Funding Climate Change Adaptation:

The Case for Public Compensation in the Context of Pre-emptive Managed Retreat

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Executive summary

Purpose: This paper considers how New Zealand should fund *pre-emptive managed retreat* during the 21st century and beyond in response to sea level rise and other climate change-related impacts. A key focus is on whether, to what extent, and on what basis private property owners (especially residential owners) should receive public compensation for their losses. The broad conclusion is that substantial public compensation is justified and will be essential to ensure that the long-term costs of climate change adaptation are minimized and important social equity objectives are realized. Moreover, in a democracy like New Zealand with strong solidaristic traditions, substantial public compensation is almost inevitable for political reasons. Aside from funding issues, pre-emptive managed retreat is unlikely to be conducted competently or effectively without robust public institutions that encourage sound anticipatory governance. Significant institutional, planning, and regulatory reforms will be required to facilitate high-quality governance.

Context: Climate change constitutes an unparalleled, slow-motion disaster. It will generate ever more formidable adaptation challenges as the century progresses. As a maritime state with a long coastline and many low-lying coastal towns and cities, New Zealand will be disproportionately affected by sea level rise. While it is hard to predict how much the sea level rise will rise during the 21st century, policy-makers need to prepare for an increase of at least a metre by 2100 and, in all likelihood, multi-metre increases by 2200.

It will either be too expensive or technically impossible to protect many existing coastal (and other vulnerable) settlements and related public infrastructure, both in New Zealand and elsewhere. Hence, large numbers of people will almost certainly need to be moved pre-emptively to safe locations. The number, scale, and duration of such relocations will exceed anything previously encountered in human history. They will severely test the existing governance arrangements and financial resources of many, if not most, OECD countries.

Current policy settings in New Zealand and, it seems, most other OECD countries are not well suited to the magnitude and complexity of the adaptation challenges societies will confront. Indeed, they fall far short of what might be regarded as optimal in many crucial respects. Overall, existing policy frameworks are largely reactive rather than pro-active, and ad hoc rather than systematic. Too often they are focused on moving people from at-risk communities *after*, rather than *before*, a natural disaster has occurred. This approach lacks any logical basis.

To compound matters, there is generally a gross mismatch between the resources required for large-scale, pre-emptive managed retreat and the funding available via existing policy mechanisms. Without funding reforms and commensurate changes to governance arrangements, spatial planning, and regulatory frameworks, current policy settings are

destined to increase risk exposure, encourage moral hazard, exacerbate socio-economic inequalities, and contribute to higher overall adaptation costs. To enable sound anticipatory governance, major policy reforms are essential.

The way forward: If pre-emptive managed retreat is to be strategic, timely, and competently implemented, it will need to be well funded. One way or another, substantial public funding will be required. About this claim, there is little disagreement, certainly among those with expertise in the field of climate change adaptation.

Against this, there is no consensus among policy-makers and researchers about the issue of *compensation*, namely whether, to what extent, and on what basis public compensation should be provided for the loss of private property. This paper make the case, not least in the interests of long-term cost minimisation and fairness, for significant public compensation. Plainly, however, designing a comprehensive compensatory policy regime – one that commands adequate and hopefully enduring public backing and cross-party support – will be difficult. But the task needs tackling. Otherwise, policy-makers in New Zealand (and most other OECD countries) will limp from one unfortunate episode of coastal erosion or serious flooding to another, with resultant inconsistencies, delays, inefficiencies, and inequities.

In developing a strategic policy framework for pre-emptive managed retreat, the following considerations deserve attention:

1. In a centralized polity like New Zealand, only the central government possesses the revenue raising and borrowing capacity to fund large-scale population relocations. This capacity places the primary obligation – or 'remedial responsibility' – to act squarely on the central government. Acceptance of this responsibility will be fundamental to the design of any comprehensive, effective, and equitable adaptation funding framework.

2. To be sure, it may be feasible for small-scale projects of managed retreat to be funded and administered by regional councils and local authorities. Hence, there may be scope for adaptation funding arrangements to vary depending on the number and scale of the required policy interventions (including whether they have significant implications for public infrastructure and public services – educational, health care, elder care, social, etc.). Against this, there are likely to be advantages (e.g. in terms of consistency, cost-effectiveness, minimising compliance costs, and ensuring equity) in having a *single funder and an integrated administrative structure*, together with nationally-determined eligibility criteria for public assistance, standardized levels and types of public assistance, and so forth. Such arrangements will need to be mandated via a suitable, fit-for-purpose statute.

3. Some form of public compensation for private property losses resulting from programmes of managed retreat (and other impacts of, or policy responses to, climate change) will be unavoidable. Every effort should be made to reach a durable cross-party agreement on the principles, criteria, and administrative procedures governing such compensation. I strongly suspect it will be necessary to provide levels of compensation for residential (and probably non-residential) properties which reflect monetary losses based on suitably determined market valuations.

4. US evidence highlights the complications and sub-optimal outcomes that can arise when buyouts of at-risk properties are co-funded by multiple levels of government. This evidence must be taken seriously in designing adaptation funding arrangements in New Zealand.

5. There is a good case, based on considerations of inter-generational fairness, for pre-funding some of the expected costs of managed retreat later in the century.

6. If pre-emptive managed retreat is to be competently implemented, well-designed governance, institutional, planning, and regulatory arrangements will be essential. This must include proper monitoring, evaluation, and feedback in order to facilitate effective policy learning and innovation.

7. Decision-making for pre-emptive managed retreat must be properly integrated and coordinated with other aspects of climate change adaptation, including spatial planning, the funding of protective structures, the climate-proofing of public infrastructure, and the provision of public assistance to cover loss and damage arising from other climate-related impacts.

Introduction

Climate change constitutes an unparalleled, slow-motion disaster. It will generate multiple and ever more serious negative impacts: accelerating sea level rise; more severe droughts and rainfall events; new biosecurity risks; faster biodiversity loss; and changing disease vectors. Many of these impacts will be well outside the variability ranges previously experienced, certainly during human habitation of the Earth. Mitigating and adapting to these impacts poses unprecedented technical, administrative and political challenges. Collectively, these challenges constitute a 'wicked' policy problem, if not a 'super-wicked' policy problem' (Lazarus, 2009).

This paper focuses on some of the policy issues posed by sea level rise. More specifically, it considers how *managed retreat* – that is, the planned removal and relocation of human settlements – should be *funded*.[1] The analysis is predicated on at least three assumptions. First, large-scale relocations are inevitable over the coming century and beyond – with the number, pace, and magnitude increasing over time. Second, *pre-emptive* managed retreat will be essential if the societal costs of adaptation are to be minimised and important equity goals achieved. Third, in most OECD countries, only central (or federal) governments possess the financial resources and other capabilities required to devise and implement population movements of the scale that will be required.

In addressing the question of how managed retreat should be funded, the paper builds on recent contributions to the debate, both in New Zealand (e.g. Boston and Lawrence, 2017, 2018; Climate Change Adaptation Technical Working Group, 2017, 2018; Dudley Tombs and France-Hudson, 2018; Ellis, 2018; Hodder, 2019; Local Government New Zealand [LGNZ], 2016a, 2016b, 2019; New Zealand Productivity Commission [NZPC], 2019; Parliamentary Commissioner for the Environment [PCE], 2015) and in other OECD countries (e.g. Freudenberg, et al., 2016a, 2016b; Hinkel, et al., 2018; Hino, et al., 2017; Mach, et al., 2019; OECD, 2019; Siders, 2019; Siders et al., 2019; Weber and Moore, 2019).

Among the issues at the heart of the funding of managed retreat is *public compensation*: should the owners of properties at risk from sea level rise and related coastal erosion, flooding, and inundation be eligible for public compensation for their losses and, if so, to what extent and on what basis? Discussing compensation is highly controversial, but unavoidable (Dudley Tombs and France-Hudson, 2018). It raises multiple concerns – fiscal, legal, social, economic, and distributional. It is not possible to explore all these concerns in-depth in a single paper. Partly for this reason, the primary focus here is on compensating *residential* property owners for the loss of their land and homes; compensation for the loss of other buildings and physical structures (including public facilities, community rooms, recreational buildings, commercial enterprises, farm buildings, places of worship, sacred sites, etc.) is not discussed in any detail; nor is the issue of providing compensation for business disruption and other financial losses caused by sea level rise and related climate change impacts. This is not to suggest that compensation for the loss of *non-residential* properties is unimportant or unjustified, but

[1] 'Managed retreat' can be defined in a coastal setting as 'the application of coastal zone management and mitigation tools designed to move existing and planned development out of the path of eroding coastlines and coastal hazards' (quoted in Hino, Field and Mach, 2017, p.1). It is deliberate, intentional, coordinated and planned. The aim is to reduce natural hazard risk permanently, rather than temporarily.

distinctive compensatory issues are likely to arise for different categories of property and these would need careful investigation.

It is important to recognize that retreat from existing areas of human settlement in response to coastal erosion, flooding, and inundation has been an ongoing feature of civilisation across the globe for centuries, if not millennia. Until recently, however, most instances of retreat were unplanned and unmanaged. Typically, they occur in the wake of a significant storm event and related coastal erosions and flooding, rather than pre-emptively. Also, in the vast majority of cases, those affected received little, if any, public assistance. But given the extent of sea level rise projected during the 21st century, relying on ad hoc, unplanned, and uncoordinated responses will be increasingly risky, socially undesirable, economically damaging, and politically unsustainable – certainly in advanced industrialized democracies. Instead, it will be essential for retreat to be properly *managed* – that is, publicly planned, legally mandated, and authoritatively supervised. Simply leaving vulnerable populations to the mercy of a rising tide cannot be countenanced morally. Indeed, in a civilized society it is surely unthinkable.

Managed retreat, however, poses a plethora of policy issues, many of which are complex and deeply controversial politically. While funding questions are pivotal, there are many others; invariably, they are interconnected. They include, for instance, the overall planning and regulatory framework, the role of private insurance, the processes for public consultation, the location of decision-rights (e.g. centrally or locally or in combination), the provision of appeal rights, the development of new settlements for relocation, the provision of new public infrastructure, and so forth. Ideally, such issues should be considered in an integrated and coordinated manner. But that is not possible here: to do so systematically and robustly would require a book-length treatment. The following issues, therefore, are out of scope:

1. The way spatial planning and related decision-making processes should be reformed (including the mechanisms for public consultation and participation) so as to enable the relocations of at-risk populations to be well-managed.
2. The development and application of policy tools to enhance the quality of decision-making in response to climate-related impacts and uncertainty (e.g. real options analysis and dynamic adaptive policy pathways).
3. The regulatory and other policy reforms required to enable the implementation of managed retreat in a cost-effective and equitable manner (e.g. with respect to insurance, loan facilities, and social assistance programmes).
4. How to fund the costs of upgrading and climate-proofing existing public infrastructure (e.g. transport networks, water services, etc.).
5. How to fund the costs of building (or improving) protective structures (whether soft or hard) and other devices (e.g. drainage systems and pumps) to reduce risk exposure.
6. How to share the burden of various other climate change-related impacts and adaptive responses (e.g. agricultural losses from droughts and storms, forestry losses from fires or fishing industry losses from warmer and more acidic seas).

It is fully acknowledged that all such issues are significant and increasingly pressing. Regarding the sixth issue, for instance, it is worth noting that in Australia substantial federal and state assistance is currently being provided to drought-affected farmers and rural communities (especially in New South Wales and Queensland). Proposals have also been advanced for public buyouts of farms that are no longer financially viable. Clearly,

there are parallels here with proposals for property buyouts due to sea level rise. Hence, such matters deserve proper analysis – albeit on another occasion.

The same applies to the fifth topic, namely the funding of protective structures. Obviously, the options of *fight* or *flight* in response to sea level rise are closely connected. Policy decisions to strengthen protective structures are likely to reduce – or at least delay – the need for managed retreat. In some situations strategies to enhance exiting coastal and river defences may be deliberately short-term, with the aim of allowing more time to design and implement a proper programme of managed retreat.

