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# Mitigating Climate Change in Urban Aotearoa: towards transformative policies

## Abstract

Carbon emissions, the dominant greenhouse gas emissions in urban Aotearoa New Zealand, must fall. This article considers how New Zealand can implement transformative urban mitigation policies. First, it is time to move beyond a fixation with the emissions trading system and vehicle electrification, and apply a comprehensive set of known, effective policy measures. Second, policies must consider effects on wellbeing. Third, systemic solutions are needed to redress systemic problems of urban sprawl and car dependence, and offer a credible prospect of transformative urban mitigation.

**Keywords** mitigation, cities, transport, building, co-benefits, wellbeing, transformation

As this article is being finalised, the Intergovernmental Panel on Climate Change has just reported again, with Working Group III reviewing action to reduce emissions (IPCC, 2022a). The Working Group III report notes that per capita greenhouse gas emissions from New Zealand, Australia and Japan have been among the highest in the world. More generally, it argues that by 2025 emissions must be falling globally if there is to be significant hope of staying 'inside' the global warming target of 1.5°C. It warns, chillingly, that 'Without a strengthening of policies …, GHG emissions are projected to rise beyond 2025, leading to a median global warming of [around] 3.2°C by 2100' (ibid., para C.1). Such an outcome would be hugely irresponsible to our descendants.

Currently, New Zealand is off track in its mitigation trajectory. It has not been able to implement more than modest mitigation policies, for reasons including largely locked-in car dependence and construction approaches, together with entrenched interests in sectors such as transport (Chapman et al., 2017; Mattioli et al., 2020; Thinkstep-anz, 2019). New Zealand is unlikely to achieve its 'fair share' target of at least halving emissions by 2030, as recommended by the IPCC (IPCC, 2018). For example, Auckland would need to reduce its transport carbon emissions by 64% by 2030 (against a 2016 baseline), according to the Auckland Climate Plan (Auckland Council, 2020). This would require emissions reductions of around 10% or so each year, a stretch made more challenging by disruption from Covid-19. Even tracking to net zero emissions by 2050 will be difficult if the country fails to engage in a comprehensive mitigation strategy.

Cities house a majority of people and produce a majority of $CO_2$ emissions globally, and New Zealand, despite high agricultural emissions, is no exception to this pattern. Climate mitigation policies focused on urban transport, infrastructure and buildings in New Zealand towns and cities are critical, and cannot remain a matter of incremental change. An ambitious overall mitigation strategy needs to include robust, durable urban policies that go well beyond conventional neoclassical economic remedies such as carbon pricing (Hall and McLachlan, 2022) and gradual motor vehicle electrification (Hasan and Chapman, 2019). Those remedies are helping, but are not sufficient, as suggested by the steady rise since 1990 in carbon emissions from transport – 96% by 2019, while overall gross emissions increased 26% (Ministry for the Environment, 2021). Taking the language of climate emergency seriously means applying *all* the reasonably cost-effective instruments available (Chapman, 2019). Being wise in

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policy choices also means recognising co-benefits and equity as well as costs, and how good policies will interact to redress systemic problems such as urban sprawl, car dependence and other social and environmental impacts.

In understanding the barriers to ambitious urban mitigation policy, the wider policy context matters. Like other countries operating a growth-focused model (including China), New Zealand faces a fundamental 'operating system' dilemma. A growth orientation has to date generated a systemic de-emphasis of the importance of the environment, including climate stability. Conventional policy reform has been too slow to prevent growing damage to the environment, as higher incomes and consumption have dominated policy agendas and populations have inexorably expanded. The evident effects of these forces strongly suggest that, at a global level, economic growth cannot be maintained into the future (Hickel and Kallis, 2020; see also Boston in this issue).

Instead of focusing on growing incomes, a shift is needed to the higher goal of wellbeing. This would certainly be more environmentally sustainable, and may also be transformative. Despite the initial efforts of the current New Zealand government (Robertson, 2019), the appetite for it is so far only slowly emerging. Nevertheless, focusing urban policies on wellbeing within environmental and social limits (Chapman and Howden-Chapman, 2021) is likely to be an important part of a sustainable way forward.

The next section of this article critiques New Zealand mitigation policy to date. The pressures to emit more created by what can be described loosely as the 'urban' sector – transport, urban form, infrastructure and building[1] – are considered. The focus here is largely on transport, as currently 47% of the country's domestic carbon dioxide emissions are from this sector (Ministry of Transport, 2021, p.10). The following section reviews forthcoming urban mitigation policies, covering key measures recommended by He Pou a Rangi, the Climate Change Commission, or foreshadowed by the government in its lead-up to the major emissions reduction plan due by mid-2022. The clear risk is that the urban policies so far signalled may not be enough; this article identifies the main areas where New Zealand is likely to need to do more. The conclusion of this article is that an assessment of urban mitigation policies should ask not only whether the policies are sufficiently ambitious, but whether they support the wider transformation of our society's goals and practices towards living much more sustainably, seriously practising kaitiakitanga.

