Why emissions pricing cannot do it alone

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Abstract

This article explores whether emissions pricing is sufficient to achieve the low-emissions transition in Aotearoa New Zealand. It draws on a critical review of the international literature on emissions pricing, policy interactions and political economy to make three broad arguments. First, that emissions pricing alone cannot be expected to induce the necessary levels of behaviour change and technological transition in the urgent timeframe required. Second, non-pricing policies can deliver emissions reductions, even within the context of emissions trading under a volume cap. Third, even if emissions pricing could induce sufficient change, there are political economy constraints to reaching the adequate price in a feasible and equitable way. Consequently, we argue that the weight of evidence lies with utilising emissions pricing as part of a policy mix.

1. Introduction

There is strong agreement among economists that emissions pricing ought to play a central role in climate change policy. In the absence of emissions pricing, the climate impact of our choices as consumers, producers and investors is not reflected in market price signals – it is *externalised* in the economic parlance – such that market behaviour is incentivised to contribute to the long-term damages of climate change (Keohane and Olmstead, 2007; Aldy and Stavins, 2012). Among neoclassical economists in particular, emissions pricing is championed as the most efficient way to mitigate greenhouse gas emissions (e.g. Whaples, 2006; Howard and Sylvan, 2015; Climate Leadership Council,

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2019). This theoretical judgment is informed by the neoclassical commitment to maximising allocative efficiency and, therefore, favouring price signals over regulations.

As emissions pricing mechanisms are implemented around the world, there is an opportunity to match theory with empirical observation. Emissions pricing mechanisms are now implemented in at least 78 different jurisdictions; in 2021 a price will be paid on 22% of the world's emissions (World Bank 2020). Perhaps the most rigorous cross-country analysis is Best, Burke and Jotzo (2020). Using econometric modelling of 142 countries, the study estimates that the 43 countries with a carbon price have on average had annual CO_2 emissions growth rates that are about 2 percentage points lower than the 99 countries without a carbon price, all else being equal. Of course, international averages can obscure individual successes, so it is worth noting that reviews of the EU ETS, the world's longest running emissions trading scheme, estimate that emissions in energy and industry were reduced by about 3% between 2005 and 2010 (Martin, Muûls and Wagner, 2016), or 3.8% between 2008 and 2016 (Bayer and Aklin, 2020). The modest positive impact of emissions pricing is corroborated by other reviews and ex-post evaluations (Haites et al., 2018; Narassimham et al., 2018; Tvinnereim and Mehling, 2018; Rafaty, Dolphin and Pretis, 2020). Others draw more pessimistic conclusions (Lilliestam, Patt and Bersalli, 2020; Green, 2021), while others argue that the impact of emissions pricing is constrained by its relative novelty and historically low prices (van der Bergh and Savin, 2021). In sum, although the empirical record is incomplete and evolving, it demonstrates a modest, positive impact and therefore corroborates the *efficacy* of emissions pricing instruments.

Still, even if we accept that emissions pricing is efficacious, is it *sufficient* as a policy response to climate change? Arguments to the affirmative are becoming increasingly adamant in Aotearoa New Zealand (e.g. Hartwich, 2021, Prebble, 2021, Hazeldine, 2021). What unifies these opinion pieces is, firstly, their shared appeals to a supposed economic consensus to justify the sufficiency of emissions pricing and, secondly, their claim that the Climate Change Commission should be disregarded, if not dismantled, for recommending a policy mix that goes beyond emissions pricing. However, this is inconsistent with international experience, and betrays a disconnect from the specialist literature on the applied economics of climate change. As we find in this literature review, there is no consensus on the sufficiency of emissions pricing and, if anything, the evidence leans toward the opposite conclusion.

The literature on policy mixes and interactions in environmental economics is substantial (e.g. Sorrell and Sijm, 2003; Jaffe et al., 2005; Popp, 2006; Stern, 2006; Bennear and Stavins, 2007; Howlett & Rayner, 2007; Fischer and Newell, 2008; Grimaud and Lafforgue, 2008; Fischer, 2008; Schmidt and Marschinski, 2009; Acemoglu et al., 2010; Hood, 2011; Lehmann, 2012; Twomey, 2012; Lehmann and Gawel, 2013; Rogge and Reichardt, 2016; Kivimaa and Kern, 2016; Fischer, Preonas, and Newell, 2017; Tvinnereim and Mehling, 2018; Waisman, de Coninck and Rogelj, 2019; van der Bergh et al., 2021). Drawing on such insights, many economists who work on climate change – including those who advocate for emissions pricing – conclude that emissions pricing *alone* is inadequate to drive a low-emissions transition. For example, a key textbook on the subject, *The Economics and Politics of Climate Change* (Hepburn and Stern, 2009, p.49, emphasis added), remarks that:

> [A] carbon price would be sufficient to internalize the greenhouse externality in a world without any imperfections. *But, in our imperfect world, a carbon price alone is inadequate*, given the urgency of reducing emissions, the inertia in decision-making, and the other market imperfections, including those relating to low-carbon R&D. So *a carbon price is a necessary, but not a sufficient, component…*

of global climate policy. More recently, an expert workshop in the US concluded that '*carbon pricing cannot stand alone*. Politically feasible carbon pricing policies are not sufficient to drive emissions reductions or innovation at the scale and pace necessary' (Jenkins, Stokes and Wagner 2020, emphasis added).

There are analysts who draw more pessimistic conclusions, arguing that emissions pricing is at best a marginal factor in behaviour change, at worst a distraction (e.g. Spash, 2010; Pearse and Böhm, 2014; Patt and Lilliestam, 2018; Rosenbloom et al., 2020). But even those who defend emissions pricing against such critiques will often accept that emissions pricing should be part of a diverse policy portfolio. For example, Kirchner, Schmidt and Wehrle (2019) defend 'what we believe has been the consensus for many years now, namely that the deep decarbonization of our economies essentially requires a comprehensive and disruptive policy package that includes carbon pricing among other measures, such as technology-specific support schemes' (see also Bowen 2011; Baranzini et al 2017; Burke, Byrnes and Fankauser 2019; van den Bergh and Botzen 2020). There are climate economists who endorse a more purist approach to emissions pricing (e.g. Nordhaus 2013; Parry, 2019), but this is far from being a professional consensus.