A final caveat: while focused on managed retreat, the following discussion is limited to situations occurring *within* countries, and specifically within *developed* states. Hence, no consideration is given to situations involving cross-border issues, or where the actions of one state are likely to affect another, or the distinctive issues confronting least developed states like Bangladesh (see Mortreux, et al., 2018). Nor does this paper address the moral and legal responsibilities of *developed* countries to assist *developing* countries afflicted by the impacts of climate change, including all the philosophical and practical issues surrounding climate-change related 'loss and damage' (e.g. matters of attribution, historical responsibility, liability, and inter-governmental compensation) (see Roberts and Pelling, 2018). Finally, no attention is given to situations where the loss of state-hood may arise (e.g. due to sea level rise rendering low-lying atoll states, such as Tuvalu, uninhabitable) and the related need for trans-national managed retreat. While such matters are highly pertinent and are rightly receiving increasing international consideration (e.g. via the establishment of the Warsaw International Mechanism for Loss and Damage), they are beyond the scope of this analysis.

The paper is structured as follows. First, it briefly comments on the scale and scope of the challenges posed by sea level rise, both globally and with respect to New Zealand. Second, it discusses some of the constraints upon, and challenges facing, governmental decision-makers in the context of policy complexity, uncertainty, and public opposition. Third, the paper outlines and assesses the policy approaches adopted in several OECD countries, most notably the United States and the United Kingdom, to address the impacts of sea level rise, with a particular focus on the provision of public compensation for property losses in the context of managed retreat. Fourth, the paper enunciates the goals and principles that should guide policy-making in relation to the funding of climate change adaptation, giving prominence to two core policy goals, namely minimizing the long-term societal costs of adaptation and ensuring that the financial and other burdens are fairly shared. Fifth, the paper summarizes and evaluates the arguments for and against the provision of public compensation for those likely to be affected by sea level rise and related coastal erosion, flooding, and inundation. Sixth, the paper briefly reviews the main weaknesses of New Zealand's current policy framework for climate change adaptation and, based on the preceding analysis, discusses how this framework should be reformed. The paper concludes with a series of policy proposals.

Method

But first, a brief word on method. This paper draws on previous papers I prepared with Dr Judy Lawrence (i.e. Boston and Lawrence, 2017, 2018), a review of the relevant international literature (see the list of references at the end of the paper), and discussions with a range of British researchers and civil servants with expertise in the areas of climate change adaptation and risk management (see Appendix 1). It also draws upon the draft

findings of the New Zealand Productivity Commission (2019) regarding its review of *Local Government Funding and Financing* and the work on 'community resilience' being undertaken by officials in the Department of Internal Affairs and the Treasury.

Section 1: The impacts of sea level rise

There is now a burgeoning international literature on sea level projections for 2100 and beyond. Based on such projections, there have been many detailed analyses of the likely impacts on particular countries (e.g. for the UK see Edwards, 2017). Some of these studies include estimates of the anticipated costs of sea level rise (Boettle et al., 2016; Hallegatte et al., 2003; Hinkel et al., 2014; IPCC, 2014; Lincke and Hinkel, 2018). As might be expected, the estimates depend on: the timeframes under consideration; the projected path of global greenhouse gas (GHG) emissions; the projected impact of global warming on the polar ice sheets, ocean currents and storm patterns; the assumptions made about the pattern and scale of future human development; the methodologies used to assess the likely number of people living in vulnerable locations (Kulp and Strauss, 2019); the nature and types of risks considered and their related costs (e.g. direct and indirect, market and non-market); how losses (e.g. land, buildings and infrastructure) are valued; and the kind of adaptation measures or protection strategies adopted.

Importantly, some recent analyses suggest that the number of people likely to be affected by sea level rise this century could be much greater than previously thought. For instance, Kulp and Strauss (2019) have estimated that around 190 million people globally are currently living in areas below projected high tide lines in 2100, based on a low carbon emissions scenario. This is about 80 million more than the number currently at risk (i.e. around 110 million). On a high emissions scenario, by 2100 they estimate that about 630 million people will live in areas where annual flooding is likely, compared with about 250 million currently.

Hallegatte et al (2013) estimated, based on a study of 136 major coastal cities, that without additional protective measures, sea level rise and related changes to storm surges, floods and major storms could cost globally as much as US$1 trillion annually by 2050 and multiple times this figure by 2100. Likewise, Hinkel et al. (2014) estimated that if the sea level rises by 1.23 metres by 2100, and if no adaptation occurs, then up to 4.6% of the global population would be flooded annually, with expected annual losses of over 9% of global domestic product. Such losses would be unsustainable economically and socially. Effective coastal adaptation measures, including managed retreat, can be expected to reduce these losses substantially (see also Reisinger et al. 2015).

Standing back from the particulars, the following broad conclusions are evident:

1. the costs of sea level rise will increase in a non-linear manner (i.e. as seas rise, the costs will rise even faster);
2. the costs will be greater if global GHG emissions peak late and then fall slowly;
3. the costs will escalate significantly as the century advances;
4. the costs will be greater if urban development continues in areas exposed to rising seas and inundation;
5. the costs will fall unevenly geographically and intermittently; and
6. the costs will be greater if governments (national and sub-national) fail to plan and invest in effective risk reduction and adaptation initiatives.

The New Zealand context

From a global perspective, New Zealand is highly vulnerable to sea level rise. At around 15,000 kilometres, the country has the 9th longest coastline in the world. Inevitably, therefore, it will be disproportionately affected over the coming centuries by coastal erosion, flooding, and inundation (Climate Change Adaptation Technical Working Group, 2017, 2018; Royal Society of New Zealand, 2016; Stephenson, et al., 2017). To compound matters, most of the country's major cities, as well as numerous towns and other settlements, are located on the coast. Substantial numbers of people live only a few metres (or less) above the high spring tide level and significant amounts of public infrastructure are located next to the coast (e.g. roads, railway lines, and water services). Further, large parts of the central business districts of several cities (e.g. Napier, Nelson, and Wellington) are only a few metres above sea level.

Complicating matters is the fact that many vulnerable low-lying coastal areas are sparsely populated, thus reducing the economic case for protective structures (i.e. on the basis of standard cost-benefit analyses). In many instances, too, the construction of sea walls, barriers, dykes and other defences will be complicated technically as a result of seismic geological, and other factors. Hence, even assuming that global energy systems are rapidly decarbonized over the next few decades, the sea level could rise by up to metre by 2100 and large numbers of people will need resettling in safe locations. If rapid decarbonization does not occur, the outlook will be even bleaker.

Estimating how much sea level rise will cost New Zealand over the coming century poses a variety of methodological and analytical challenges. Initial modelling work by Bell, Paulik and Wadwha (2015) for the Parliamentary Commissioner for the Environment (PCE) (2015) indicated that at least 43,683 homes (or about 133,000 people) and 1,448 commercial properties are within 1.5 metres of the current average high tide in spring. But this study did not cover the whole country. Nevertheless, the buildings affected had an estimated replacement cost of $20 billion (in 2011 dollars). By contrast, with sea level rise of up to three metres, over 280,000 people would be affected, with damage to buildings exceeding $50 billion (in 2011 dollars). There would also be significant impact on public infrastructure, such as transport networks, energy systems and water services (including numerous wastewater treatment plants).

More recent modelling work by Paulik et al. (2019), as part of the Deep South Science Challenge, indicates that each 10cm rise in the sea level will put at risk an additional 7,000 buildings (with a replacement cost of about $2.4b), 133 kms of roads and 10 kms of railway line. The analysis suggests that sea level rise of a metre would impact on over 125,000 homes and other buildings valued at about $38 billion.

Fortunately, the impacts of climate change and their related costs can be reduced by preventing further housing development in risky areas, relocating existing settlements, and prudent investments in more resilient infrastructure. Significantly, Local Government New Zealand estimates that $1 spent on risk reduction saves at least $3 on future disaster costs by avoiding losses and disruption (Deloitte Access Economics, 2013). Some international estimates of the likely savings are substantially higher (Healy and Malhotra, 2009).

Section 2: The political challenges

Adapting to the impacts of climate change poses distinctive and formidable political challenges (see Gibbs, 2016). First, there are numerous uncertainties – in some cases 'deep uncertainty' (Walker et al., 2012, 2013). To be sure, there is no doubt that the sea level will rise over the coming century (and probably well beyond), but, as noted, the speed and magnitude of the rise is much harder to predict. Depending on the assumptions adopted, the magnitude of the impacts could differ substantially, thus influencing the required policy responses. But a rising sea level is only one of several factors that will afflict coastal settlements and their related public infrastructure and amenities (e.g. schools, health care facilities, libraries, public parks and recreational facilities, social housing, etc.). More powerful storms (and hence stronger winds, more intense precipitation, and higher storm surges) will compound the problems generated by sea level rise and contribute to multiple and often cascading risks (e.g. between and across economic sectors and domains of interest).

Second, the planning horizons in relation to sea level rise are very long (e.g. a century or more). By comparison, electoral cycles are extremely short – only three years in New Zealand at both the national and sub-national levels. This creates inevitable political tensions. Decisions are needed to protect citizens' *long-term* interests, but the political incentives facing governments are strongly *short-term*.

Third, and related to this, adaptation raises profound distributional issues and complicated policy trade-offs: some of these are intra-generational, others are inter-generational. For instance, safeguarding future interests will often entail significant *upfront* fiscal costs. But whereas such costs are relatively visible, direct, and certain, the hoped-for benefits of effective adaptive measures tend to be indirect, uncertain and more intangible – and thus less easy for voters to grasp. Non-simultaneous exchanges of this nature are invariably hard to justify politically.

Related to this, governments find it more difficult to secure electoral support for public expenditure on precautionary measures, such as *pre-event risk reduction,* than to fund *post-disaster recovery*. Put differently, voters are generally reluctant for governments to spend heavily on mitigating risks or preventing disasters but much more willing to support substantial public spending on disaster relief and recovery (see Healy and Malhotra, 2009). Such phenomena transcend political boundaries. They reflect humanity's cognitive biases, such as myopia, a status quo bias, and the downplaying of long-term and/or unfamiliar risks. In general, citizens tend to discount the future and value post-event cures more highly than preventative interventions (Boston, 2017a, 2017b; White and Haughton, 2017). To complicate matters, precautionary measures often entail opportunity costs and individuals' acceptance of risk (and thus their tolerance of losses) varies depending on the context. Risk aversion increases after a disaster.

The implications for adaptation strategies involving precautionary, pre-emptive managed retreat are rather obvious: even with excellent frameworks for national and spatial planning, the best available scientific evidence, rigorous public consultation, first-rate participative mechanisms, robust decision-making processes, and comprehensive compensatory packages, undertaking such strategies will entail significant political risks and long delays. Vigorous and concerted opposition – including litigation, public protests, and strongly contested local elections – can be readily anticipated. Finding ways to counter such propensities will be crucial. Otherwise, there will be many (more) sub-

optimal policy decisions – ones that increase and entrench risk exposure, thereby placing additional burdens on future generations. This is contrary to a core goal of effective adaptation, namely to reduce risk now and for the future. Put differently, a key objective in the face of climate change must be to devise planning, funding, regulatory, and risk management frameworks that help incentivise precautionary actions and wise stewardship, not least by reducing some of the political costs associated with prudent long-term decision-making.

Section 3: The funding of managed retreat in the OECD

The international literature on the funding and regulatory aspects of climate change adaptation in OECD countries is relatively modest compared with that regarding mitigation (i.e. decarbonization). For instance, there are few detailed analyses of the various approaches to adaptation funding, including comparative investigations of the different models and arrangements across the OECD, and their respective strengths and weaknesses. To be sure, the OECD (2019) has recently published a useful comparative study with a series of interesting case studies, including one in New Zealand focused on policy initiatives in the Hawke's Bay. But the OECD study leaves numerous questions unanswered, especially in relation to adaptation funding.