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**Mitigation achievements and failures to date**

Despite a dismal overall record since 1990 in mitigating gross greenhouse gas emissions, and leaving aside successive governments' failure to tackle agricultural (methane and nitrous oxide) emissions, there have been some salient achievements in New Zealand's climate policy. Major steps include the development of the Emissions Trading Scheme and its recent strengthening, and urban policy reforms such as the National Policy Statement on Urban Development 2020.

However, there have been three major barriers to better policy. First, the emphasis on price instruments (especially emissions trading) has eclipsed more thoughtful approaches. The price instrument emphasis has moderated over time but still holds sway (Crampton, 2021). It centres on the conviction that price is the most cost-effective policy tool, a stance increasingly challenged by evidence about human decision making (Gowdy, 2008). Other instruments, such as investment and regulation, may be more effective in some contexts, as is evident from a wider analysis of policy merits and demerits (Rosenbloom et al., 2020).

Non-price policies often have significant co-benefits, side effects and behavioural features that need to be considered in policy appraisal, but typically are not. Cost–benefit analysis struggles to include nuances of co-benefit and other impacts, but if it is to be used, it should try. An example is the cost–benefit analysis of investing in active transport. This can generate health gains that considerably exceed investment costs. Where health gains are included in assessment, the benefit:cost ratio can easily reach around 10:1 (Chapman et al., 2018), but if those health benefits are ignored, the benefit:cost ratio looks insufficient.

The OECD has traditionally advocated carbon pricing, but now accepts that by itself it is an inadequate instrument, even if emissions trading prices were lifted substantially: 'efficient complementary measures, which address market failures not corrected by carbon pricing alone, still need to be taken' (OECD, 2022, p.14). Of direct relevance to the present analysis, an OECD study notes that the 'effectiveness [of carbon pricing] is limited in car-dependent [urban] systems where … choices are not convenient or available, and where carbon prices can generate negative distributional impacts and thus are publicly difficult to implement' (OECD, 2021, p.168).

Second, the choice to rely heavily on carbon sequestration by forest carbon sinks and a willingness to envisage buying carbon permits offshore have together encouraged a dangerous deferral of policies to reduce New Zealand's gross emissions domestically. Delaying mitigation, especially evident under the 2008–17 National government, limits options for future governments by locking in patterns of emissions, such as those generated by heavy fossil-fuelled vehicles. Twenty-five years after the Kyoto Protocol was signed, New Zealand's tentative approach to cutting gross emissions means New Zealanders face a large bill to buy international carbon credits in order to meet the country's 2030 COP26 NDC (nationally determined contribution), even if such credits are available. Direct costs of buying units offshore might have been around $5 billion under the pre-COP26 pledge (McLachlan, 2021), but with the 'enhanced' pledge, and the *indirect* costs of investing less domestically to cut carbon, total costs could be over $30 billion (Climate Change Commission, 2021, p.369).

Third, many New Zealanders have long thought about mitigation passively in terms of 'what new technology comes along' (Daalder, 2022a). But mitigation success will largely depend on what existing low-carbon technology New Zealand households and

businesses adopt and how widely it is used, what adopters are prepared to pay for it, and the changes in everyday practice they choose to make. Given the intense pressures we all now face to reduce emissions without delay, and to avoid deferring mitigation in anticipation of dubious technologies such as autonomous vehicles, New Zealanders can deploy their skills in innovatively adapting and improving established emission-reducing technologies and practices. One means by which this might be supported is by funding pathfinder projects, pilots or experimentation in specific regions or cities. This concept is being advanced in the UK to 'enable learning about what is actually required to make net zero a reality, including the roadblocks and other likely stumbles' (Hepburn et al., 2020, p.33).

**Pressures in the 'urban sector'**

By far the majority (86%) of New Zealanders live in cities and towns, so how urban lives are lived has a large influence on the country's total emissions. Understanding and changing how people live requires understanding the systemic nature of urban settlements. To date there has been insufficient joined-up or systemic consideration of how policies might interact in response to visible pressures and constraints within cities. For example, affordability of transport has not been a central consideration in regard to transport pricing or investment policy. Although it would reduce carbon emissions over time, electrification of light-duty cars may well increase car travel (since the price per kilometre would fall) and congestion, and would also be notably less affordable for most households than other strategic policies, such as widespread adoption of e-bikes (Callister and O'Callahan, 2021, p.6).