In short, even if the *efficacy* of emissions pricing is granted, it does not follow that emissions pricing is *sufficient* to meet New Zealand's domestic targets and international commitments, let alone a fair contribution to global emissions reductions consistent with thresholds such as 1.5°C or 2°C (see Table 1 for how steep those reductions need to be). As Tvinnereim and Mehling (2018) conclude: 'Empirical studies show that carbon pricing can successfully incentivise incremental emissions reductions. But meeting temperature targets within defined timelines as agreed under the Paris Agreement requires more than incremental improvements: it requires achieving net zero emissions within a few decades.'

This article reviews the international literature to reflect upon the sufficiency of emissions pricing in Aotearoa New Zealand. We argue, first, that emissions pricing *alone* cannot be expected to induce the behaviour change and technological transition that is needed. Second, we argue that non-pricing policies can deliver emissions reductions, even in the context of emissions trading. Third, we argue that even if emissions pricing *could* induce sufficient change, there are political economy constraints to reaching the adequate price in a feasible and equitable way. Consequently, we argue that the weight of evidence sits with retaining emissions pricing as part of a policy mix.

Table 1: New Zealand's greenhouse gas emissions in 2016 and 2019, and target emissions in 2030 (in million tonnes of CO_2 equivalent)

		2016	2019	% change	2030	% change
Carbon dioxide (CO_2)	Electricity	3.0	4.2	38%	1.3	−70%
	Food processing	2.7	3.2	20%	1.5	−55%
	All other industry	12.0	12.1	1%	9.4	−22%
	Buildings	1.6	1.8	11%	1.3	−24%
	Transport	15.0	16.2	8%	14.0	−14%
Gross CO_2 total		34.3	37.5	9%	27.5	−27%
Other long-lived gases	Agriculture	8.8	9.0	2%	8.0	−11%
	Forests	−13.8	−7.4	−46%	−11.6	57%
	Waste and fluorinated gases	1.8	2.0	11%	1.6	−20%
Net long-lived gases		31.1	41.1	32%	25.5	−38%
Biogenic methane	Agriculture	30.3	30.6	1%	27.1	−12%
	Waste	3.2	3.1	−5%	2.3	−26%
Gross all gases		78.5	82.2	5%	66.4	−19%
Net all gases		64.7	74.8	16%	54.8	−27%

Source: McLachlan 2021. Data for 2016 and 2019 emissions from UNFCCC, using AR4 emissions factors. The 2030 target emissions are extrapolated from the Climate Change Commission's (2021) demonstration pathway. 'Forestry' refers to LULUCF emissions using the CCC's 'NDC (averaging)' methodology.

2. Can the NZ ETS alone drive the low-emissions transition?

The primary pricing instrument in Aotearoa New Zealand is the Emissions Trading Scheme (NZ ETS). Yet as Leining et al. (2020) conclude in a substantive policy review,

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'the NZ ETS has not significantly reduced domestic emissions to date.' The reasons for this inefficacy are well-canvassed; in particular, the absence of an effective cap on unit volume, unlimited exposure to units of low integrity through international linking, and various transitional measures such as one-for-two surrender obligations and a fixed-price option that diluted the price signal (Bertram and Terry, 2010; Bullock, 2012; Richter and Mundaca, 2014; Richter and Chambers, 2014; Simmons and Young, 2016; Diaz-Rainey and Tulloch, 2018; Nassarimham et al., 2018). These limitations were partly unintentional design flaws, partly intentional adjustments to 'moderate' the economic impacts of the NZ ETS after the Global Financial Crisis (Hall, 2021).

Of course, it would be fallacious to infer from the past that the NZ ETS is not capable of effectively driving technological and behavioural change in the future. Successive governments have introduced changes to ETS settings to improve its efficacy, including the cessation of international linking, introduction of a flexible cap on emissions, the phase-out of various transitional measures, and the institutional commitment of the Climate Change Response (Zero Carbon) Amendment Act 2019. Consequently, the price of NZUs has risen substantially since its nadir in 2013 at NZ$1.45 per tonne; at the time of writing, the price on secondary markets is over $60 per tonne. The most recent auction clearing price was $53.85, above the $50 trigger price for the cost-containment reserve (NZX and EEX 2021). The New Zealand Government has also updated its price control settings to mandate an upward trajectory: the price corridor[1] will increase to $30–70 in 2022, up to about $40–110 in 2026 (MfE 2021c). The upward bounds of these settings would see the NZ ETS trending just below current EU ETS prices, which were 62 euros (NZD$105) per tonne in September 2021.

Consequently, it is reasonable to expect that the NZ ETS will drive greater emissions reductions than it historically has. Its price signal is stronger than ever before. Also, the ETS now has a descending cap on unit volume to be set with regard to emissions budgets, which means that cumulative rights to emit are finite and diminishing. But will

[1] It is important to note that the price corridor influences the future price trajectory, but does not strictly determine it. The auction reserve price sets a lower bound for auction clearing prices, but not prices in the secondary market; so for instance an oversupply of units from afforestation could drive down secondary market prices below the auction reserve. At the upper end, the cost containment reserve trigger price releases a fixed amount of additional volume into the market to moderate prices, but, as the September 2021 auction demonstrated, both primary and secondary market prices could exceed the CCR trigger price. As such it is not a hard cap or impermeable ceiling; rather, it is like road spikes or an arrester bed that seriously slows, rather than abruptly stops, a speeding vehicle (we thank Reviewer 1 for the metaphor).

associated emissions reductions be substantive enough and certain enough to render other sorts of policy unnecessary?

The Climate Change Commission expects not and recommends instead a 'comprehensive policy package' (CCC 2021, chap. 11). Echoing the foundational analysis of 'planetary economics' by Grubb, Hourcade and Neuboff (2014), emissions pricing is one of three policy pillars, alongside policies to overcome non-price barriers, and to enable innovation and system transformation. The Commission (2021) argues: 'International research and experience clearly show that the most effective approach… is emissions pricing that works in conjunction with companion policies that help to provide a wider range of low-emissions options'. It further identifies 'a range of structural, political and behavioural barriers that prevent people and businesses from making the most of cost-effective opportunities to reduce emissions' (ibid.), which are summarised in Table 2.