A more general overview of approaches to community resilience in the face of climate change has been prepared by the Department of Internal Affairs (DIA) with assistance from the Treasury (2019). This includes brief summaries of the adaptation policy frameworks in selected OECD countries. But while this literature review contains a lot of useful information, as with the OECD study it is by no means comprehensive.

As far as *managed retreat* is concerned, the international literature is even more modest. There are few cross-national studies; most analyses are country-specific. The latter include some detailed case studies, especially in the US which has some of the longest running and best established programmes of managed retreat in the world. The cases examine the post-disaster recovery programmes, including property buyouts, following Hurricane Katrina, Hurricane Sandy, and other major storms. Overall, however, there are relatively few studies exploring funding models and approaches, including the specific issues of *public compensation* for the loss of private property (and/or use rights). Similarly, there are few detailed analyses of the economic, social, psychological, and distributional impacts of programmes of managed retreat – including the implications for business and different ethnic, cultural, and socio-economic groups. No doubt this situation will change as the scale of the challenges posed by sea level rise become ever more apparent to policy-makers and as it becomes more evident that it will be too expensive and/or technically impossible to protect many low-lying coastal and flood-prone settlements and their related public infrastructure.

The modest nature of the current literature is perhaps surprising given that managed retreat has been increasingly widely practiced in recent decades. To quote Siders et al. (2019, p.762):

> Retreat to date has involved bans on rebuilding (such as in Australia, Germany, Japan, New Zealand, the Philippines, and Sri Lanka), required resettlement to pre-identified locations (such as in Colombia, India, and Mozambique), property acquisition (such as in Colombia, Japan, Netherlands, New Zealand, and the United States), and a few examples of whole-community relocation (such as in Australia, China, Fiji, India, Vietnam, and the United States).

Cumulatively, over the past three decades it is estimated that approximately 1.3 million people in 22 countries have been relocated via managed retreat – in both pre- and post-disaster contexts and both voluntarily and involuntarily (Hino, Field and Mach, 2017). Although 1.3 million is a significant number, the scale of displacement will increase markedly over the coming decades.

Drawing on the findings of the recent DIA/Treasury (2019) literature review and other sources, various points about climate change adaptation, and specifically managed retreat, deserve highlighting:

1. Across the OECD active planning for climate change adaptation, especially at the national level, remains in its infancy. Having said this, legislative requirements for governments to produce national adaptation strategies and/or plans are becoming ever more common, and many sub-national governments (especially cities which are flood-prone and/or exposed to sea level rise) are increasingly engaged in serious planning to reduce their risks and enhance societal resilience.

2. There are as yet relatively few examples of comprehensive reforms to national planning and funding frameworks to enable more effective responses to the current and projected impacts of climate change, but changes are certainly underway (e.g. in relation to risk management strategies, building regulations and standards, land-use planning, insurance arrangements and coverage, the design of infrastructure and protective structures, etc.). More extensive modifications to current policy frameworks are inevitable.

3. Only a few OECD countries have dedicated and systematic national-level policy frameworks dealing with the *costs* of climate change adaptation (e.g. who pays for what and on what basis). Instead, current funding responses tend to be ad hoc and unsystematic. Additionally, as far as I am aware, there are no examples of governments *pre-funding* some of the expected costs of climate change adaptation (e.g. by establishing dedicated funds in the near-term to be drawn down at some point in the future as the costs of adaptation escalate).

4. Where national-level funding is available for adaptation purposes, it is often focused on *post-disaster recovery* (e.g. after major storms) rather than *pre-disaster prevention* and risk reduction. Hence, typically public funds for managed retreat/relocation can only be allocated once a disaster has occurred. Pressures to rectify this state of affairs are mounting.

5. Most of the public funding available for adaptation is allocated to schemes to protect property (e.g. via the construction of seawalls and other flood defenses) or enhance the resilience of public infrastructure. The funding of such schemes is generally subject to satisfactory cost-benefit analyses. Relatively little public funding is provided for managed retreat/relocation. Hence, to date most buyout programmes across the OECD have been small-scale involving a few dozen or a few hundred residential properties, not thousands.

6. Local authorities are typically reluctant to fund or co-fund property buyouts: their financial resources are limited; providing compensation to property owners raises

politically sensitive issues; the loss of properties reduces their income from property rates/taxes.

7. The greater willingness of public authorities to fund protective structures but not to fund managed retreat creates a politically-salient policy asymmetry: it increases the public demand for protective structures, even in situations where their cost-effectiveness is questionable.

8. Few OECD countries appear to have comprehensive or well-funded programmes for managed retreat, including significant public compensation for the owners of private property (whether residential or commercial), but compensation is certainly being provided in some cases (e.g. in the US, as discussed below).

9. Where public compensation is authorized, property buyouts are generally voluntary rather than compulsory. Against this, it is highly doubtful whether voluntaristic arrangements will be adequate in the future given the scope and scale of the projected impacts of sea level rise.

10. Where public compensation is available, it often entails co-funding by national and sub-national agencies. But such arrangements add to the policy complexity, contribute to delays, and raise equity issues, not least because of the unequal resources and capabilities of sub-national governments.

11. The level of, and eligibility for, compensation in the event of managed retreat varies across the OECD: in some cases property owners are fully compensated based on a (pre-disaster) fair market value; in some cases compensation provides for full replacement in a similar, but low risk, neighbourhood; in yet other cases there is only partial compensation and/or caps on the size of payouts. Some compensation packages include relocation assistance and help for renters.

12. The issue of public compensation remains politically and socially controversial in many OECD countries. Community opposition to buyouts and relocation is relatively common. Such reactions are understandable. People often have strong ties to their place of residence: for many, after all, it is their home – and their property may have been owned by family members for several generations. Moving to a new community is often stressful, if not traumatic (especially in a post-disaster context). Affordable housing nearby in low-risk locations may be difficult to secure. Significant equity issues frequently arise (e.g. with low-income households being disproportionately affected). Equally, concerns and disagreements can often occur with regard to:

    - the reliability of the risk assessments on the basis of which retreat is being proposed;
    - zoning decisions, and hence which properties are eligible for compensation and which are not;
    - the implications for properties immediately adjacent to (or nearby) the designated hazard zones;
    - the timeframes for property buyouts and relocation;
    - the availability, suitability, and affordability of any sites designated for resettlement;

- the provision of public services and amenities for those directly and indirectly affected; and
- the management and use of the land that is vacated.

13. Despite the many difficulties associated with managed retreat, it will often constitute the most cost-effective and perhaps the only technically feasible solution to sea level rise. If well planned and executed, pre-emptive retreat will reduce risk and enhance a community's resilience. Equally, unlike protective structures which are likely to require periodic enhancements, ideally each instance of retreat should constitute a one-off (and thus non-repeated) investment. Having said this, not all schemes for managed retreat have been well planned or competently executed (e.g. some affected residents have been relocated to areas that may eventually be at risk of flooding as the sea level rises).

14. Projects involving managed retreat in various OECD countries highlight the need for strong inter-agency and inter-governmental cooperation, and the close integration of spatial planning and funding arrangements.

The US approach to managed retreat

Over the years the US federal government and sub-national governments have developed a range of policies and funding mechanisms to respond to the impacts of natural disasters. Many of these are highly relevant to climate change adaptation and the specific issue of managed retreat. At the federal level they include the National Flood Insurance Program (NFIP) – which was initiated in 1968 to enhance the provision and affordability of insurance to property owners in flood-prone areas – and various programmes administered by the Federal Emergency Management Agency (FEMA) and the Department of Housing and Urban Development (HUD).

For managed retreat, funding is available for property buyouts via various federal and state-mandated programmes. Federally, the largest is the Hazard Mitigation Grants Program (HMGP) administered by FEMA. Examples of other programmes include the Neighbourhood Stabilization Program (NSP), which is one of a number of programs operated via HUD's Community Development Block Grant Program, and the Department of Agriculture's Emergency Watershed Protection Floodplain Easement Program, which can allocate funds for property buyouts in specific circumstances. The focus here is on the HMGP and related state-level initiatives.

By way of background, FEMA is an agency of the Department of Homeland Security with a responsibility to coordinate governmental responses to major natural disasters. It has an annual budget of close to US$30 billion, employs nearly 8,000 staff, and administers more than 40 grant programmes. For many decades FEMA has provided funding, through its various programmes, to assist states and communities to mitigate the risks of natural hazards (especially flooding) and undertake post-disaster recovery. The HMGP, with an annual budget of approximately US$160 million, is the main source of federal funding to enable state and local governments to purchase flood-damaged dwellings that are vulnerable to future flooding. Hazard Assistance Grants under the HMGP are predicated on the assumption that retreat or relocation is sometimes, if not often, more cost-effective than strengthening existing defences or building new ones. Despite this assumption, as Siders et al. (2019, p.761) have highlighted, in the US:

> Retreat has been seen largely as a last resort, a failure to adapt, or a one-time emergency action; thus, little research has focused on retreat, leaving practitioners with little guidance. Such a narrow conception of retreat has limited decision-makers' perception of the tools available and stilted innovation.

Regarding Hazard Assistance Grants, the key details can be summarized as follows:[2]

1. If a major disaster is declared by federal authorities, FEMA has the right to decide whether or not to provide funding for property purchases. If it does so, the affected local government(s) can apply for funding on behalf of affected property owners. The proposed projects must be approved by FEMA. The local governments in question are responsible for managing their respective projects.
2. Buyouts are voluntary rather than compulsory – i.e. the sellers must be willing.
3. To be eligible for funding, properties must contain at least one structure. Having said this, undeveloped flood-prone land can be acquired if: a) it borders a property which is eligible for a buyout; and b) the purchase of both properties is deemed to be cost-effective.
4. All residential and non-residential properties are potentially eligible for buyouts, but there are limits on the scale of the businesses that are eligible.
5. Only properties insured by the NFIP are eligible, Currently, the NFIP is about US$25 billion in debt as a result of the major losses caused by three recent hurricanes – Sandy, Katrina, and Ike.
6. The buyouts are generally based on pre-flood, fair market values.
7. FEMA funds 75% of the cost, with state and local governments responsible for the remaining 25%. In certain circumstances (e.g. (where local communities are very poor and/or the risk of future damage is severe), the share of funds provided by FEMA can be increased (drawing on funds from other programs as necessary).
8. The purchased properties must be removed or demolished, and the land must be returned to open space – future development is severely restricted.
9. FEMA also provides funds for relocation and/or rental expenses (e.g. for displaced renters). For instance, shortfall allowances (e.g. up to $31,000 per property in 2016) are available for owners where there is a sufficiently large discrepancy between the pre-storm value of their home and comparable homes in a similar area that is not flood-prone. Assistance to renters, shortfall allowances, and related matters are regulated by the Uniform Relocation Assistance and Real Property Acquisition Policies Act (1970). This legislation is designed to ensure fair compensation and assistance in the event of compulsory property acquisitions for public use.

Since 1989 FEMA has supported voluntary buyouts of over 43,000 properties (or close to 1,500 a year on average) across the US at a total cost in excess of US$4 billion (Weber and Moore, 2019). Around 90% of these buyouts were through grants under the HMGP, with the remainder via other FEMA programmes. The volume of purchases, however, has varied significantly over time. The peak was in 1993 following a major flood in the upper Midwest of the US affecting nine states and damaging around 50,000 homes. Close to 8,000 flood-prone properties were acquired in this instance. In most cases, however, the number of properties purchased is small. As of October 2018, about 4,600 at-risk properties were part of an on-going buyout project.