Some of the affordability pressures on households can be ascribed to urban form, where misguided funding policies have worsened sprawl, raising infrastructure costs which flow on to section and housing prices. Policy coherence has been sacrificed to ongoing, substantial road building, sending problematic signals to the motoring public about future vehicle acceptability, and to developers about future urban land use. Although electric vehicles clearly do use roads, a more intensified urban form and rail transit infrastructure investment could minimise new road construction and carbon emissions (Erdogan, 2020). As one commentator writes, 'new roads may not be compatible with climate targets' (McLachlan, 2021). Ongoing urban road building certainly puts at risk housing affordability and local council rate affordability.

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Pressure on New Zealand motorists to shift to lower-carbon cars, or financial help to switch to e-bikes, has been minimal. The Emissions Trading Scheme has since its introduction in 2010 had little impact on vehicle purchase and use patterns, and hence emissions, although it might in future if the price of carbon reached levels reflecting its environmental damage (Hasan et al., 2020).[2] While the policy emphasis recently has been on the emissions reductions achievable with car electrification, accelerated by introducing stricter vehicle emissions standards (Wood and Shaw, 2021) and clean car 'feebates', the car dependence fostered by e-car assistance has been downplayed. Purchases of fossil-fuelled utes and SUVs continue in large numbers (Woodward, Wisniewski and Wild, 2021). Cleaner car policies (Cox et al., 2020; Karlsson, Alfredsson and Westling, 2020) can be worthwhile in shifting consumer preferences, but have typically disregarded hidden emissions and other disadvantages of car proliferation. Vehicle *operating* emissions are only part of the wider picture of urban-related emissions arising from vehicle manufacturing, shipping and disposal (Hasan and Chapman, 2019), emissions from road and related infrastructure construction and maintenance, emissions from electricity generation in a sector that is now largely decarbonised, emissions from cement production, and so on.

In short, narrow project-by-project assessments of urban policy actions need to give way to a more far-reaching and systemic approach to managing transport, infrastructure and building projects to ensure that reducing emissions in one domain reinforces emission reduction (and preferably social or environmental goals) in other parts of the urban system. As well as creating synergies, connected policies increase New Zealanders' confidence as citizens that the city is changing in a more sustainable direction while improving wellbeing.

Probably the toughest pressures have arisen around land use in New Zealand cities. Car-dependent transport has largely locked in emissions by encouraging a dispersed urban form, reducing households' transport choices, and raising costs of infrastructure investment, such as extended three waters networks (Chapman et al., 2021). Sprawling development has supported a dominance of the car throughout the urban area, as well as making it difficult to transform the urban core into an active travel-oriented place with a culture that is human-centred, car free, slow and interactive (Filion, 2015). Such patterns have exposed the need for change in planning rules and critical investments (such as Auckland's City Rail Link).

New planning rules, driven by the National Policy Statement on Urban Development, and new investments offer a path away from car dependence and dispersed form towards new and more intensive neighbourhoods, with more innovative housing designs, varied streetscapes, micro greenspaces, and an abundance of bikes, scooters and walkers, where motor vehicles are sparse, and a different and more vibrant culture and way of living emerges.

The Climate Change Commission recently acknowledged, in its advice to the government in July 2021, that it now recognises 'the importance urban form has at a system wide level' and that a key element of policy direction is to 'improve understanding of how urban form and function can reduce emissions' (Climate Change Commission, 2021, pp.30, 7). This is welcome, although it downplays considerable international research. For example, a major recent European study

argued that active transport is a key ingredient for net zero, healthy cities (Brand, 2021; Brand et al., 2021). Cycling has about one-thirtieth the carbon footprint of a fossil car (and in Europe about one-tenth that of an electric car). Also, car-oriented urban development has relied on carbon-intensive infrastructure – including wider roads, highways, roundabouts, carparking buildings and airports – and has fostered and embedded car-dependent, high-carbon lifestyles (International Transport Forum, 2021), a long way from what Edwards and Tsouros (2008) characterise as the healthier lifestyles that more intensified, active cities can encourage. Most recently, the IPCC (2022a, pp.10–15) notes that urban infrastructure can make a decisive difference in energy use and induced greenhouse gas emissions, citing Erdogan (2020).

**State of play: current and expected urban mitigation policy**

New Zealand is taking useful, but so far modest, policy steps (e.g., investing in cycling infrastructure, electrifying buses and lowering public transport fares) towards active travel and quality public transport, allowing for more human interaction than does car travel.[3] In addition, there has been encouraging innovation in biofuels, e-bikes, shared e-cars and road reallocation for bus lanes; urban infill and densification; and, in the buildings area, deep energy retrofits, heat pumps, pellet burners, and the beginnings of solar PV linked to micro-grids, to name a few examples (Grant, Viggers and Howden-Chapman, 2021). But it is evident that better practices and innovation in these areas will not be enough to reduce emissions at the pace needed. Each element helps, but has limited effect in rapidly and radically changing the overall picture of urban emissions and the urban culture which drives that.