Table 2. Barriers to the low-emissions transition.

Barrier	Description
Imperfect or asymmetric information	Inability to make informed decisions due to lack of accurate and intelligible knowledge about costs and emissions.
Uncertainty about future emissions prices	Inability to make informed decisions due to uncertainty about future prices, often as a result of regulatory variation.
Split incentives	Instances where the person who pays for an action is not the one who benefits from that action, and therefore lacks the incentive to act. For example, a building owner lacks the incentive to invest in energy efficiency gains that tenants will benefit from.
Bounded rationality and myopia	Inability to make informed decisions due to mental heuristics and cognitive biases that distort judgments of economically rational outcomes.
Barriers to accessing capital	Inability to access finance to meet the up-front capital costs of emissions reductions.
Infrastructure lock-in	Unresponsiveness of systems to changing incentives due to the long life and long lead-in time of fixed infrastructure.
Network externalities	Instances where the benefits to an individual from using a product depend on how many others are also using the product. For example,

	availability of charging infrastructure for EVs may depend upon a critical mass of EV users.
Policy coordination	Inefficiencies and conflicts that result from suboptimal interactions between policies.
Co-benefits or other externalities	Public and private value of policies in addition to abatement value, thus favouring a multi-solving policy that addresses overlapping policy challenges. For example, native forest can contribute biodiversity value and landscape resilience in addition to carbon sequestration.
Innovation and learning spillovers	The co-benefits of innovation and learning where knowledge from one technology 'spills over' to support further innovation for other technologies.

Source: Climate Change Commission 2021.

This acknowledgement of barriers is not inconsistent with neoclassical economics. Some economists (e.g. Bennear and Stavins, 2007; Fischer, 2008; Labandeira and Linares, 2010; Jenkins, 2014; Stern and Stiglitz, 2021) arrive at this conclusion via the theory of the second best (Lipsey and Lancaster 1956). On this view, emissions pricing might be the 'first-best' response to what Stern (2006) famously described as 'the greatest and widest-ranging market failure ever seen'. However, we live in a 'second-best' world which is characterised by multiple constraints to achieving the Pareto optimal conditions. The failure to integrate these constraints into Integrated Assessment Models (IAMs) is cause for growing consternation within the climate modelling community (e.g. Fisher-Vanden & Weyant 2020; Keppo et al. 2021; Peng et al. 2021). Meanwhile, economic models that incorporate these non-ideal aspects of real-world constraints are more attuned to the unresponsiveness to emissions pricing than conventional macroeconomic modelling which relies upon first-best assumptions (e.g. Waisman et al., 2012; Stenning, Bui and Pavelka, 2020).

Consequently, there is a role for 'second-best' responses to market and policy failures, as well as limitations to institutional capacity, prohibitive transaction costs, and challenges of political economy. Instruments might include technology standards, performance standards, information disclosure, taxes, subsidies, export credit guarantees, feed-in tariffs, R&D support, public investment, public procurement, tradable permits, product or process bans, planned obsolescence, tort liability, industry self-regulation, management-based regulation, and capability-building for transition intermediaries (see Rogge & Reichardt 2016 for a neat typology). As such, the policy toolbox might include supply-side measures, such as moratoriums on oil and gas extraction, or the proposed Fossil Fuel Non-proliferation Treaty (Green and Denniss 2018; Newell and Simms 2019; Piggot et al 2020). It might also include demand-side measures other than pricing, such as nudges and behavioural insights (e.g. van der Linden and Weber 2021), public campaigns and communications (e.g. Munshi et al 2020), and education and sustainable citizenship (e.g. Hayward 2020).

As Bennear and Stavins (2007) put it: 'Different instruments are appropriate for different types of problems in different circumstances. The challenge is to determine the conditions under which each instrument, or set of instruments, is the appropriate choice.' We cannot here do justice to the factors that ought to determine choice; suffice to say that economic efficiency is only one factor which might also include effectiveness, political feasibility, ease of implementation, policy harmonisation, equity or distributional impacts, competitiveness, and social acceptability (ibid.; see also Howlett and Rayner, 2007; Rogge and Reichardt, 2016; van der Bergh et al., 2021; Peñasco, Anadón and Verdolini, 2021).

3. Changing systems: the case of transport

To flesh out the argument so far, road transport is an illuminating example.

Road transport emissions contribute nearly 43% of New Zealand's energy-related CO2 emissions, rising by 8% in the three years to 2019 (from 13.6 to 14.7 Mt CO_2) and projected to rise further (MfE2021a). Aotearoa has the highest rate of car ownership in the OECD and the fifth highest per capita rates of CO2 emissions from road transport among the 43 OECD countries (OECD 2017). Light vehicle emissions are 2.65 tonnes CO_2 per person in Aotearoa, compared to 1.3 tonnes in the EU (Buysse, 2021). Recent modelling by the Ministry of Transport (MoT 2021) found that, to align with the Climate Change Commission's demonstration pathway of 41% reductions in transport emissions below 2019 by 2035, there would need to be a 39% reduction in light vehicle distance travelled, a 27% increase in electric vehicle uptake, as well as increased use of public transport, biofuels and electrification of heavy vehicle like trucks and buses.

In theory, emissions pricing should incentivise change in transport behaviour. The logic is straightforward: by internalising the costs of climate change into transport decisions, behaviour should shift away from high-emissions transport options toward low-emissions alternatives. Internationally, however, even relatively aggressive pricing has had minor effects on transport emissions. Consider a recent study of Sweden's carbon tax which claims to be 'the first to find a significant causal effect of carbon taxes on emissions' (Andersson 2019). It is the highest carbon tax in the world today and one of the earliest, introduced in 1991 at SEK 250 and rising to SEK 1,200 today (NZD$196). But Andersson finds that, over the 15 years from 1990 to 2005, Sweden's carbon tax reduced transport emissions by 6.3%. To be sure, this is a positive result (although compare Bohlin [1998] and Lin and Li [2011] who find no significant impact) and, as one would expect, attributed reductions increase as the carbon price rises. Nevertheless, the scale of impact is disappointing.