[2] For full details see: https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf

These figures contrast markedly with the possible need to relocate up to 13 million US citizens by 2100, depending on the extent of sea level rise. The scale of current voluntary buyouts is also extremely modest compared with the overall public funding currently available via FEMA for disaster recovery. For instance, in response to the estimated $80 billion damage caused by Hurricane Sandy on the east coast of the US in 2012, around $60 billion was allocated by the federal government for disaster relief and recovery (mainly to sub-national governments). Only a small fraction of this, however, was spent on voluntary buyouts – altogether affecting about 1,500 properties in a context where hundreds of thousands of homes had been damaged or destroyed by the hurricane.

The federal authorities have begun to respond to the growing threats posed by climate change, including the inevitable impacts of sea level rise. Under the Disaster Recovery Reform Act (DRRA) 2018, which reformed FEMA's disaster assistance programmes, FEMA is permitted to invest more of its resources than previously on pre-disaster prevention, resilience and risk reduction. Under Section 1234 of the DRRA, for instance, FEMA can allocate up to 6% of estimated disaster expenses for each major disaster to fund pre-disaster mitigation. As a result, FEMA has replaced its Pre-Disaster Mitigation (PDM) program (and related resources of about US$250 million) with the Building Resilient Infrastructure and Communities (BRIC) program, and will be increasing the funding available for buyout projects (among a range of interventions). Nevertheless, the focus of FEMA remains squarely on *disaster recovery*, and the cap of 6% on disaster prevention is restrictive.

As well as federal initiatives to reduce hazard risk through property buyouts, there are also various programmes administered by state and local governments. One such example is the New York Rising program. To quote from the DIA/Treasury (2019) literature review:

> … the *New York Rising* program distinguishes between buyouts and acquisitions. Buyouts are purchases within the enhancement zones—areas that regularly are at risk of flooding— that are made at pre-storm fair market value; buyout properties are preserved as open space in perpetuity. Acquisitions are properties purchased outside of enhancement zones at post-storm value and allow for more flood-safe rebuilding on the parcels. *New York Rising* identifies areas that are regularly at risk of flooding. Homeowners in these enhancement areas who agree to sell their homes can receive the fair market value plus a 10% incentive if all property owners in the area agree to participate in the program. A 5% incentive is offered to property owners in enhanced buyout areas who relocate within the same county. Buyout and acquisition programs are always voluntary.

Assessing US practice regarding managed retreat

Independent studies of FEMA's approach to property buyouts, as funded via the HMGP (and related programmes), have highlighted the numerous concerns, many of which are relevant for the design of future policy initiatives in New Zealand for managed retreat (see, for instance, Brokopp Binder and Greer, 2016; Freudenberg, et al., 2016a, 2016b; Greer and Brokopp Binder, 2017; Mach, et al., 2019; Poon, 2019; Robinson, et al., 2018; Siders, 2019; Siders et al., 2019; Weber and Moore, 2019).

Overall, the evidence points to low levels of policy learning, a failure to adapt policy frameworks to respond to changing needs and risk profiles, and a lack of rigorous evaluation by the agencies responsible for the various adaptation progammes. Other key concerns can be summarized as follows:

1. ***Funding inadequacy***: the funding currently available via FEMA (and other federal agencies) for voluntary buyouts is insufficient to cope with current needs and will be increasingly inadequate to meet the challenges of sea level rise; hence, a massive scaling up of current programmes will be required. Also, while small-scale voluntary buyouts may be warranted in some situations, they can also create difficulties (e.g. the problems facing flood-prone communities may be only partially addressed with remaining residents and buildings precluding the creation of a fully restored open space in the flood-prone area). In short, buyout programmes need to match the scale of the problems requiring attention and be fit for purpose.

2. ***Co-funding issues***: the general requirement for state and local governments to co-fund voluntary buyout projects creates additional complexities, inequities, and delays because sub-national governments often have very tight budgets, not least in the wake of a major natural disaster. These funding challenges are expected to increase: many local authorities in the US are already heavily in debt, thus reducing the extent to which it will be possible to fund buyouts (or the building of protecting structures) via bonds and related funding instruments.

3. ***Backward rather than forward-looking***: the current policy framework at the federal level is insufficiently anticipatory: in most cases property buyouts are limited to damaged properties, with the owners of undamaged properties at an increasing risk of damage (due to sea level rise and flooding) in the future being ineligible for federal assistance. More forward-looking funding arrangements will become increasingly vital.

4. ***Inequities***: currently funding and spatial planning arrangements are beset with inequities and often exacerbate existing socio-economic and ethnic inequalities. For instance, in relation to flood-prone properties, there is evidence that voluntary buyout projects are less likely to be initiated in poorer communities than in better-off communities (Mach, et al., 2019). This may reflect the fact that the latter communities have more wherewithal to seek public assistance and navigate the complex implementation processes, a greater capacity to relocate if assistance is available, and more political clout with the relevant local authorities (which must co-sponsor, co-fund and administer the projects). To compound matters, wealthier communities are also more likely to receive flood protection – no doubt in part because when cost-benefit analyses are undertaken, the higher value of their properties makes protection appear more economically justifiable. In this context, the detailed analyses by Freudenberg et al. (2016b), Mach et al. (2019), and Weber and Moore (2019) exploring the design, implementation and outcomes of property buyouts in the US warrant careful study.

5. ***Lengthy delays and their social impact***: most buyout projects take a relatively long time (i.e. several years) to initiate and implement, resulting in long delays for property owners. This is often frustrating and stressful. It reduces social and

political trust. And it limits the capacity of many residents to move on with their lives following a natural disaster. For instance, Weber and Moore (2019) of the Natural Resources Defense Council (NRDC) examined almost three decades of FEMA data on property buyouts. They found that the median timeframe between a flood event and the completion of a buyout project was five years. For instance, it usually takes at least 18 months for FEMA to give funding approval after the declaration of a disaster, and then another 42 months for the relevant sub-national governments to undertake the approved property purchases. In some cases the whole process can take up to a decade. As a result, some properties experience repeated flooding prior to their final purchase, thereby imposing additional costs on property owners – many of whom are obliged to continue making mortgage and insurance payments until the buyouts are completed. Low-income households with few assets are inevitably disproportionately affected. In some cases property owners may be forced to pull out of buyout programme and sell at a substantial discount (e.g. to speculators), rather than wait for a payment. With the rate of sea level rise very likely to accelerate significantly over the coming decades, more efficient, stream-lined processes for manage retreat will be essential; otherwise increasing numbers of property owners will be faced with multiple flooding events, and the inequities will grow markedly.

6. ***Poor integration of managed retreat and other policy initiatives***: some buyout programmes are not properly coordinated with other important policy settings, such as land-use planning, controls on development, the construction of housing, and infrastructure investment. For instance, there are examples where sea walls have been proposed in areas where all the dwellings are being vacated, removed, or demolished. To quote Siders et al. (2019):

   '…retreat to date has focused overwhelmingly on physical removal of people and buildings, with limited discussion of the social, cultural, psychological, or long-term economic consequences (such as gentrification, loss of heritage, or changes in housing and transport demand) … Also, by largely overlooking remaining and receiving communities, ad hoc retreat can lead to inefficient investments, such as allowing development in or near areas soon to be abandoned … or failing to build social and physical infrastructure needed to accommodate growing populations.'

In response to these and related concerns, various researchers have recommended significant changes to existing US adaptation policies, including the funding of, and processes for undertaking, managed retreat. Above all, it is argued that managed retreat must cease being regarded as a *last resort* or as indicative of *policy failure*. Instead, it must be seen as a *strategic* policy response to the impacts of climate change – one that is prudent, legitimate, empowering, and purposeful. Siders et al. (2019, p.761) argue, for instance, that retreat should be fully integrated into a country's 'long-term development goals' and applied in a manner that is 'innovative, evidence-based, and context-specific'. In so doing, managed retreat should be reconceptualised as 'as set of tools used to achieve societal goals', such as greater fairness, sustainability, resilience, and community revitalization. In other words, retreat should not be regarded as a goal, but rather as a means to accomplish important public purposes.

In this respect, researchers have highlighted the political incentives and societal dynamics surrounding managed retreat, and the need for them to receive more in-depth analysis. Such matters include:

- the financial incentives for local governments to support the status quo in order to maximize their revenues from property taxes and minimize the costs associated with retreat;
- the risk of developers and speculators engaging in various kinds of 'rent-seeking' behaviour, including encouraging regulators to enable development in risk-prone areas;
- the challenges of coordinating complex initiatives across different levels of government and multiple agencies (e.g. those responsible for planning, infrastructure, education, health, housing, and social services); and
- the risk of buyout programmes (and their sluggish implementation) exacerbating social inequalities and hence the need for extra help to the most vulnerable citizens, including affordable housing in safe locations.

Finally, some US researchers (e.g. Mach, et al., 2019) contend that policy frameworks in the future need to provide for greater flexibility to accommodate the diversity of situations where managed retreat will be necessary, thus enabling more experimentation in the design and implementation of buyout programmes and related governmental initiatives. Such flexibility must be coupled with improved transparency, better information, enhanced evaluation, and hence the opportunity for policy learning and improvement.

The UK approach to managed retreat

In many respects, the UK has a well-designed national policy framework for climate change adaptation. In brief, this consists of the following key elements.

First, the UK has a long-term environment plan – *A Green Future: Our 25 Year Plan to Improve the Environment*. This was published in early 2018 and enunciates a range of overarching goals and initiatives, including policy measures to enhance adaptation.

Second, under the Climate Change Act (2008) the government is required to publish a Climate Change Risk Assessment (CCRA) every five years. The CCRA sets out the major risks generated by, and the opportunities arising from, climate change. The first such report was published in 2011, the second in 2016. These reports identified and assessed a variety of risks including: those from flooding, coastal erosion and water deficits; risks to health and productivity from higher temperatures; risks to ecosystems and biodiversity; and risks from new and emerging pests and diseases. The Climate Change Committee (CCC), established under the Act, is required to advise the government on the preparation of its CCRA and to publish that advice. The most recent such advice was released in 2017 – the *UK Climate Change Risk Assessment 2017 Evidence Report*.

Third, under the Climate Change Act the government is required to publish a National Adaptation Programme (NAP) every five years outlining its strategy to address the main risks and opportunities identified in each CCRA. As a result of devolution, there are separate strategies for England, Scotland, Wales, and Northern Ireland. The first NAP for England was published in 2013, the second in 2018. The most recent report, which was prepared by the Department for Environment, Food and Rural Affairs (DEFRA), focused on:

- increasing public awareness about the need to adapt to climate change;
- enhancing the evidence base; and
- taking timely measures to improve resilience to the main risks identified in the most recent CCRA.

The CCC is required under the Act to report to Parliament on the government's progress in implementing its strategy. Thus far, the CCC has published three progress reports on England's NAPs (2015, 2017, and 2019), as well as reports on the Scottish and Welsh adaptation plans.

Fourth, under the Flood and Water Management Act (FWMA) (2010), the Environment Agency (which is an executive non-departmental public body, sponsored by DEFRA) has a responsibility to develop, maintain, apply and monitor a national flood and coastal erosion risk management strategy. The most recent strategy was published in 2011. Currently, the Agency is consulting on a new draft strategy for England. The revised strategy is expected to be published in 2020. The overall goal, as specified in the draft, is to reduce the risk of harm to people, the environment and the economy from flooding and coastal change. The Environment Agency has a substantial staff (over 10,000 people) and a budget of around £1.3 billion, much of which is allocated to maintaining and improving flood protection, including coastal defences.

Fifth, there are Shoreline Management Plans (SMPs) for the entire coast of the UK. These categorize the coast into one of four classifications: hold the line; managed realignment (use of natural defences); advance the line (sea defences moved seaward, which is rare); and no active intervention. The current SMPs are not fully funded and the CCC (2018) has identified significant implementation problems.