*Transformative change*

A more comprehensive approach to increasing both accessibility (Rode and da Cruz, 2018) and sustainability in a systemic way is needed. A recent OECD review points to two conceptual shifts:

> For the transport sector the mind-set shifts … translate into moving: i) from a focus on mobility towards accessibility; and ii) from improving vehicles' performance in car-dependent systems towards transforming the systems' functioning (i.e. a systemic mind-set) so that people can access places with ease without the need to travel long distances for every daily need. This shift in thinking expands the scope of climate action, as policies can now focus on reversing car dependency, rather than just improving vehicles' performance. (OECD, 2021, p.167)

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Policies with the potential (if enacted together and at scale) to reverse car dependency include measures to support shared mobility (e.g., shared scooters, e-bikes, e-cars) and, critically, 'street redesign and improved management of public space, [and] spatial planning focused on creating proximity' (ibid.).

A proximity-creating strategy is the 15-minute city, which can 'allow urban areas and their hinterlands to become networks of 15-minute cities in which people can move across the territory, but no longer need to travel long distances to meet their everyday needs' (ibid., p.9). In New Zealand, Hamilton is planning to realise such thinking, but it is also being considered more widely (Hamilton City Council, 2020; Walch and Bartle, 2021). The 15-minute city is likely to have wide benefits, especially for disadvantaged populations for whom accessibility is often challenging (Wild et al., 2021). The systemic point is that transforming mobility and transforming land use are heavily interconnected. In the words of one urbanist, with only a little exaggeration, 'Land use and transportation are the same thing described in different languages' (Alter, 2021, citing Jarrett Walker).

A growing awareness of the need for integrated car dependency-reversing policies, extending to all aspects of urban planning, housing and transport investment, is now seen in some of the government's documents. A seminal policy green paper of mid-2021, *Hīkina te Kohupara* (Ministry of Transport, 2021), for example, places top priority on actions ('Theme 1') to shape New Zealand's towns and cities to make it easier, safer and more attractive for people to access work, schools, shops and other opportunities by public transport, walking and cycling.

The Ministry of Transport does not overlook more conventional actions of vehicle electrification, improving the efficiency of supply chains and shifting freight to low-emission modes, together with existing policies such as the Clean Car Standard, decarbonisation of the public transport fleet and the biofuels mandate. Minister Michael Wood has described this set of policies as 'a solid start' (ibid., foreword). But the ministry recognises that, to effectively and rapidly reduce emissions across the entire transport system, more is needed. It acknowledges that conventional policy measures centred on electrification and efficiency would not be transformative.

The green paper is a breath of fresh air in its use of the 'Avoid, Shift, Improve' framework (for a recent elaboration see IPCC, 2022a, Table 5.1) and its embrace of the case for reshaping towns and cities to support transport mode shift, especially in its pathway 4. This pathway involves saving nearly 40% of the light vehicle kilometres travelled by 2035 through reducing trip distances and encouraging mode shift to public transport, walking and cycling (Ministry of Transport, 2021, p.107). However, a significant risk is that the solutions favoured by political decision makers (to be revealed in May 2022) may downscale the more innovative pathways (especially pathway 4) explored in the green paper.

*Infrastructure*

A key arena where systemic thinking is becoming more evident is infrastructure development, but such thinking is starting from a low base. Infrastructure investment patterns over recent years, including big ticket items such as Transmission Gully, demonstrate that climate and other environmental considerations have played second fiddle to considerations such as travel time savings (critiqued by some as largely spurious – see Cervero, 2011) and profitable land development. Waka Kotahi has avoided a comprehensive treatment of carbon emissions, including the critical matter

of how highway building can encourage urban sprawl.[4] A strong case can also be made that its investment modelling has also been flawed (Callister and O'Callahan, 2021, p.7). Its modelling appears to be subject to the same problem that besets many travel demand models: they 'do not typically include all of the feedback loops necessary to accurately predict the induced travel effect' (Volker, Lee and Handy, 2020). In short, it is slow in adequately addressing systemic effects, including the interaction between infrastructure and behaviour.

Encouragingly, the Climate Change Commission is now actively pointing out to agencies such as the Infrastructure Commission that better-directed investment in infrastructure is vital for mitigation: 'designing compact communities with infrastructure that enables easy access to rapid/frequent transit, and supports walking and cycling, can lead to significant emissions reductions over time by reducing reliance on private vehicles' (Carr, 2021, p.1). The Climate Change Commission also notes that: 'It is important that policy decisions and investments made now do not lock Aotearoa into a high emissions development path' (ibid., p.3).