Economic modelling of emissions pricing in Aotearoa New Zealand reinforces the point. Hasan (2020) estimates that a carbon price of NZD$235/t$CO_2$ is required to reduce road transport emissions by 44% in 2030 (that is, 4.4% on average annually over 2017-2030). This is about four times today's carbon price and implies an increase of about 54 cents per litre at the pump. Hasan notes that higher emissions prices should be complemented with 'an increased number of alternative modes and transport fuels (to increase price responsiveness)' (ibid., p.107). An even weaker result comes from recent MBIE (2021) modelling which compares a high price pathway that rises from $84/t in 2025 to $250/t in 2050 against a counterfactual reference scenario that assumes a constant $35/t in real terms. Yet the high price pathway only realises a 12-18% reduction of transport sector emissions by 2050, rather than the 84% reduction that is required. This not only raises questions about effectiveness, but also questions of political feasibility and equity that we return to later.

Why such unresponsiveness to high prices? Road transport is an illustrative example of *carbon lock-in* – that is, 'the interlocking technological, institutional and social forces that can create policy inertia towards the mitigation of global climate change' (Unruh 2000). New Zealand has a car-dependent transport system (Adams and Chapman, 2016; Hasan et al., 2020). As in other developed nations, this dependency is produced by the overprovision of car infrastructure, inadequate provision of public transport, the facilitation of urban sprawl, mass production in the automotive industry, and the emergence of 'car cultures' which shape human desires and preferences (Mattioli et al., 2020).

It follows that decarbonisation of the transport sector requires substantive socio-technological change. But emissions pricing alone is unlikely to induce such change. Recent international reviews (Tvinnereim and Mehling, 2018; Green, 2021; Lilliestam, Patt and Bersalli, 2021) find that, although emissions pricing can induce incremental, short-term operational effects in the energy and transport sectors, such as fuel-switching and energy efficiency, there is thin empirical evidence of technological change, especially as evidenced by zero-carbon investment and innovation. Other analysts are more optimistic, arguing that the effects are small but not insignificant, and a contingent function of historically low prices (van der Bergh and Savin, 2021). Even so, these analysts concur that deep decarbonisation requires a policy mix (ibid.).

The issue of price elasticity is critical here, which is a measure of a market's response to price changes. If a market is elastic with respect to emissions pricing, then people are responsive to the higher costs of emissions-intensive goods and services, for example, by switching to low-emissions alternatives or reducing consumption. Ex-post evaluation of the empirical effects of emissions pricing suggests that inelasticity has been underestimated across all sectors, because conventional modelling has neglected political realities (Rafaty, Dolphin & Pretis 2020). However, transport has long been known to be relatively unresponsive (Allcot and Wozny, 2013). Vehicle transport demand is influenced not only by emissions pricing, but other price factors, demographic factors, availability of alternative transport options, land use and urban form, and demand management strategies (for review, see Litman, 2021). As such, pricing can have little effect if other factors of demand are misaligned; for example, improved quality of transport alternatives tends to increase price sensitivity, which means that areas without inadequate investment into transport infrastructure are more likely to be inelastic.

Consequently, transport researchers are already applying such insights to the design of an integrated policy mix (e.g. Givoni et al., 2013; Axsen, Plötz and Wolinetz, 2020; Bhardwaj et al., 2020; Lam et al., 2021) to address barriers to change. Tellingly, transport is the only sector for which the Climate Change Commission (2021, p.218) proposes fixes for all ten types of market barrier (see Table 2) with a combination of vehicle emissions efficiency standards, cost reductions for EVs, investment into charging infrastructure, greater transport alternatives by public and active transport and integrated urban design, support for low-carbon fuels and mode shifting for heavy transport and freight, and adoption of government targets, strategies and shadow pricing. Deploying a broad suite of measures to induce technological change is consistent with the transport sector's relative unresponsiveness to emissions pricing.

There are other rationales for going beyond emissions pricing. A virtue of emissions pricing is that, under ideal conditions, it motivates the least-cost emissions reductions. This is the logic of marginal abatement cost (MAC) curves, which are designed to organise abatement options from the most to least cost-efficient, with the implication that decision makers should start with the former and work progressively toward the latter (e.g. MfE, 2020). As a strategy for decarbonisation, however, MAC curves have numerous weaknesses,[2] one of which is the implication that action ought to be delayed in critical sectors until emissions pricing reaches a certain threshold, only after which expensive sectoral abatement becomes economic (Vogt-Schlib, Meunier and Hallegatte, 2018a). This implies an abrupt transition that will be needlessly costly, because complex logistical tasks (such as importing EVs and installing charging infrastructure) will be attempted only once the price threshold is reached. This is unrealistic and inefficient: 'In sectors that are particularly expensive and difficult to decarbonise, like transportation, it is therefore preferable to start early to make the transformation as progressive and smooth as possible, minimising long-term costs' (Vogt-Schlib, Meunier and Hallegatte, 2018b).

To be clear, this is not a matter of abandoning the efficiency criterion. It is a matter of replacing a static conception of efficiency that is biased toward the present for a dynamic conception of efficiency that stretches across multiple decades. Only on this longer view does the strategic challenge of societal decarbonisation come fully into view. As Lilliestam and Patt (2018) put it, 'Carbon taxes stimulate a search for low-

[2] MAC curves and least-cost approaches gloss over other relevant factors, such as neglecting the different warming impacts of different gases and removals; omitting co-benefits and external costs; failing to consider the distribution of costs and benefits; and neglecting intertemporal dynamics such as changes in technology costs over time and the effects of early adoption (see Kesicki and Ekins 2012). I thank Reviewer 2 for recommending these shortcomings be addressed.

hanging fruit. That ceases to matter when we know we must eventually pick all of the apples on the tree.'