The funding of managed retreat

Notwithstanding this relatively comprehensive policy framework for adaptation, unlike the US, the UK lacks dedicated policy instruments or programmes for funding managed retreat. To date, no *large-scale* property purchases have been undertaken by government agencies (at any level of government) to address issues of coastal erosion and inundation. There have, however, been some small-scale purchases in various communities (e.g. Norfolk).

The current UK approach is predicated on the assumption that the loss of land and/or buildings due to sea level rise is the responsibility of the owners: public authorities are not legally obliged to assist, let alone provide full compensation for the losses incurred. They are, however, responsible for the safety of citizens and for overseeing the relocation of communities faced with regular flooding, inundation, and coastal erosion.

As it stands, there are a growing number of communities across the UK – some small (e.g. Barmouth, Borth, and Fairbourne in Wales) and some much larger (e.g. the city of Hull) – which are very low-lying and faced, in the absence of additional protective structures, with inundation from sea level rise over the next few decades. In some cases, however, such structures are not considered to be economically justified and/or technically viable.

The town of Fairbourne is one such case. Fairbourne borders the Irish Sea on the west coast of Wales (Wall, 2019). It has around 400 houses and other dwellings, and is currently protected by a sea wall, earth banks and drainage channels. The local authority responsible for town's fate – Gwynedd council – upgraded the existing defences some years ago, but concluded in 2013 that protecting the village indefinitely was simply not feasible. It has thus proposed that the town be 'decommissioned', commencing around 2045. This will entail removing all the buildings, infrastructure, and other amenities in the

town and the immediate vicinity, and allowing the currently occupied land to be inundated gradually by the sea.

Unsurprisingly, the council's decision has prompted a sharp fall in property prices in the town. The council has informed residents that it is unable to provide compensation, not least because it lacks the financial resources to do so. It currently faces a large budget shortfall, and there is no central government funding available to subsidize such purchases. Against this, modest relocation assistance may be available to remaining residents at some point in the future. Understandably, Fairbourne residents, some of who have lived in the neighbourhood for much of their lives, feel abandoned by the authorities. Moreover, the collapse of property prices means that many residents lack the resources to buy suitable accommodation in nearby communities. No doubt, too, potential buyers of Fairbourne properties will be unable to secure mortgages or property insurance. Almost certainly, the absence of proper compensation will exacerbate social inequities and contribute to financial and psychological stress. Similarly, without a well-planned and coordinated relocation plan, those residents most able to move elsewhere (because they have the wherewithal to do so) will relocate, leaving behind an increasingly run-down and de-populated town. Again, this will have implications for the remaining residents, many of whom are likely to be poor and/or elderly.

From my discussions in the UK, it is evident that the deficiencies in current funding arrangements are widely understood and acknowledged by adaptation experts. For instance, the CCC highlighted in a report in 2018 – *Managing the coast in a changing climate* – that adaptation funding is both insufficient and excessively focused on building hard defences. To quote:

> Decisions about funding should be based on a broader and more inclusive economic case than is current practice. Current funding streams provide value for money, largely by delivering hard defences where there is the best economic case supplemented with local 'partnership funding' contributions. Places where continued investment in hard defences is uneconomic tend to lose out. However, these places also need funding to assist them to adapt to inevitable changes, so whilst hard defences may not be fundable they still need support for a broader package of adaptation actions, including community engagement, asset relocation and compensation to move households where appropriate. This should be addressed either by altering existing funding formulae or developing a new funding mechanism, which could, for instance, take inspiration from innovative green finance models or community development corporations. The economic case to support long-term funding should be determined not just by the protection of physical assets but should also incorporate environmental implications and social justice considerations (CCC, 2018, p.12).

Based on this assessment, the CCC recommended that: 'Government should make available long-term funding/investment to deliver a wider set of adaptation actions' (ibid.).

There are other well-recognized problems with current adaptation funding arrangements. For instance, some existing policies increase, rather than reduce, long-term risks. One example is Flood Re. This is a levy and pool insurance scheme negotiated between the government and insurance companies several years ago; it is due to be phased out in 2039. Under the scheme, insurance companies have agreed to continue providing flood

insurance coverage to residential properties constructed prior to 2009 that are assessed to have a significant risk of flooding; the insurance of such properties is subsidized by the owners of low-risk properties. It is estimated that as many as 350,000 UK properties (or around 2% of the total) have benefitted from the lower insurance premiums resulting from Flood Re. Obviously, such arrangements mean that insurance premiums do not reflect changing risk profiles; they also redistribute insurance costs across the society. But whatever the equity case for subsidizing the owners of flood-prone dwellings, Flood Re merely delays the point when the viability of such properties must be reviewed and increases the likelihood of large-scale financial losses from major flood events in the future. Note that Flood Re does not cover commercial properties. It is also important to recognize that insurers are often reluctant to charge risk-related premiums because of the likely consumer resistance and negative publicity.

Section 4: Policy principles for adaptation funding

Having explored briefly the policy arrangements (or lack thereof) for managed retreat in several OECD countries, it is time to consider the principles that should inform the funding of climate change adaptation, including the specific question of whether public compensation for property losses is justified and, if so, under what conditions.

As Judy Lawrence and I have argued elsewhere (Boston and Lawrence, 2018), any policy framework for climate change adaptation funding should be guided by two overarching goals: long-term cost minimization and equitable burden sharing.

1. *Long-term cost minimization* – funding arrangements should seek to minimize the long-term net costs of adaptation by encouraging cost-effective decisions regarding spatial planning and investment in public infrastructure. The aim should be to reduce the likely costs of climate-related impacts (e.g. from major floods) through cost-effective measures to future-proof infrastructure and undertake managed retreat. Successful adaptation will, in turn, help to reduce future insurance costs (including those associated with EQC), thereby keeping insurance more affordable and available. Consistent with this, funding arrangements, and related spatial planning and regulatory frameworks, must be well-coordinated and designed to minimize moral hazard (e.g. the risk of giving individuals, companies or other organizations incentives to act in ways that are likely to increase overall adaptation costs and/or shift costs inappropriately onto taxpayers or ratepayers).

2. *Equitable burden sharing* – funding arrangements should be consistent with widely accepted principles of distributive justice (fairness or social equity) (Ellis, 2018; Kunreuther and Pauly, 2017; Siders, 2019). There are many such principles and they sometimes conflict (see, for instance, Ellis, 2018). One broadly endorsed and intuitively appealing principle is the fair opportunity requirement. This is the idea that people should not be discriminated against or suffer disadvantages for things over which they have little or no control. Such a principle provides an ethical basis for funding assistance for people who suffer an accident or are harmed by a natural disaster which could not have been reasonably foreseen or avoided. Another widely supported principle is that of ‘comparative justice’ or ‘like treatment’. This requires that cases which are alike in all morally relevant respects should be treated alike; where cases differ, various ‘material principles’ of justice can be applied to determine the extent to which, and the means by which,

differential treatment is justified. These include considerations of need, the capacity to pay, and various notions of moral responsibility (Miller, 2007). One of the latter, known as 'outcome responsibility', is the idea that people (and public authorities) should bear responsibility for their own actions and decisions. Another is the idea of 'remedial responsibility'. This latter responsibility arises whenever there is a situation needing a remedy. If those who have caused the harm are in a position to rectify the problem, then they have a moral responsibility to do so. If they are unable, but there are others with the requisite capacity (e.g. a central government), then the remedial responsibility falls to those who are most capable. Regarding the costs of climate change adaptation, the relevant principles of distributive justice should be applied both inter-generationally and intra-generationally.

Any adaptation funding framework (and related institutional arrangements and policy instruments) should also take into account a range of other considerations (Boston, 2017a; Boston and Lawrence, 2018) including:

i. making the best possible use of the available scientific evidence and relevant expert advice;
ii. minimizing administrative and compliance costs;
iii. ensuring procedural fairness and thereby minimizing the likelihood of costly litigation;
iv. ensuring sufficient policy clarity, consistency and stability over time to facilitate effective long-term regional spatial planning and infrastructure investment, thus generating an adequate degree of certainty for affected households, businesses and other organizations;
v. enabling sufficient policy flexibility to accommodate changing risk profiles;
vi. disincentivizing policy responses that create undesirable forms of path dependence;
vii. ensuring a high level of transparency, and hence accountability, in relation to revenue collection and funding allocations; and
viii. ensuring fiscal sustainability.

Applying these principles to the question of who pays, for what and when in relation to climate change adaptation raises numerous practical questions. As indicated at the outset of this paper, the focus here is on the issue of public compensation.

Section 5: Public compensation and managed retreat

The basic notion of *compensation* is uncomplicated. It involves providing the financial equivalent (or part thereof) for what has been lost and/or deprived (Dudley Tombs and France-Hudson, 2018). The idea that *public* compensation should be provided under certain circumstances is a well-established legal principle, with roots in the Magna Carta (1297). It reflects the value which most societies have attached to the concept of private property and the desirability of protecting various rights associated with property ownership. Hence, when the state acquires private property (e.g. to enable a new motorway, rail-link or water treatment plant to be constructed) or is involved in some other kind of 'taking', it is only right and proper that (fair) compensation should be provided. Having said this, the precise rules and procedures surrounding the provision of public compensation vary across the world, reflecting different political, cultural, and legal traditions. Some countries, for instance, have protections in their constitutions for

private property; others do not. Similarly, some countries have a greater commitment than others to solidaristic arrangements and collective burden-sharing following major natural disasters.

Such differences are reflected in the divergent policy responses to the impacts of climate change: currently, there is no consistent approach across OECD countries as to whether those who lose property (i.e. land and buildings) and/or income due to climate change impacts (or the policy responses to these impacts) should receive public compensation. Regarding managed retreat, as discussed earlier, the US and the UK have different approaches to public compensation. Whether a greater harmonization of practices across the OECD occurs in the future remains to be seen. Currently, there is no urgency for policy-makers in the UK to adopt US practices. But this might readily change as the scope and scale of the impacts of sea level rise become more evident.

The absence of comprehensive public compensation arrangements in countries like the UK for losses arising from the impacts of climate change partly reflects the distinctive features of these impacts. Take, for instance, sea level rise and the associated coastal erosion, flooding, and inundation: here the loss of private property is due largely to the action of the sea (or rivers). It is not because the state has decided to acquire such property for public works, whether by compulsion or through voluntary purchases. If the state were to seek to acquire private property by compulsion for a clearly-stated and desirable public purpose (such as new coastal infrastructure or a public park), there would be strong legal, moral, and political arguments in favour of compensating the affected property owners – and, of course, for ensuring that such compensation is 'fair' (e.g. based on recent market valuations). But if ocean waves wash away a piece of private land and demolish adjacent buildings and other physical structures, the case for public compensation is, at least on the surface, less compelling. Indeed, conflicting intuitions and principles readily come into play (see Boston and Lawrence, 2018; NZPC, 2019; Sprinz and von Bünau, 2013).

To start with, coastal property is often highly valued (i.e. in terms of its market price) and is frequently owned by wealthy people, sometimes as a second or third property (e.g. as a weekend retreat). Why, it might be asked, should taxpayers or ratepayers be expected to compensate those who are wealthy? After all, they will not be left destitute if they lose one of their several properties? From a distributional perspective, providing compensation in such circumstances might be considered regressive.

Related to this, there is the issue of foresight and foreseeability: many coastal properties are likely to have been acquired in the full knowledge that climate change would render them uninhabitable at some point in the future. If people are willing to take the risk and buy such properties, why should they be compensated for the readily foreseeable losses they subsequently incur?

Against this, of course, there are many conflicting considerations. Not all coastal properties are owned by the rich. Many are owned by people of modest means or are rented, often to those on low incomes who may struggle to find alternative accommodation. Likewise, some of those who have purchased properties near the coast or in low-lying areas may have been totally unaware of the long-term risks posed by climate change and sea level rise. Indeed, it is often hard to determine whether particular risks could have been reasonably foreseen and how readily those affected can bear the expected losses. In practice, many of the situations that will arise over coming decades are likely to be complex and uncertain, not least because of rapidly changing risk profiles

and unpleasant surprises. For instance, coastal areas previously regarded as 'safe' may unexpectedly face the risk of inundation, perhaps because the sea level may rise faster and/or by a greater amount than previously projected.