A mixed picture of the reorientation to more sustainable infrastructure is seen in the allocation of the Covid-19 Response and Recovery Fund. An analysis of the energy projects financed by this fund is not inspiring: researchers working with the Energy Policy Tracker research network found that of New Zealand's early $50 billion spending allocation, about 45% went to fossil fuel-related spending and 55% to clean energy spending (Hall and Ives, 2021).[5] 'Conditionality' helps where it supports alternative modes – e.g., road upgrades that incorporate cycling and pedestrian infrastructure – but is not sufficient to materially offset the pattern of fossil fuel vehicle dependency. In short, only substantial reallocation (including during crises) will be enough to attain New Zealand's climate targets.

*Building sector*

A related but different process is going on in the building sector (including housing). Buildings and infrastructure are responsible for about 20% of New Zealand's $CO_2$ emissions, if consumption-based accounting is used, embodied carbon is considered and international trade is included (ThinkStep Australasia, 2018). Most buildings and infrastructure are in urban areas. Indeed, if we look at buildings and transport together, the majority of New Zealand's energy-related emissions can likely be attributed to making the materials for our buildings and cars, and operating our buildings and cars (Alter, 2021).

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While improving housing quality is essential, including upgrading the building code, the main current challenge for the housing sub-sector recently has been to increase production while containing costs (Grant, Viggers and Howden-Chapman, 2021). As part of a solution, the government is making regulation of the design and form of Aotearoa's major cities more permissive, recently with the support of the National Party. This has encountered some resistance focused on New Zealanders' views of the desirable form of cities and what constitutes ideals of housing. The intentions of both the 2020 National Policy Statement on Urban Development and the intensification-enabling RMA amendment of 2021[6] stem from the pressing need for Aotearoa's five largest cities to intensify. In practice, both regulatory initiatives are also likely to reduce car dependence. The national policy statement usefully removes council minimum parking requirements, but could have done more to actively discourage car use (e.g., by penalising car parks in buildings).

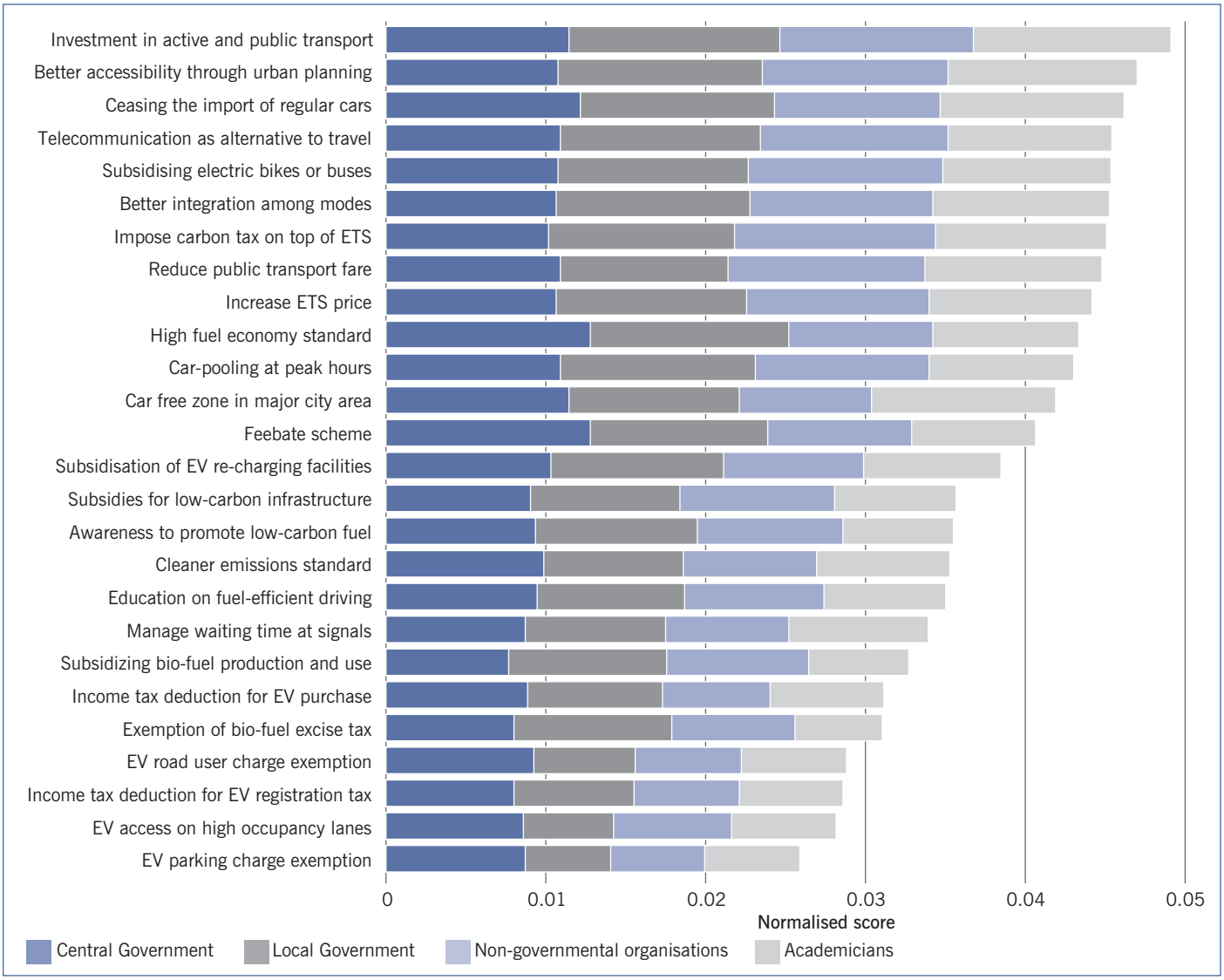
Opposition to intensification has focused on fears of loss of urban character, and exactly how the RMA regulation is implemented from August 2022 will be a delicate business. Some concern has arisen over loss of sunlight and housing character in non-central areas where district plans will enable medium-density development of three storeys as of right (Mehlhopt and Dickson, 2021; Parker, 2021b), with the national policy statement enabling more than six storeys in metropolitan centre zones. Some of this concern may be based on a desire to protect traditional suburban property values. But from a social equity and climate viewpoint, a change in priorities is sorely needed: expansion of the housing stock, an important part of improving housing affordability, and ensuring low-carbon urban form. Possible solutions to the urban form challenge lie in ensuring that district plans enable and encourage intensification close to main arteries and urban centres, and allow new solutions, such as perimeter block housing (Nunns, 2017), while protecting the best of our heritage housing and other buildings. Given the ongoing consequences for our wellbeing of how we build our houses and other buildings, and shape urban form, a strategic future orientation is vital in this part of the urban system.