Moreover, if the challenge is technological and structural change, then there is a substantial empirical and theoretical literature on socio-technical transitions which treats the complex problems of lock-in and technological incumbency as central to its analysis (e.g. Rotmans, Kemp and van Asselt 2001; Geels et al., 2017; Rosenbloom, 2017; Kivimaa and Kern, 2017; Loorbach, Frantzeskaki and Avelino, 2017). This literature also has a strong empirical basis by deriving insights from how technological transitions have actually occurred in history (e.g. Mazzucato, 2016; Cantner et al., 2016; Turnheim and Geels, 2017). On this view, the challenge is how to induce change in spite of the self-reinforcing tendencies of systems. Socio-technical transitions are non-linear processes of change that result from interactions between the growth of niche innovations, the weakening of incumbent systems, and increased pressures from the wider social, economic and cultural landscape (Geels et al., 2017). Potentially, these processes can be accelerated by the strategic activation of tipping points, where self-reinforcing feedback loops create upward-scaling cascades of technological diffusion (Lenton, 2020; Sharpe and Menton, 2021; Farmer et al., 2021). Consequently, transition-oriented approaches place a strong emphasis on proactive strategies to induce change through anticipatory and mission-oriented governance (Tõnurist and Hanson, 2020; Mazzucato, 2021). This places a strong emphasis on the role of R&D and innovation policy, but ultimately involves pragmatic support for whatever changes will destabilise incumbent systems and support the dispersal of alternatives (Geels and Schott, 2007; Bernstein and Hoffmann, 2018). Empirical examples of positive technological feedbacks include the use of progressive taxation to enable rapid EV uptake in Norway and the combination of overlapping pricing and regulatory policies to displace coal from the UK energy sector (Sharpe and Menton, 2021). Clearly, emissions pricing can function as a system-wide lever (van den Bergh and Botzen, 2020), particularly to weaken the market advantage of high-emissions systems and assist the cost-competitiveness of low-emissions alternatives. But on this view, pricing might be the complementary policy, while non-pricing policies such as technological support and regulation are the main act.

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4. Puncturing the waterbed

The purpose of the NZ ETS is not only to produce a price, it is also to set a cap on emissions. This is an advantage over a carbon tax, a pure price instrument, which relies entirely on its success as a financial (dis)incentive to drive change. An ETS, by contrast, limits the volume of emissions by allocating ever fewer allowances through auctions and free allocations. This ensures that, with sufficient enforcement, emissions will decline over time. But it also raises the question of whether actual emission reductions can run ahead of what the ETS allows.

One argument against overlapping policies within the context of emissions trading is that, even if additional policies succeed in reducing emissions in the target sector (e.g. if a feebate accelerates uptake of low-emissions vehicles), then this only frees up units for other emitters to use. This is the so-called 'waterbed effect', an analogy with the fixed volume of water in a waterbed which, if squeezed in one place, simply bulges out elsewhere. In this vein, it is argued that 'the ETS entirely neutralises other emissions policies' (Burgess, 2021). But this outdated argument does not accurately reflect how real-world cap-and-trade schemes, including the NZ ETS and EU ETS, have evolved.

It is far from certain that units freed up by abatement activity will be used by others to emit more in the near term. Emitters are motivated by many factors beyond emissions pricing – such as consumer and investor expectations for ESG alignment – which means that some will hold to voluntary emissions reduction targets rather than exploit every opportunity to emit. Moreover, many units freed up by additional abatement may instead join the stockpile – that is, the surplus that is 'banked' in private accounts instead of being surrendered or cancelled. In the EU ETS, for instance, actual emissions have remained 10% or more below the cap since 2008, which demonstrates that 'present emissions reductions are manifestly not being replaced in full by emissions elsewhere' (Sandbag, 2016). In New Zealand, the cap is too new to confirm similar trends. However, the stockpile is very large, over 138 million units as at June 2021 (EPA, 2021). Market behaviour in the September 2021 auction is also suggestive: the cost containment reserve was triggered and entirely drained by participants, despite the market already being oversupplied. A significant factor in market demand is expectations of rising carbon prices in future, now mandated domestically by the upward trajectory of price control settings.

But does this not simply mean that the waterbed effect will occur across time, as stockpiled units trickle back into secondary markets in the future? Not necessarily, because this eventuality can be managed.

Both the EU ETS and NZ ETS – and indeed others such as the California Cap-and-Trade system – are hybrid instruments that use market stability mechanisms to manage both the volume and the price of units. By managing future volume, the abatement created by ambitious policies can be 'locked in' when the cap descends to occupy the gap that abatements create. In the EU ETS, Phase 4 rules 'puncture the waterbed' (Perino 2018), specifically by postponing the release of allowances (to be stored in the Market Stability Reserve) as a function of the number of stockpiled units in the market.

In the case of the NZ ETS, the government decides future unit supply guided by considerations in the Climate Change Response Act 2002, which includes accordance with emissions budgets and Nationally Determined Contributions (NDCs), proper functioning of the ETS, and other considerations. Currently, when setting limits on future unit supply, the government accounts for the stockpile and adjusts the auction volume accordingly. An auction reserve price sets a minimum unit price at auction and a complementary confidential reserve price further constrains auction prices at the lower end for the secondary market. The cost-containment reserve helps to moderate prices at the upper end by making a finite amount of additional supply available when the trigger price is reached.

These features make the NZ ETS neither a pure quantity instrument with a fixed cap, nor a pure price instrument like a carbon tax, but rather a hybrid instrument with a flexible cap that allows adjustments to the allocation of units in response to price (Kollenberg and Taschini, 2016). In September 2021, the cap's flexibility was demonstrated by the triggering of the cost containment reserve, which released 7 million units beyond the intended auction volume for the calendar year.[3] The inverse is also possible – that is, the volume of units can be reduced to respond to contingencies. The Climate Change Response Act 2002 [5ZE] empowers the Minister of Climate Change to adjust emissions budgets after they are set in response to significant changes to considerations applied to setting budgets. Similarly, ETS unit supply settings can be retrospectively adjusted in response to changes in emissions budgets or NDCs,

[3] The government is obligated to compensate for cost containment reserve units that cause emissions budgets to be exceeded.

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significant changes to considerations used to set unit supply, or force majeure events. Future changes to ETS settings could improve its capacity to manage unit volume, including the re-entry of banked units into the market.