The arguments for public compensation

Let us now review the arguments for and against public compensation in the context of (pre-emptive) managed retreat. The case for public compensation might rest on one or more of the following considerations (see Boston and Lawrence, 2018; NZPC, 2019):

1. ***Collective responsibility for climate change***: those facing significant property losses due to coastal erosion and inundation or related riverine flooding have generally not contributed disproportionately to the problem; the impacts are mostly beyond their control, unintended, and often arbitrary and unforeseeable. Added to this, it is highly unlikely that those who are disproportionately responsible for anthropogenic climate change (e.g. major fossil fuel firms and their shareholders) will ever be held to account for their actions, not least because of the problems of attribution and the limitations of current trans-boundary legal processes. Hence, securing substantial compensation from major multi-national companies is unlikely. For such reasons, there may be little alternative but for societies to accept collective responsibility for climate change-related harm (i.e. loss and damage) and then seek to share the burden of adjustment as fairly as possible.

2. ***Traditions of equitable risk pooling and social solidarity***: it is common, if not the norm, for societies to act collectively through the state when faced with serious, large-scale, if not existential, threats (e.g. natural disasters, war, terrorism, etc.). One reason for this is that individuals, families, and local communities vary significantly in their resources, resilience, and coping capacities. Often only collective action at the national level will enable an adequate response to the threat and ensure that those affected are treated fairly.

3. ***Legal and political precedents***: across the OECD there are numerous examples of various risks to communities (e.g. from natural disasters) being socialized to one degree or another. New Zealand is no exception. The NZPC (2019, p.226) draft report highlights multiple cases of public funding being provided to compensate property owners and/or local communities for disaster-related losses, and/or to protect communities from known hazards.

   Note that since the draft NZPC report was published, the government has agreed to co-fund, with the Bay of Plenty Regional Council and the Whakatāne District Council, the estimated $15 million required to enable a case of managed retreat affecting 16 houses and 18 vacant sections in a small coastal settlement in the Eastern Bay of Plenty (Mahuta, 2019). The properties in question – at Awatarariki, Matatā – are deemed to be in a location that poses an 'intolerable risk-to-life' because of their susceptibility to flooding (ibid., p.1). In this instance, the Crown has agreed to contribute a third of the expected cost of the property purchases, up to a maximum of $5.019 million. The two councils in question are each contributing a third, with the Whakatāne District Council bearing any residual costs, together with the costs of maintaining the proposed reserve (which will replace the previously private-owned land). The property purchases will be

voluntary, but the District Council expects a high take-up rate. There is disagreement over whether this particular co-funding agreement will set a precedent for future cases of managed retreat. The government believes not (ibid., p.4); the Treasury, however, thinks otherwise (ibid., p.5). In my view, such an agreement seems destined to *influence* future policy decisions on compensating private property owners for their losses due to sea level rise and associated risks. It will not, of course, *dictate* the terms of future agreements. Moreover, there is no reason to believe that a co-funding formula in which the three tiers of government each contribute a third of the compensatory costs will be either normatively compelling or practically feasible in many future cases, especially those where the retreat is of a much greater scale and scope.

4. ***Compulsory acquisition of property and relocation***: it is highly likely that sea level rise and related climate change impacts will sometimes require the compulsory acquisition of property and the relocation of those affected in the public interest (e.g. to protect life or achieve other worthy public purposes). Traditionally, as noted earlier, governments have provided fair compensation in the event of compulsion (e.g. for public works).

5. ***Long-term cost minimization***: if governments fund protective structures (e.g. sea walls) but do not compensate property owners for the losses due to sea level rise and associated risks, there will be an automatic and powerful policy bias favouring (often expensive) protection. Those with at-risk properties are likely to demand better protection. As a result, some communities will be (unfairly) protected at very considerable public expense when it would have been cheaper financially to relocate the affected community.

6. ***Consistency and fairness of treatment***: building new (or reinforcing existing) protective structures may require the acquisition of land. Compensating property owners for losses caused by the construction of protective structures but refusing compensation to those facing losses due to sea level is likely to be considered inconsistent and unfair – and thus politically controversial.

7. ***Coordinating the funding of public infrastructure with decisions on the relocation of human settlements***: in the face of climate change, public investment in (often expensive) climate-resilient infrastructure will be essential. But decisions on what infrastructure to build and where must be coordinated with decisions on the location/relocation of vulnerable communities. Such coordination is likely to be more difficult without compensatory arrangements (e.g. as a result of lengthy legal disputes involving the affected residents).

8. ***Minimizing the risk of protracted litigation***: without a settled policy framework that includes fair public compensation for climate-induced property losses, protracted legal action through the courts is highly probable. Democratically-determined decisions in such situations are likely to be preferable to judicial ones. It is worth noting in relation to 'red-zoned' properties in Christchurch, that the courts were generally favourably disposed to the claims of the so-called 'quake outcasts' regarding their non-insured or inadequately insured properties.

9. ***Private insurance will not address the problem***: as the risks from sea level rise (and related climate impacts) increase, private insurers will withdraw. Without governmental intervention, growing numbers of property owners will find it impossible to insure their properties. As the scale of the problems increase over the 21st century, there will be ever larger implications for property values, insurers, and mortgage holders, with potential threats to the viability of heavily exposed financial institutions. A comprehensive and well-designed compensatory regime will help minimize such risks.

In short, a good case can be made based on a range of (often interconnected) arguments for compensating those facing property losses because of sea level rise and related climate change impacts. Not all the arguments outlined above are equally compelling. But in a democracy, the will of the people ultimately prevails, and in New Zealand, given its cultural and political traditions, it seems highly probable that the majority of citizens will favour some form of public compensation. Against this, considerable disagreement is likely over the criteria governing such arrangements (i.e. who should be eligible, under what circumstances, and for what?). Such matters will need extensive public consultation and debate.

The arguments against public compensation

The main arguments against public compensation can be summarized as follows (see Boston and Lawrence, 2018; NZPC, 2019).

1. ***The excessive fiscal liability***: compensating all those likely to lose private property as a result of sea level rise and related impacts will be costly fiscally. Moreover, such costs are bound to escalate substantially during the second half of the century and beyond. The precise cost is impossible to calculate, as noted earlier, but there is no question that it will be significant. To be sure, the total fiscal liability could be reduced by limiting compensation in various ways. For instance, compensation could potentially be limited to residential property owners, but that would raise significant equity issues. Alternatively, the extent of compensation could be curbed in some way (e.g. via a nominal dollar cap per property, by funding only a proportion of the estimated losses, and/or by providing an ever diminishing level of compensation per property as the century progressed).

   With respect to the long-term fiscal liability, Siders et al. (2019, p.762) comment in relation to the US that: 'property acquisitions are likely too expensive to deploy at the massive scales that may be required in the future'. Whether or not this conclusion is justified, it is clear that there will be very large property losses in the future due to sea level rise. But the crucial policy question is this: how should the burden of these losses be shared? Should most, or all, of the burden fall on private citizens or should the state bear a substantial portion of the loss, thus partly or largely socializing the costs? Ultimately, this is an ethical and political question, not a technical question. If a democratic society decides that most of the losses should be socialized via the state, then the necessary tax revenue will need to be found to provide the agreed compensation.

2. ***The risk of compensatory 'creep'***: compensating those who lose private property as a result of sea level rise and related impacts is likely to increase public demands to compensate other losses associated with climate change, such as those arising

from severe droughts, more extreme weather events (e.g. hail storms and heat waves), changing disease vectors, ocean acidification, and so on. Any compensatory 'creep' of this nature will be fiscally burdensome.

Such concerns are understandable and plausible. But, as noted earlier, climate change will cause many damaging impacts and these will generate ever stronger, louder, and compelling calls for public assistance. Indeed, many OECD governments are already increasing the funding they provide in response to adverse weather events and more severe natural disasters. Over time, new and ever more comprehensive compensatory frameworks are likely to be required. Under such a scenario, compensation for the losses caused by sea level rise will be but one of a series of policy initiatives – albeit the largest fiscally in most countries.

3. ***Providing public compensation is unfair***: regardless of the scale of the fiscal challenge or the risk of compensatory 'creep', it might be argued that providing public compensation is inconsistent with well-established principles of justice. Three specific concerns deserve attention:

    a. As noted earlier, it is sometimes contended that compensating those who have knowingly taken a risk by purchasing a property on an eroding coastline or in a floor-prone neighbourhood is unfair. But while this proposition may seem intuitively appealing, attempting to design policies based on such a premise is likely to be fraught with difficulty. For instance, there will be issues over the extent to which the risks were adequately well-established, whether the risks were properly understood when the various property transactions occurred, whether the relevant public authorities provided adequate guidance to property purchasers, whether the local authority should have zoned the property differently, and so forth. In the case of accident compensation, a no-fault approach applies (certainly in New Zealand). Hence, accident victims are not deprived of medical treatment or earning-related compensation because they were negligent, clumsy or failed to exercise proper foresight. There are good reasons for a non-fault approach: it reduces the likelihood of litigation (and all the related costs and delays); and it is often difficult in practice to establish causation and hence who was at fault and to what extent. Such considerations are likely to apply in relation to the risks associated with sea level rise and other climate change-related impacts.

    b. A different equity argument against compensation is based on the proposition that at-risk coastal properties are likely to be owned disproportionately by high-income individuals and/or those with a relatively high net worth. But even if such assumptions are broadly correct (and there are bound to many exceptions), the provision of public compensation in most contexts is not affected by the financial circumstances of those who suffer a loss. When land is acquired by a government agency in the public interest (e.g. for a new road), the owners are compensated on the same basis irrespective of whether they are multi-millionaires or relatively poor. Applying means-tests to property purchases in the case of managed retreat is likely to prompt undesirable behavioural changes and exacerbate the problems of implementation (e.g. those with

wealth above a designated threshold will have an incentive to transfer their assets into a family trust, thereby ensuring that they are eligible for public compensation). Against this, there might be a case for capping the level of compensation for individual properties. But any such caps would need to be devised and implemented with care, and ideally with broad public support.

c. Yet another equity argument against compensation takes the following form: while governments are justified in providing income support and transitional assistance to those in need as a result of the disruption caused by sea level rise, there is no case for public compensation for property losses. Normal social assistance is sufficient. Compensatory payments are neither necessary nor justified.

   In response to this argument, two points are worth mentioning. First, given the scope, scale, and complexity of the impacts and policy issues that sea level rise is likely to generate, it is doubtful whether existing social programmes will be adequate. Leaving aside issues of compensation, it is likely that new and additional forms of social assistance (e.g. relocation allowances, temporary rental assistance, etc.) will be required, with these being specifically designed to address the distinctive social and other problems associated with large-scale relocations. Second, income support and compensation are not mutually exclusive. There are situations where both income support *and* compensation may be justified (e.g. as applies in relation to ACC in New Zealand).

4. ***The risk of moral hazard***: a final objection to public compensation is that it will increase the risk of moral hazard (NZPC, 2019). The concept of moral hazard refers to situations where individuals and organizations increase their exposure to a risk because they do not bear the (full) costs of those risks. In the case of sea level rise and managed retreat, the concern is as follows: if governments guarantee (full) compensation for any property losses, they will increase the incentives for property owners to develop their properties further, thus exacerbating the amount and value of the property at risk and adding to the government's long-term fiscal liability.