**Why expected urban policies may not be enough**

Especially with the high cost of light rail per kilometre in New Zealand (Worrall, 2022), investing in public transport options and active travel is only likely to induce a certain amount of change, and work for a limited proportion of the population. In the right conditions, active travel infrastructure investment can reap rapid results (e.g. in Seville, Spain, a six-year network buildout increased working day cycle trips by 450%, from 13,000 to 72,000) (Marqués et al., 2015). To date in New Zealand, active transport investment has had to compete with private car-favouring investment that does not pay its way: consumers do not pay the full cost of car use at the point of consumption.

Unless distorted transportation 'markets' can be significantly reformed, and given that 'a third to a half of current motor vehicle use may result from market distortions' (Litman, 2021, p.47), some transport experts and urban planners have concluded that it is necessary to work on the 'push' side of the picture, not just the 'pull' side (Adam, Jones and Brömmelstroet, 2020). This includes working to improve the extent to which travelling by car better reflects the costs it imposes on others. This means pushing up its price and reducing its convenience – e.g., by including much higher carbon and

**Figure 1: Multi-criteria analysis of transport policy options, from interviews with experts, showing support for policy options (normalised scores)**




Source: Hasan, Chapman and Frame, 2020

congestion prices and parking tariffs (Harms, Bertolini and Brömmelstroet, 2016). A less appealing means is letting congestion increase, without validating increases in traffic by increased road building, with the result that car speeds drop and active travel becomes safer and relatively more attractive. In addition, one (infrastructural) mechanism in central areas is reducing road space available to cars (space usually not paid for by car users in any case) and creating more space for alternative modes (Marqués et al., 2015). Examples are putting city centre roads on 'diets' (Cycling Action Network, n.d.; Daalder, 2022b), limiting car movement, and managing car parking supply (Adam, Jones and Brömmelstroet, 2020). Such largely regulatory measures can reinforce infrastructural investments in supporting active and public transport.

Transport experts tend to support this way of thinking about preferred non-EV policy measures for Aotearoa, a multi-criteria analysis study suggests (Hasan, Chapman and Frame, 2020) – see Figure 1. In this study of 25 policy experts' views, options that aim to promote electric vehicle uptake are not seen as ineffective as such, but they are seen as less suitable alternatives to reduce Aotearoa's transport sector emissions. Of the 26 policy options examined, investments in active and public transport are seen as the most sustainable policy option to reduce emissions from the transport sector. They were supported by other 'top' policy options including: ensuring better accessibility through urban land use planning; ceasing the import of fossil-fuelled cars into New Zealand by 2030; using telecommunication services as alternatives to travel; and subsidising electric bikes or buses.