Let us rephrase the point. A pure price instrument, like a carbon tax in the absence of a target, would have a waterbed effect of precisely zero because there is no cap on volume. A pure quantity instrument, such as a fixed-cap-and-trade scheme with no stockpile, would have a waterbed effect of precisely 100%. But hybrid instruments, being neither pure-price nor pure-quantity, will have a waterbed effect somewhere in between – that is, 'abating one ton of CO2 emissions will result in an emission reduction of less than one ton' (Perino, 2018). This has been modelled across a range of pricing systems in Europe and North America, with different policies being associated with different potentials for internal leakage (Perino, Ritz and van Benthem, 2019). The NZ ETS, as a hybrid instrument, will have a waterbed effect of between 0% and 100% that can be strategically managed by integrated policy making.

Consequently, the waterbed effect is not an inevitability, it is a *political choice*. The neutralisation of additional abatement could be allowed by a Minister who wants net emissions to reduce no faster than existing emissions budgets. But the waterbed effect could be mitigated by a Minister who chooses to harmonise emissions budgets, ETS unit supply settings and emissions reduction plan measures as an integrated package.

The real challenge is how to design a policy mix that achieves a desirable low-emissions future for Aotearoa New Zealand.

5. Can the ETS alone ensure the transition is just?

The reasons for policy mixes are not limited to driving technology change. Another set of reasons relate to managing the constraints of political economy (Jenkins, 2014; Rabe, 2018; Mildenberger, 2020; Levi, Flaschland and Jakob, 2020). These arise because of emissions pricing's success – that is, its success in producing a financial disincentive to emit greenhouse gases. Individuals and organisations, rather than respond to this signal by mitigating emissions, may instead attempt to suppress or avoid emissions pricing by exercising political influence. This may occur through political lobbying and petitioning, political party donations, submissions to policy consultations, tactical voting, even protest and civil disobedience. Consequently, emissions pricing, in pursuing the intended outcome of a meaningful price signal, creates adverse conditions for achieving the ultimate objective of low-emissions transition. It produces its own political headwinds which result in its moderation, selective exemptions, or even (in the unique case of Australia's carbon pricing scheme) its own undoing (Mildenberger, 2020, Ch. 6).

Not only is emissions pricing vulnerable to resistance, it is also far from obvious that emissions pricing has natural, broad-based constituencies of support. Indeed, Meckling, Sterner and Wagner (2017) have shown that it is precisely complementary policies that helped to build support for pricing instruments in real-world jurisdictions. Green innovation and industrial policy reduce the burden of emission pricing by helping low-emissions technologies to 'travel up the learning curve and down the cost curve' (ibid.), and creates new interest groups that see a competitive advantage from emissions pricing (see also Michaelowa, Allen and Sha, 2018).

There is a significant literature on resistance to climate action by companies and individuals who self-interestedly seek to avoid the costs of internalising externalities (e.g. Dunlap and McCright, 2011; Supran and Oreskes, 2017). As a timely example, Exxon Mobil was recently exposed for publicly endorsing emissions pricing in the US on precisely the grounds that it is politically infeasible and therefore a costless signal for the company, a cynical way to talk the talk on climate action while not expecting to walk the walk (Carter, 2021). It is easy to imagine a parallel argument in Aotearoa New Zealand; that is, to endorse a sole reliance on the ETS knowing that elected officials could never tolerate the political consequences of raising prices to a level sufficient to meet emissions budgets and the NDC.

But emissions pricing not only faces resistance for self-interested reasons, but also reasons grounded in familiar principles of justice. Equity is an essential aspect of a just transition (e.g. Hall, 2019; White and Leining, 2021). Insofar as emissions pricing creates inequitable burdens, it therefore results in *unjust* transitions that lack political legitimacy and so are likely to be constrained by the negative feedbacks of political economy. The Yellow Jacket protests in France (*les gilets jaunes*) is a striking example, but similar blowbacks have occurred in other jurisdictions (Green, 2021). One issue is the different sectoral effects of a single price, which is especially relevant in New Zealand given the wide sectoral coverage of the ETS (although currently excluding agriculture). Recent experience suggests that, in contrast to transport sector, land-use change is highly responsive to emissions pricing. MfE modelling suggested that the area of farmland economic to convert to forest as a function of marginal abatement cost is 4.7 million hectares at $50/t. At over $100/t, forestry conversions are economic across almost the entire land area available for planting, which includes of 3.3 million hectares of hill country sheep and beef land, 1.9 million hectares of intensive sheep and beef land, and 1.9 million hectares of dairy land (MfE, 2020). That effectively displaces the entire sheep and beef sector (although the speed of actual forestry conversions would be inhibited by various logistical bottlenecks, such as availability of land, labour and nursery supplies). A reliance on large-scale, ETS-driven afforestation is highly questionable as a prudent strategy for managing climate risks,[4] and also raises issues of regional equity given that the costs, benefits, risks and opportunities of land-use change are unevenly distributed among rural and urban economies (Frame, 2019). Mass planting of permanent forests could displace traditional land uses and disrupt rural communities in order to produce 'rights to emit' that urban populations will disproportionately benefit from through transport, electricity and industrial uses. Meanwhile, unharvested forests make a minimal contribution to regional economies, because upfront carbon payments go mostly to investors (Rau 2021). Consequently, large-scale carbon farming lacks social licence among rural communities (Collins and McFetridge 2021), as evidenced by recent protests by farmers. It also carries an opportunity cost for achieving a more integrated approach that weaves carbon into the landscape while maximising co-benefits such as biodiversity and disaster risk reduction (e.g. Hall, 2018; Seddon, 2021; di Sacco 2021).