   Such concerns are valid. But refusing public compensation is not the only viable response. Another option would be to ensure that strict limits are placed on property development in areas that are currently (or soon likely to be) exposed to significant risks of coastal erosion, flooding, and inundation. This means, of course, that adaptation policy frameworks must ensure the close integration and coordination of spatial planning and funding decisions. One other point deserves mention: placing new restrictions on existing use rights may well be controversial and could result in demands for public compensation. As I understand it, Ben France-Hudson is currently considering these issues as part of the Deep South Science Challenge, and I am very happy to leave such matters in his capable legal hands!

5. ***Co-funding is the norm in cases of social insurance***: a final argument accepts the case for *some* public compensation, but contends that those eligible for assistance

should be required to bear *part* of the burden of their losses (costs), as this is normal where risks are (largely) socialized. An argument along these lines was advanced by the NZPC (2019) in its draft Report on *Local Government Funding and Financing*. For instance, the Report cites the settlement reached between the various parties involved in the 'leaky homes' debacle. In this case, it was agreed that a third of the costs would be borne by taxpayers, a third by local government (i.e. ratepayers), and a third by homeowners.

The case for co-funding or co-payments by property owners appears to rest on at least three grounds: historical precedent; considerations of fairness; and incentivizing actions to reduce risk. But each ground is questionable. First, in relation to historical precedent, there are many examples where explicit co-funding is *not* a feature of the relevant policy framework. Instead, full compensation applies (e.g. property acquisitions under the Public Works Act).

Second, as argued above, there are multiple principles of fairness. Depending on which principles are privileged and how they are weighted, it is possible to construct an argument for fully compensating property owners, at least under certain conditions.

Third, in terms of incentives to reduce risk, there are several issues. One is empirical: does co-funding result in behavioural changes that reduce the overall level of risk, thus contributing to cost minimization? Potentially, in relation to pre-emptive managed retreat co-funding will not reduce the risks; planning and regulatory frameworks will be much more important in this regard. A second issue is whether co-payments have unintended consequences, some of which may be undesirable (e.g. causing people to delay taking actions to address a foreseeable and impending problem). Arguably, a failure to provide full (or nearly full) compensation will complicate the implementation of progammes of managed retreat and contribute to costly delays.

Be that as it may, to the extent that the settlement in relation to leaky buildings is seen as a relevant precedent for managed retreat (as the NZPC implies), then it suggests that there is a robust case for public compensation and that such compensation should cover the *majority* of the costs or losses incurred.

Summary

To sum up, in relation to funding the costs of managed retreat, the fundamental policy issue is not *whether* public funding should be provided, but *how much*, *to whom*, and *under what conditions*. Plainly, there are arguments for and against *compensating* those who lose private property as a result of sea level rise and related climate impacts. Overall, the arguments in favour of providing compensation are more convincing than those against.

This does not mean, however, that all financial losses should be *fully* compensated by the state. But for developed countries like New Zealand it certainly points to the desirability of having a nationally consistent, comprehensive, systematic, and carefully-crafted policy framework for public compensation. Ideally, such a framework should cover the full range of losses and other costs associated with the impacts of climate change and should not be limited to those associated with sea level rise; nor should it be restricted to losses of

private *residential* property. It is acknowledged that developing a comprehensive funding framework for climate change adaptation will be challenging. But it will become increasingly unavoidable. The sooner serious work begins on creating such a framework, the better.

It should never be forgotten that the direct financial losses are only part of losses associated with managed retreat. For many people the loss of their community and sense of 'place' and identity will be of considerable importance. Such losses are difficult, if not impossible, to monetise, let alone compensate for.

Section 6: The policy implications for New Zealand

This section of the paper briefly assesses the current policy framework for climate change adaptation in New Zealand with particular reference to managed retreat. Then, drawing on the analysis in previous sections, it outlines some of the policy lessons from other countries and offers a series of proposals and conclusions.

The current policy framework for adaptation

New Zealand's current adaptation framework is not fit for purpose, as various commentators and recent reports have highlighted (Boston and Lawrence, 2018; Climate Change Adaptation Technical Working Group, 2017, 2018; Hodder, 2019; Lawrence, 2015, 2016; Local Government New Zealand, 2016a; NZPC, 2019; PCE, 2015). It is not adequate for the nature, scale or duration of the challenges posed by climate change, and particularly sea level rise. It is not consistent with the principles of sound anticipatory governance (see Boston, 2017b; Guston, 2014; Quay, 2010). It will not deliver least-cost outcomes. And it will not ensure that the burdens of adjustment are shared equitably, whether intra-generationally or inter-generationally.

There is no need here to comment in detail on the current policy weaknesses. But the key deficiencies include:

1. Existing statutory arrangements for adaptation are poorly aligned. The relevant statutes include the Resource Management Act (RMA), 1991, the Soil Conservation and Rivers Control Act 1941, the Civil Defence Emergency Management Act 2002 and the Building Act 2004. For instance, whereas the Building Act focuses on a 50-year timeframe, the New Zealand Coastal Policy Statement issued under the RMA requires local authorities to look forward 'at least 100 years'. Likewise, while current statutory provisions provide strong protections for existing uses, the need for restrictions on some uses is becoming increasing urgent. To compound matters, existing legislative and regulatory requirements have been applied inconsistently by decision-makers, and the central government has provided insufficient guidance and support to local authorities

2. Despite their responsibilities to mitigate long-term risks, many local authorities continue to approve major new sub-divisions and other developments in low-lying areas that will be increasingly flood-prone in the longer-term. Pressure from developers, the risk of legal challenges, and the opportunity costs associated with precautionary decisions (e.g. the loss of potential rate revenue) have no doubt influenced consenting decisions in some instances. Against this, councils are aware of the risk of future liability claims in the event that they grant consent for

developments in potentially vulnerable locations (Hodder, 2019; NZPC, 2019; PCE, 2015).

3. As in the US, current policy arrangements are insufficiently anticipatory and precautionary. Policy instruments such as the Natural Disaster Fund (administered by EQC) and the Adverse Events Fund (administered by the Ministry for Primary Industries to assist rural communities) are focused primarily on providing *post-event* assistance (e.g. the funding for post-disaster recovery). There are insufficient funding and other policy mechanisms that are preventative, pre-emptive or *pre-event* – i.e. mechanisms designed to enhance societal resilience, reduce risk exposure, and enable cost-effective adjustments and transitions. Be that as it may, even the *post-event* funding arrangements tend to be ad hoc and inconsistent (e.g. consider the different policy responses to uninsured 'red-zoned' properties in post-quake Christchurch and uninsured properties in Edgecumbe following the 2017 flood).

4. Related to this, there is central government funding available to *repair* damaged local government infrastructure. For instance, the national civil defence plan provides for the central government to contribute up to 60% of the costs of repairing underground water and sewerage services after a catastrophic event. By contrast, guaranteed contributions for *future-proofing* infrastructure are lacking.

5. There is currently no central government fund, such as the HMGP administered by FEMA, which is designed specifically to fund buyouts of flood-prone properties, thereby facilitating managed retreat. As a result, some local authorities have developed their own approaches (e.g. Hawke's Bay, Lower Hutt, and Waitākere) (see Boston and Lawrence, 2018; OECD, 2019; PCE, 2015; Vandenbeld and MacDonald, 2013). But this poses the risk of inconsistent practices and uneven compensatory arrangements (i.e. depending on the resources available to the local authorities in question), greater opposition from affected residents, lengthy and expensive legal proceedings, prevarication and delay, and increased demand for the construction (or reinforcement) of hard structures to protect at-risk properties.

6. There is a gross mismatch between the resources and capabilities of local authorities and the scale of their adaptation challenges. For instance, many communities (e.g. Dunedin, the Eastern Bay of Plenty, and the West Coast of the South Island) face the prospect of relocating a significant proportion of their residents by mid-century. Their existing rating base and borrowing limits, however, severely constrain their capacity to fund large-scale relocations (e.g. including the demolition of existing structures, the purchase of land for resettlement, the construction of new infrastructure and public amenities, and the provision of relocation assistance to those with limited means). Many councils would not be in a position to fund a substantial number of property buyouts or even co-fund such purchases. Aside from managed retreat, some councils will struggle to raise the capital necessary for renewing, upgrading, and future-proofing their existing public infrastructure (NZPC, 2019).

7. The provisions in most household insurance contracts (and related EQC cover) lack provisions for 'betterment'. Hence, while an insurer will repair homes at risk

of future flooding, they will not contribute to the relocation of such homes or the construction of new homes in a safer location.

In short, without reforms, existing policy frameworks appear destined to increase, rather than reduce risk exposure, exacerbate future adaptation costs, and contribute to multiple inequities. In the interests of sound anticipatory governance, a better policy framework is required.

Lessons from other OECD countries regarding the funding of managed retreat

In developing that framework, there are numerous lessons – both positive and negative – to be drawn from the experience of other jurisdictions, as discussed earlier in this paper. As the preceding analysis has indicated, pre-emptive managed retreat is bound to be a complex and difficult enterprise, however well designed the overarching policy framework. Moving large numbers of people, sometimes reluctantly, from at-risk communities will never be easy. Matters will be further complicated by the need to relocate significant amounts of public infrastructure (e.g. roading networks), as well as (in some instances) the entire business districts of substantial towns and cities. Such endeavours will test even the best spatial planning, regulatory, and funding arrangements.

Moreover, *pre-emptive* managed retreat that is strategic and precautionary is likely to be even more difficult that *post-event* retreat because of the difficulties of persuading communities of the risks they face and a strong preference in many cases for protection rather than relocation. But given that such problems can be anticipated, there is the opportunity to craft policy frameworks and tools that can help to ease the required transitions and adjustments. With that in mind, the following policy lessons and considerations deserve emphasis.

1. ***The ability of societies to adapt to sea level rise is largely political not technical***

International research (e.g. see Hinkel, et al., 2018) highlights that the ability of societies to adapt to sea level rise and enhance their resilience to the impacts of climate change is less about their technical prowess and more about social and political factors, such as the quality of governance. Adaptive capacity, in other words, depends on having the necessary decision-making processes and policy frameworks in place to resolve (or at least manage) the inevitable societal conflicts, enable informed and prudent decision-making, and mobilise the required financial and other resources. Funding arrangements are especially crucial as these largely determine the policy options available to communities. Where pre-emptive managed retreat is the most cost-effective long-term option but insufficient public funding is available to support the necessary measures (including property buyouts), the affected communities will be faced with ever-increasing risks and adaptation deficits, and thus declining resilience.

The fundamental tensions over funding are essentially distributional and political, namely the conflict between the desire of taxpayers (and/or ratepayers) to minimize their financial contributions to the state versus the need of coastal (and other at-risk) communities for public support for climate-related adaptation. In short, therefore, the question is whether a society like New Zealand is *willing* and *able* to resolve such tensions and do so in a way that facilitates cost-effective and equitable adaptive responses. If not, then future generations will face even greater risks, costs, disruption, and dislocation.

2. ***Sea level rise poses profound equity issues and is likely to widen social divisions without strong countervailing measures***

The economic and social impacts of climate change over the coming century will be very large. How the burden of adjustment is shared will have significant distributional implications – both intra-generationally and inter-generationally.

The evidence to date suggests that income and wealth inequality, along with other social divisions (e.g. ethnic, gender, and religious), can be readily exacerbated by: a) the impacts of climate change, and especially sea level rise, and b) the policy responses to these impacts (Siders, 2019; Siders et al., 2019). Wealthy coastal communities, other things being equal, tend to secure a disproportionate amount of the public resources available for adaptation, especially for protective structures. US and UK evidence, as noted earlier, highlights that socio-economic inequalities are bound to be aggravated if public funding for managed retreat is unduly limited. The same, of course, applies to developing countries like Bangladesh (see Mortreux et al., 2018). But unlike some developing countries, a developed country like New Zealand, has the resources to address many of the equity issues posed by climate change. The question, therefore, is whether it chooses to do so. Again this highlights the *political* nature of the choices New Zealand faces: are governments prepared to raise the necessary revenue from taxes (and other levies) to minimize the socio-economic inequalities generated by climate or will they allow such divisions to intensify?