Additional to the multi-criteria analysis policies above are others to restructure funding incentives: these would be a valuable element in the New Zealand government's forthcoming emissions reduction plan. To support more sustainable transport investment, the financial assistance rates for public and active transport projects would be lifted to favour such transport, not roading. Similarly, central government and councils would make funding for any roading projects, including maintenance and renewals, contingent on a requirement to roll out counterpart cycling and walking improvements across the network and constrain motor vehicle use (Callister and O'Callahan, 2021).

The Climate Change Commission has taken an increasingly broad view of the mix of urban mitigation policies needed, in light of the pressing need to achieve significant emissions reductions in transport and other urban domains. The international literature has been addressing these issues for some time. It notes powerful long-run linkages between more sustainable urban form and emissions

reduction when key urban form drivers of emission reduction, such as density, land use mix, connectivity and accessibility, are considered, and, in most cases, concludes that changes to favour these goals will contribute to important co-benefits in health and wellbeing.

For example, the IPCC's fifth assessment report found that 'co-locating higher residential densities with higher employment densities, coupled with significant public transit improvements, higher land use mixes, and other supportive demand management measures can lead to greater emissions savings in the long run … (robust evidence, high agreement)' (Seto et al., 2014), p.928). The 2022 IPCC Working Group III report notes that '[m]any mitigation strategies in the transport sector would have various co-benefits, including air quality improvements, health benefits, equitable access to transportation services, reduced congestion, and reduced material demand (*high confidence*)' (IPCC, 2022b, para C.8).

The 2014–15 Global Commission on the Economy and Climate reached similar conclusions. It concluded that well-managed urban development is critical for aligning wellbeing and prosperity with climate stability. Cities, in their view, should be able to expand but should be as compact as possible, with higher densities and mixed neighbourhoods, be walkable and of human scale, redeveloping brownfield sites and ensuring green space. Connected infrastructure, including smarter public transport, cycling, car sharing, electric cars and energy-efficient buildings, have a strong complementary role. Too often, in their view, cities expand in a way that locks in inefficient infrastructure and future emissions. As an example, the commission contrasted costs of transport in compact Copenhagen (about 4% of its gross domestic product) with that of sprawling Houston, where transport costs about 14% of its GDP and generates much higher emissions. They underlined the large health gains and carbon savings possible from a global scenario based on compact cities with connected infrastructure: for example, global transport emissions could be cut about 1.5 billion tonnes per year (Floater et al., 2015).

Such international evidence makes clear that the way cities are built or upgraded, including where and how roads are built, and where different sorts of building are permitted, deeply influences not only how much carbon is emitted in the longer term, but also the wellbeing of citizens.

A 'local' example of integrated thinking about cities, transport and emissions is provided by an OECD report on Auckland's emissions (OECD, 2020). This study modelled regional and local transport and land use (urban form) policies. It found that road transport $CO_2$ emissions could be cut by 70% per capita (p.23) and overall by around 30% (p.12) by 2050 (slower than a target of 50% by 2030, but a major contribution). The following policies are envisaged:

- policies to promote public transport, biking and walking and discourage private vehicles by 'drastically increasing the cost of private vehicle ownership' (p.12);
- substantial subsidies and tax exemptions for electric cars, and faster innovation in the EV sector;
- land use policies to reduce kilometres travelled, by altering the spatial structure of Auckland over time, and enabling widespread densification.

The report notes that, 'Policies that promote a more compact urban form are fundamental in the long-run success of urban transport decarbonisation strategies' (p.18).

While some motorists might disagree with the specific prescriptions of this study, it illustrates that substantial emission savings can be made from a mix of urban form (land use) policies along with transport policies that include favouring electric vehicles, in general accord with the direction in which policy is heading in New Zealand, but so far much too slowly.

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**Conclusion: a broader prescription for cities**

While the most mutually reinforcing transport policy options for New Zealand cities are likely similar to the Ministry of Transport's 'pathway 4' identified above, some institutional changes may help to ensure that these policies really do extend into urban planning, infrastructure management, and the building sector (including housing). One recent suggestion is to establish a Ministry of Green Works, not just in relation to climate resilience but in relation to the housing shortage, infrastructure deficit and other areas of stress in the public sector (Harris and Paul, 2021). The authors of this paper question whether 'the existing range of public institutions have the right expertise to be far-sighted in anticipating future problems, and agile in response to short-term emergencies' (p.33), and ask how we can ensure all new infrastructure will be 'green'. The first of these questions is a good one, and echoes the questions posed by Boston (2016) in relation to ensuring a greater future orientation of public agencies. But the proposal of a Ministry of Green Works is a centralist structural solution, and may fail to address problems of wider coordination and incentives. Such a ministry might founder under problems of internal coordination and structural overreach.

