caveats attached. Overall emissions have not been growing over the past decade, although they have yet to show the sustained downward trajectory required to meet New Zealand's commitments to zero carbon by 2050. Research is ongoing and firming up the understanding of areas at risk of climate change. And recent adverse meteorological events have elevated awareness of the challenges ahead.

So far, so good and not so good

Announcements of current policy made in 2022 have helped articulate the direction and trajectory for domestic emissions to demonstrate New Zealand's practical support for international agreements on emissions reduction. They have signalled the expectation that emission prices will need to rise progressively over time to bring on substitution to lower-emitting activities. And they have adopted a split-gas approach that recognises biogenic methane is not the main cause of global warming and that greater priority, and higher price, should be attached to displacing fossil fuels.

However, the current planned emission trajectory and adaptation actions are not necessarily optimal. They should be subject to challenge and revision in response to new evidence, technical opportunities and market signals. Improving efficiency may require changing the mix of activities receiving support to equalise the cost of emission abatement across all activities. And policy needs to be realistic about what it can achieve by not decimating domestic industries to demonstrate commitment.

Price signalling must be applied consistently over the long term, curbing the political urge to fiddle with prices to relieve the short-term cost of living concerns. Cutting petrol taxes to reduce pump prices also reduces the land transport fund revenue, which provides for infrastructure maintenance and repair costs that are rising with climate change.

The split gas approach also needs to be implemented consistently to recognise the shadow price of emission reductions varies across different gases and sources (RFF 2022). This may mean supplementing the emissions trading price where this doesn't reflect the full social cost of emission externalities or stepping up incentives against under-priced consumption activity rather than adding undue costs on production.

The road, rail or cycleway ahead

Private entities, businesses and households need policy coherence and certainty to invest with confidence in climate change mitigation and adaptation, all of which involve adjustment costs that people will be reluctant to incur in a policy climate that changes material incentives too often. They also want the flexibility to choose the method and timing most suited to their needs. This implies fewer prescriptive regulations and more incentive instruments that are effective, efficient and evenly applied. Prices on emissions or emission-related activity are part of that mix, creating widely felt incentives across the economy for behaviour change.

While the Government has introduced policies on climate-related disclosures in corporate financial reporting and introduced standards for that reporting, guidance on risks of climate change and adaptation has been led by private interests in insurance costs and risk assessment (Institutional Investors Group on Climate Change 2020). Climate change risks apply to assets like property, infrastructure and agricultural systems and to the value chains that support the supply and distribution of goods and services, and to the preferences of customers in diverse markets. People need to make better decisions aligned with minimising the combined cost of abatement and adaptation and meeting international commitments, enabled by climate response policies that are readily understood and predictable in effect.

In turn, central government needs to bring the public along to understand where climate policy is heading and ensure that the light at the end of the transitional tunnel is not an oncoming train. This includes a greater focus on economic analysis than has been apparent in much of the public discourse around climate change responses to date, including:

- Improved communication about New Zealand's distinctive profile and its implications to dampen divisive arguments around farm emissions and production that have profound effects on New Zealanders' wellbeing and are a distraction from the real deal of reducing dependence on fossil fuels.
- A broader stocktake of the economic efficiency of proposed adaptation and emission reduction measures to refine allocation of effort to those that are most effective, with a process for measuring outcomes for climate change from all parts of its policies, reviewing benefit realisation and improving or removing actions, if required.
- Review of items in the current emission reduction plans (to the extent they can be costed) to give greater assurance than is apparent in the current set, that there is an efficient allocation of resources into areas that can achieve emission reductions at least cost to the community.
- Prepare more and clearer comparative analyses of costs and benefits from actions on adaptation to current climate risks and emission abatement to reduce future risks: as yet, there is no costed assessment of national adaptation plans despite adaptation being more within the control of New Zealand policy than emission reductions.
- Because of uncertainty around climate change impacts and mitigation measures, prioritise actions that are worthwhile for their own sake apart from their contribution to assisting the climate change response, including potential broadening of scope to include other externalities (e.g. congestion pricing to reduce transport externalities, reducing food waste in supply chains).

New Zealand needs a mix of measures that, in combination, are the most effective in adapting to climate change or reducing emissions with the lowest cost and least disruption to economic activity and people's wellbeing. And it needs all sectors to face an emission price proportionate to their contribution to the externality to incentivise them to find cost-effective emission reductions or offset measures.

Above all, it requires an overarching plan for a progressive and cost-effective reduction in reliance on fossil fuels, as these are the key drivers of global warming. Such a plan, aligned to global effects and opportunities arising from climate change abatement or adaptation, and focused on demonstrating cost-effectiveness of actions, would be more productive in dealing with climate change than sacrificing cows on the altar of lowering New Zealand's greenhouse gas inventory.

Big picture, limited capacity

New Zealand's policies on climate change need to be reviewed and revised to make a more effective contribution to reducing the global harms of climate change in a way the public can align with. There are four changes it can make to the current direction:

1. Take a truly global perspective on the climate change issue, recognising that New Zealand's emissions are too small for their reduction to have any appreciable effect on global climate;

that its interests in demonstrating support for wider international action are not best served by inflicting disproportionate costs on its economy ahead of other countries; and that there is a high risk of carbon leakage to other countries in leaning on New Zealand's agriculture to reduce the uniquely high share of methane in its national emissions profile.

2. Thoroughly investigate the big trade-offs underpinning climate response, the mix of emission abatement and climate change adaptation; the cost of precautionary actions to ensure continued international trade access against the potential cost of trade sanctions like border carbon adjustments that might be applied in some markets; and what domestic measures would be really effective in changing behaviour that is adding to carbon emissions.
3. Assess measures against the principle of maximising the 'bang for the buck' in working up the abatement cost curve, doing cheap measures early and moving more slowly on costly ones, pending research on how to apply them most effectively:
    a. It's not obvious that this is the case with the eclectic mix of measures in the emission reduction plan, some of which are obvious, others more attenuated and with longer term and less certain impacts
    b. There's no quantification at all in the national adaptation plan, which is essentially flying blind as to outcomes while spending on things like local government processes and information gathering.
4. Let pricing mechanisms work to incentivise change as they haven't been allowed to in the past; rather than manipulate the ETS price down, signal a clear trajectory of rising carbon price over time; also apply prices to other externalities to curb their contribution to emissions growth (e.g. traffic congestion).

These four steps need further investigation as the climate change policies heat up in the years ahead. As this year's tempestuous summer has shown, the climate is already changing faster than previously forecast. Climate policies must adapt to find a sustainable set of measures that people can easily understand and work with to achieve an effective and efficient response.

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