Another equity issue is the regressive effect on low-income households who spend a higher proportion of their discretionary income on consumables. The regressiveness of this inflationary pressure is not inevitable: it is significantly context dependent (Sterner 2012; Sager 2019). However, emissions pricing is more likely to be regressive in

[4] From a climate resilience perspective, this large-scale afforestation is arguably a maladaptive outcome, because carbon payments strongly incentive fast-growing exotic monocultures that lack biodiversity and hence resilience to climate-related impacts and other natural disasters (Messier et al 2021). This also creates risks for long-term pathways to decarbonisation, because of the risk of reversal for terrestrial carbon sinks in a heating world (Anderegg et al 2020), and the risk of mitigation deterrence insofar as structural decarbonisation is delayed by the use of offsetting under net-zero accounting (McLaren 2020).

developed countries with high economic inequality (Andersson and Giles 2020), such as Aotearoa New Zealand. To use the example of transport again, developed countries have high levels of car dependency and car ownership, which means that low-income households are relatively inelastic to emissions pricing. Indeed, local analysis corroborates this hypothesis. Notably, a 2019 Treasury analysis found that the impact of emissions pricing on lowest income quintile households was twice that of the highest income quintile households. This is because emissions-intensive goods constitute a higher proportion of household spending for low-income households, and because '[w]ith fewer resources, lower income households will have lower ability to change behaviour or invest to reduce their exposure to emissions prices' (MfE, 2019, p. 66). Similarly, an analysis of Auckland's regional fuel tax found that, as a proportion of income, low-income households faced up to 95% higher additional costs than high-income households (Blick, Comendant and Davies, 2018). In both instances, Māori are disproportionately exposed to this regressive impact, which demonstrates how the Crown can fail to uphold its partnership obligations to Māori by neglecting how climate change policy can reinforce and amplify historical and demographic inequities (Bargh 2019).

A fix for inequity?

Distributional issues can be managed and ameliorated by integrated policy making. We cannot do justice to this issue here, suffice to say that there is a potential role for labour market policies, public education and training, social assistance programmes, regional economic development, wider tax settings, and targeted financial and technical support with technology change.

In terms of emissions pricing, an oft-mentioned solution is the creation of a climate dividend – that is, a payment to households which is funded through revenue created by emissions pricing (Klenert et al., 2018). There is survey evidence that people are more amenable to emissions pricing if the revenue is recycled, either for redistribution or diverted into climate mitigation and adaptation projects (e.g. Baranzini and Carattini, 2017; Beiser-McGrath and Bernauer, 2020). Such a policy is possible given the Government's recent announcement that it will hypothecate revenue from the auctioning of NZUs toward the low-emissions transition. Over 2021-25, auctioning

89.6 million units with an estimated average price of NZ$35/t would generate NZ$3.1 billion in revenue (MfE, 2021b; Shaw 2021). Evenly split among New Zealand's population, this would create an annual dividend of about $120 per person. This might seem trivial, but of course as the clearing price rises, auctioning revenue is also poised to increase (at least until reductions to the auctioning volume have a countervailing effect).

For the sake of argument, an analysis by Infometrics economist Adolf Stroombergen (2021), commissioned by the Citizens' Climate Lobby, estimated that, if the emissions price rose to $400/tonne by 2050 (that is, six times today's price), every household would receive about $2,400 annually as a climate dividend.[5] (This assumes a population of 6.2 million and limits under 18-year-olds to only half the adult dividend.) This would increase the carbon component of petrol to 97c/litre; however, for those in the lowest household income quintile (Q1), the dividend is projected to easily surpass the fuel price. Q1 households are projected to receive about $780m from the carbon dividend, but to spend only about $94m (excluding tax) on petrol and diesel. The progressiveness of the dividend could be amplified further by targeting, such as Community Services Card holders.

If the only thing at stake were inequity, a climate dividend ought to provide a substantive solution. Yet empirical research on these redistributive mechanisms is rather less conclusive. Indeed, analysis of existing climate dividends in Canada and Switzerland reveals that public support for dividends is ambivalent, with people's attitudes shaped more by political orientation than the dividend itself (Mildenberger et al., 2020).

Firstly, there is a strong cognitive element. A recent survey of French households tested a climate dividend proposal which would increase the carbon tax by €50/t CO_2 and redistribute the revenue uniformly to each adult. Although the scheme was progressive, most households believed it would be regressive, with only 14% of households believing that they would benefit when actually 70% would. Approval ratings for the scheme – 10% in favour and 70% in opposition – mirrored that misconception (Douenne and Fabre, forthcoming). Of course, mere disapproval should not be decisive

[5] We note that Stroombergen's (2021) estimates of future revenue would not be realisable if the NZ ETS was the only pricing instrument, because the auctioning volume ought to be close to zero by 2050. It would only be realisable if the NZ ETS was complemented or substituted by a hypothecated tax on emissions. We thank Reviewer 1 for highlighting this issue.

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against implementing a policy, especially when disapproval rests on false beliefs. However, if the primary purpose of the carbon dividend is to enhance the political legitimacy of emissions pricing, then it is not obvious that a carbon dividend alone will succeed (at least not without a complementary communications strategy to overcome the barrier of bounded rationality). Moreover, if enhancing legitimacy is the objective, then it is notable that using revenue for climate-aligned investments is generally preferred over climate dividends by survey respondents overseas (see e.g. Baranzini and Carattini, 2017, Bergquist et al., 2020, Douenne and Fabre, 2020).

Which brings us to our second point: if the purpose of the exercise is decarbonisation, then why not reduce the systemic barriers to the low-emissions transition, rather than merely moderate the maldistribution of emissions pricing? To be sure, climate dividend payments potentially could help enable households to switch from high- to low-emissions goods and services in purchasing decisions, thereby reducing a household's exposure to the emissions price. But if the problem is, say, a car-dependent transport system, then individualised annual dividends in the region of $120, or even $2,400, cannot help that much. These could contribute to the price of an e-bike or EV, or bus and train fares, but cannot overcome the lock-in factors that favour private vehicles, such as urban sprawl, car-centric infrastructure, inadequate public transport, and so on. What might instead make the difference is public investment into public infrastructure, such as cycleways or public transport options, in order to induce a socio-technical transition. This is the approach taken by ETSs in the EU, Quebec, and California which redirect auctioning revenue to areas such as transport, renewable energy, energy efficiency, R&D and adaptation (Santikarn et al., 2019). Without substantive investment, without the expansion of choice that a multi-modal transport system allows, households will remain exposed to the emissions price and so transport spending will increase as a proportion of household spending. In Aotearoa New Zealand, transport already accounts for a significant proportion (16%) of household spending, just behind food (17%) and housing (26%) (Statistics NZ, 2019).