One alternative may be Environment Minister David Parker's wider 'strategic planning' and resource management legislative structure, which would better coordinate central and local government resource management planning and apply to all private sector activity involving resource use (water, air, climate, soils, and so on) and impacts on the environment. This centres on a new Strategic Planning Act and national planning framework under a Natural and Built Environments Act (Parker, 2021a). This framework will incorporate the various national policy statements and national environmental standards that have been developed under the RMA, and will consolidate the different rules the government currently has for planning, including rules around urban form. The framework will include mandatory environmental limits, and ensure the government sets out strategic views on how it wants the country to develop (desired 'outcomes') – for example, through

regional spatial strategies – rather than leaving those questions to councils and private agents. The framework would include the National Policy Statement on Urban Development referred to earlier as an important step towards more compact, lower-carbon cities.

Associated with these policies and reforms affecting urban planning, form and design, attention is needed to matters of sociocultural and behavioural change to wean, as far as feasible, car-oriented urban residents away from energy- and carbon-intensive lifestyles towards 'slower' and more community-oriented ways of living and travelling. Some writers point to educational strategies and social tipping points, underpinned by a perspective that the use of fossil fuels is, increasingly, unethical (Otto et al., 2020). Others, including some OECD advisers, emphasise a multi-pronged and deeper strategy, including reframing – e.g., moving away from technological optimism, and from analytical to systems perspectives – and rethinking goals – e.g., moving from a preoccupation with mobility towards optimising access (OECD, 2021). The 2022 IPCC report argues that such approaches, characterised as demand-side mitigation, can offer significant reductions in transport and buildings by 2050 (IPCC, 2022b, Figure SPM.6), although uncertainties remain about some practices and rebound effects.

Beyond these questions there remains a further need to reconsider the broader questions of what sort of society New Zealand wishes to be. Confronting these questions is necessary if New Zealand is to take a strategic and ethically defensible view on climate and responsibilities to future generations.

A basic ethical question is whether New Zealanders are prepared to pay a price, even if modest, in terms of forgone income, in order to rapidly mitigate climate change. The 2022 IPCC report asserts that, globally, mitigation actions (whether urban or non-urban) costing less than US$100 per tonne could reduce emissions by at least 50% (vis-à-vis 2019 levels) by 2030, and that incomes would continue growing.[7] Moreover, the economic benefit of limiting warming to 2ºC would exceed the cost of doing so (ibid., C.12). There is no reason to think these findings do not apply to New Zealand. Because the real price of major mitigation is likely negative, failing to so mitigate is not only unethical but obdurately self-interested.

It is also unethical to abrogate decisions about the contributions which our cities, our transport systems and the ways we in New Zealand live and work can make to reducing carbon emissions. In the last few decades we have pretended that we can muddle through, deferring such big questions. We cannot. The major questions we have to face up to as citizens start from how we plan our cities, our buildings and our transport systems. They widen out to matters of how much we consume, why, and whether ultimately we are more concerned about our cars, our houses and our consumption patterns in the short term, or are prepared to take a deeper, broader and longer-term view of what makes for real wellbeing and sustainability in Aotearoa New Zealand.

1 Aviation and maritime transport are not urban-related, so are excluded here, as is inter-city transport. Domestic aviation emissions grew little since 1990, but international aviation emissions grew rapidly and now exceed domestic car transport emissions (Callister and O'Callahan, 2021, p.3).

2 The Climate Change Commission notes that 'marginal abatement costs of around $140 per tonne of $CO_2e$ abated in 2030, and $250 in 2050 in real prices, are likely to be needed to reduce emissions associated with energy use' (Climate Change Commission, 2021, p.245).

3 Studies suggest pedestrians and cyclists spend more than car drivers on shopping in urban spaces, often simply because the former linger and window shop. Along with more shopping, they are also more likely to contribute to the sense of liveliness of an area, engaging with others in local parks or cafés, unlike most transient car drivers. This is where transport intersects with urban design and urban form, which are now clearly identified in the literature as vital factors in urban sociocultural change and carbon mitigation.

4 However, it is now rethinking its analysis of transport infrastructure: e.g., Waka Kotahi, 2019.

5 For a February 2022 update, see https://www.energypolicytracker.org/country/new-zealand/.

6 https://www.parliament.nz/en/get-involved/topics/all-current-topics/enabling-a-greater-supply-of-housing/.

7 US$100 is about NZ$143 in April 2022. A 2018 estimate implies that this would raise retail petrol prices by about 40c/litre (see Productivity Commission, 2018, p.293).

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