It is telling that the *gilets jaunes* protests first manifested in peri-urban and rural France 'where there is no practical alternative to the personal car as a mode of transport, and where rent or the price of housing closer to work are not within the reach of many on a modest budget, [so] the sacrifices must involve other areas of life, such as food, clothing, or the ability to go on holiday' (Devellennes, 2021, p.84). For low-income households, inelasticity entails regrettable trade-offs in household spending; meanwhile, high-income households might also be inelastic to price, because they can afford to bear the additional carbon costs. So, if private vehicles remain a necessity, increased emissions pricing can intensify economic inequalities without overcoming the causes of price inelasticity.

6. A lack of recognition

The example of *les gilets jaunes* speaks to one final issue: the shortcomings of the governance regimes that often uphold emissions pricing. Resistance to France's fuel tax was not only a protest against the economic injustice of emissions pricing, but also, 'for many, a desperate plea to be seen and be heard, to be recognized as human beings with legitimate interests and needs' (Devellennes 2021, p.84). In other words, the injustice of the fuel tax related not only to equity, but also inclusivity; not only the politics of redistribution, but also the politics of recognition – that is, the human need to have one's experience acknowledged, validated and treated with equal respect (Fraser and Honneth 2003).

The NZ-ETS was not designed or implemented with such matters in mind. In this vein, the NZ-ETS has been criticised as an instrument of techno-managerialism, grounded in administrative and expert decision making, interest group lobbying, and the use of parliamentary urgency, rather than meaningful democratic engagement (Driver, Parsons and Fisher, 2018). Less critically, we might say that the ETS's democratic legitimacy is relatively thin, exercised through political representation, stakeholder engagement, and public consultation. The NZ ETS's complexity confounds not only the public and their political representatives, but even the journalists who might simplify and explain its mechanics (Mitchell 2020). This is not an instrument that easily permits a sense of understanding or participation among citizens.

Again, this is not a sufficient reason to dispense with the NZ ETS, but it is reason to be clear-eyed about its political vulnerabilities. If prices rise and contribute noticeably to living costs or other unjust impacts, the NZ ETS does not enjoy strong loyalty and buy-in from the public, even among those who support climate action. Although the

NZ ETS is designed to preserve free choice as a market instrument, the imposition of a price may still be perceived as a form of domination by those it most affects. This speaks to its practical value of creating an incentive – that is, an extrinsic motivation – to change the behaviour of economic agents who otherwise have no interest to act on climate change. However, there is a complementary risk of being perceived as manipulative or controlling, and thereby crowding out people's intrinsic motives to act (Rode, Gómez-Baggethun and Krause, 2015; Aldred, 2016), such as the common human desire to enhance prosperity for one's children and for future generations.

In short, the NZ ETS is symptomatic of 'the poverty of theory' that dominates contemporary policy making, which treats 'policy instruments as widgets', as tools to be applied to definite problems with predictable effects. Actually these instruments are 'made and remade in specific contexts… mutate as they travel… [and] are never divorced from politics' (Boyd, 2021, p.472). Refocusing our attention on the politics of climate change – not merely as a source of hindrance, inconvenience, and irrationality, but also creativity, local intelligence and sovereign power – might help us to meet the scale, complexity and urgency of the climate challenge.

7. Conclusion

Emissions pricing is clearly insufficient as a sole response to climate change mitigation, particularly at this current juncture where deep, drastic reductions in greenhouse gas emissions are required. The NZ ETS can play an important role in encouraging efficiencies and operational change by creating a price, and also exercises a limit on cumulative emissions by managing volume. But deep decarbonisation and technological change will require transition-oriented policies that are committed to transforming systems in ways that ensure just outcomes and secure broad, enduring public support.

Of course, just because non-pricing policies are justified, this does not mean that *any* non-pricing policy is justified. The interactions among different instruments 'can be detrimental or beneficial' (Fankhauser, Hepburn and Park, 2011). Overlapping policies can result in market distortions, inefficiencies, inequities, wasted political capital, and regulatory uncertainty. But there is also the potential for synergistic policy interactions that can transcend the incremental effects of emissions pricing and deliver deep, rapid, transformational change.

In Donella Meadows' classic analysis of leverage points – that is, 'places in the system where a small change could lead to a large shift in behaviour' (Meadows 2008, 145) – she acknowledges the power of price. Price gives markets their self-correcting functions, their capacity for resilience as balancing feedback loops that returns the system to equilibrium in response to shocks and change. Consequently, she recognises the value of '[s]trengthening and clarifying market signals, such as full-cost accounting' (ibid., 154). Critically, though, there are other leverage points she regards as more important, as more capable of inducing systems change. She talks about reinforcing feedback loops which induce growth and collapse, information flows that help a system to understand itself, rules and the power to impose them, and the capacity of complex systems to self-organise and adapt. Above all, however, she talks of goals and paradigms. Reset the purpose or function of systems, or transcend the mindset out of which the system arose, and transformative change is most possible.

It is perhaps no coincidence that an absolutist stance on emissions pricing – despite all the evidence in favour of policy mixes – has intensified at the same time that the paradigm of neoclassical economics is losing its preeminence in environmental economics and policy (Atkinson and Hackler 2010; Galbraith 2020). As discourse analysis (Meckling and Allan 2020) shows, in the early to mid-2000s, the prevalence of neoclassical economics gave way to greater policy diversity, especially through the mainstreaming of post-Keynesian and neo-Schumpeterian accounts of the green economy. After the Global Financial Crisis, these latter paradigms retained their influence while market-based policy lost ground. This paradigm shift underpins the reframing of the climate challenge from 'a zero-sum to a win-win logic' (ibid.), which treats climate action an economic opportunity for green innovation and industrial policy rather than merely a cost. The demotion of emissions pricing from the status of panacea to just one element in the policy mix is a sub-theme in this larger story. And this paradigm shift is potentially the leverage point that will make the greatest difference.

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