3. ***Prudent, cost-effective adaptive responses to sea level rise, including pre-emptive managed retreat, require anticipatory (i.e. pre-event) public funding mechanisms and related regulatory measures***

Limiting public funding for managed retreat to situations where at-risk private property has already been damaged by coastal erosion and/or flooding makes no sense. Such an approach increases and entrenches risk exposure, exacerbates societal costs (both financial and non-financial), fosters uncertainty, and boosts inequality. To avoid such outcomes, and thereby enable at-risk communities to be relocated before disaster strikes, well-designed and properly resourced mechanisms are needed. In New Zealand's case this will require the establishment of at least one (and possibly several) new funding instruments – as various contributors to the debate have proposed (see Boston and Lawrence, 2018; NZPC, 2019). The precise design of such an instrument (or instruments) – including the sources of funding, the purposes for which public funds can be allocated, the criteria governing eligibility for assistance, and governance arrangements – will need careful attention and no doubt a statutory mandate. The finer details of such arrangements are not explored here, but on the basis of the foregoing discussion several matters relating to compensation and co-funding need emphasis.

4. ***Public compensation must be an integral and significant part of the policy framework for managed retreat***

As argued earlier, it is hard to envisage, certainly in a relatively affluent democracy like New Zealand, large-scale relocations of at-risk communities occurring in the absence of public compensation for property losses, along with other tailored and targeted forms of public assistance (e.g. relocation allowances and rental subsidies). Failure to provide adequate compensation seems destined to increase public pressure for uneconomic protective structures, encourage costly litigation, magnify social divisions and contribute to greater uncertainty and stress. Based on US practice, a good case can be made for

compensatory payments that reflect the market value of properties. To be fair to property owners, this means adopting the market value that prevailed prior to events or decisions which may have substantially reduced this value. These might include a major flooding event or a decision by the relevant public authorities not to invest in (further) protective structures and/or to re-zone the land in question as being at-risk of flooding and/or unsuitable for further development.

This, of course, raises a variety of issues. First, some coastal properties are likely to lose their market value long before a flood or zoning changes (e.g. based on mounting scientific evidence of increased risk exposure or in response to growing expectations that zoning changes are likely). For instance, insurance may become increasingly difficult to obtain and/or prohibitively expensive well before changes to local plans and regulatory provisions.

Second, sea level rise constitutes a slow-onset catastrophe, not a single, one-off event. Hence, in many places a series of sequential retreats will be necessary. And the relevant planning decisions will need to be taken in the context of significant uncertainty over the speed of sea level rise and how risk profiles may change in the future. Such factors are likely to affect the market value of properties some distance away from each administrative 'line in the sand'. Determining fair market values for compensatory purposes may be problematic in such circumstances, even in the context of defined statutory criteria and procedures.

As highlighted by US experience, managed retreat is likely to require additional (targeted) assistance – whether in the form of grants or loans – to enable those subject to a property buyout to purchase a broadly equivalent property in a safe (nearby) location. It will be important to ensure that the eligibility criteria and rates of assistance, together with any scope for administrative discretion, are carefully prescribed.

In regard to the suggestion that public compensation should be capped in some way, I suspect that all the available options will be politically problematic. Consider, for instance, the imposition of a fixed-point cut-off, with less generous compensatory packages being provided after a specified and legislated date (e.g. 2050) or perhaps on a declining scale over many decades (i.e. with a series of cut-offs). In practice, such arrangements will be difficult to sustain politically. As the specified dates draws closer, there will be mounting political pressure for them to be pushed further into the future.

5. **Co-funding property buyouts and related costs may seem attractive for various reasons (especially for central government), but such arrangements run the risk of complicating the design and implementation of managed retreat, with resultant delays, inequities, and other problems**

As noted, most buyouts of flood-prone properties in the US are co-funded, with the federal government (via FEMA and other agencies) bearing the largest share of the cost (usually 75%, but sometimes more). In relation to New Zealand, the NZPC (2019, p.226), favours some form of co-funding in relation to climate change adaption, albeit probably with a much smaller contribution from the central government than in the US (e.g. perhaps a third).

There are various arguments for co-funding managed retreat including: spreading the fiscal costs more broadly and thus reducing the burden on taxpayers (most of whom do not live at or near the coast); providing incentives for local councils to inhibit further

development in areas likely to be vulnerable to sea level rise (thereby reducing long-term liabilities and adaptation costs); and ensuring local involvement in, and support for, the proposed relocation project(s).

Unfortunately, however, as the evidence from the US clearly highlights, co-funding (even with a 75% federal contribution) can be highly problematic. As noted earlier, it can contribute to multiple complications and delays, as well as generating various inequities. It can also impact negatively on both the *design* (including the scope) and *implementation* of managed retreat projects (e.g. with the relevant sub-national governments endeavouring to limit their potential financial liability and delay their expected contributions).

For New Zealand, as for the US, it seems likely that co-funding (e.g. by central, regional and local government) will increase regional disparities and exacerbate socio-economic inequality: at-risk communities with relatively well-off councils (and/or those facing minimum disruption from sea level rise) can be expected to fare much better than communities with poorer councils (and/or those facing large-scale relocations).

There is a further issue: to date most cases of managed retreat in the OECD, including within New Zealand, have been small-scale (e.g. a few dozen or a few hundred properties). In the future, however, much larger relocations will be needed. These will test the capacity of even well-resourced local authorities. Poorer communities facing large-scale relocations are unlikely to cope, even if their co-funding responsibilities are modest.

Take, for instance, the situation confronting the Dunedin City Council, which already carries a not insignificant level of debt: in South Dunedin alone there are around 2,000 homes at risk from a mere 25 cm rise in the sea level, and some 3,600 homes at risk from an increase of 1.5 metres (PCE, 2015, p.54). This does not include exposed businesses, public infrastructure, schools and other public facilities. If the council were expected to contribute a significant proportion (e.g. a third) of the compensation costs, as well as bear the costs associated with major new subdivisions and related public infrastructure, it is likely to face an unmanageable funding challenge.

Accordingly, a new national policy framework for climate change adaptation must ensure that the proposed funding arrangements do not undermine the financial viability of sub-national governments. Otherwise, taxpayers will end up bailing out insolvent councils.

Such considerations suggest that a *single-funder* model may be preferable to co-funding by different tiers of government. Necessarily, for New Zealand, any single funder would need to be the central government. After all, only the central government possesses the revenue raising powers and borrowing capability to handle the scale of the adaptation challenges posed by sea level rise over the longer-term. As discussed earlier, it thus bears the primary 'remedial responsibility' to act.

Nevertheless, if co-funding were to be an integral feature of a long-term policy framework for managed retreat, the proportion of the cost borne by regional councils and/or local authorities would need to be modest (e.g. 10-20%). Similarly, as in the US, flexibility would be required to cope with large-scale relocations where the relevant sub-national governments are unable to co-fund at the standard rate.

Another possibility would be to adjust the co-funding arrangements over time (as the magnitude of the relocations increases), with the contributions of sub-national

government declining after an agreed date (e.g. 2050). But such an approach runs the risk of incentivizing local decision-makers to delay some managed retreat projects until after the point when their financial liability is reduced. In so doing, risk exposures and overall adaptation costs may be increased.

6. It is unlikely that managed retreat can be limited to voluntary property buyouts and relocations; compulsion will almost certainly be required in some instances

Managed retreat in the US and many other contexts has relied primarily on voluntary property purchases. A preference for voluntary arrangements is understandable. After all, liberal-democratic societies prize freedom and oppose state coercion. They also place a high value on private property and its associated rights. But while voluntarism has been the norm thus far, it is hard to believe – given the magnitude of the projected increase in the sea level this century and related climate change impacts – that it will be sufficient in the future. For instance, in some situations, owners who refuse to sell their at-risk properties may impose additional costs on others (via the need to maintain public services); they may also place the lives of first responders at risk (e.g. if they require rescuing in a major flood or storm). Equally, those who refuse buyout offers may delay efforts to prepare at-risk land for new (albeit often temporary) purposes (e.g. recreational uses or the creation of wetlands). Accordingly, provision will need to be made for compulsory property acquisitions, at least in some situations.

7. Pre-funding some of the future costs of adaptation warrants consideration on the grounds of inter-generational fairness

Thus far no OECD country appears to have established dedicated funding instruments to pre-fund some of the future costs of climate change adaptation, such as managed retreat. The absence of such arrangements is understandable. Fiscally, governments face multiple and never-ending demands on the public purse. And politically, as noted earlier, governments find it hard to gain electoral support for significant non-simultaneous exchanges (i.e. inter-generational transfers), no matter how justified they may be.

Other factors are also likely to weaken the case for pre-funding. First, the scale of the costs of adaptation remains uncertain. Potentially, future technological innovations may reduce the costs substantially, thus enhancing their affordability (e.g. via normal government revenues). By contrast, the costs of an ageing population are easier to predict and more readily justified politically (e.g. hence the existence of the New Zealand Superannuation Fund but no equivalent climate change adaptation fund). Second, the fiscal costs of adaptation will partly depend on whether, and to what extent, property owners are compensated for their losses. A decision to provide only modest compensation will necessarily reduce the fiscal burden of managed retreat – even though it will not affect the overall *social* costs. Third, it might be argued that future generations are highly likely to be better off than current generations, at least in terms of their real per capita incomes and overall household wealth. If so, they will be better able than current taxpayers to fund the (increasing) costs of adaptation.

Against this, the following arguments deserve mention (see Boston and Lawrence, 2018). First, there is the well-established and widely supported ethical principle that those who inflict harm on others have a responsibility to remedy the damage they have caused and/or compensate their victims in some way. This principle is embodied, for instance, in the

idea of polluter pays. As it stands, current generations are causing human-induced climate change which will impose significant costs (via damage and loss) on future generations. On this basis, it would be morally justifiable to tax current citizens (e.g. taxpayers and ratepayers) to create a public fund (or funds) which could be drawn down in the future to help cover climate change-related costs.

Second, future generations may not be better off, however 'better off' is defined. For one thing, global economic growth may be undermined by the growing ecological crisis. For another, even if real per capita incomes continue to rise during the 21st century, the moral case for pre-funding would remain: that is to say, those who have caused climate-related harm ought to contribute to the cost of the damage. To use an analogy: criminals remain morally responsible for the harm they cause irrespective of whether they are poorer than their victims.

Given such considerations, there is a plausible, if not a strong, case for pre-funding some of the future costs of climate change adaptation. Potentially, this could be achieved by means of a fund similar in concept and design to the New Zealand Superannuation Fund. Revenue for such a fund could be derived from an additional levy on fossil fuels, with the pooled funds invested domestically and internationally and then drawn down at some agreed point later in the century.

Institutional design and climate change adaptation – a brief note

Adapting effectively, efficiently, and equitably to the impacts of climate change, including sea level rise, will require significant reforms to current governance and institutional arrangements across the OECD. In New Zealand various reform proposals have been advanced (e.g. see Boston and Lawrence, 2018; LGNZ, 2016a, 2016b, 2019; NZPC, 2019). It is not possible here to outline and assess all of these proposals. But several brief comments are worth making. The NZPC (2019) has suggested several changes. First, it proposes expanding the current funding arrangements for land transport via the New Zealand Transport Agency (NZTA) to deal with climate-related impacts and for co-funding local roads. Under these proposals, central government funding would be conditional on various standards and requirements being met. Second, in relation to the funding of water services (i.e. the three waters) and river infrastructure (i.e. for river management and flood control), it proposes establishing a new Crown agency (e.g. a Climate Resilience Agency). The new Agency would be modelled on the NZTA and would oversee a new Local Government Resilience Fund. The latter would co-fund infrastructure costs, including relocation and rebuilding, with the Fund's share based on council need and capacity. These new institutional arrangements would presumably sit alongside a new funding agency (or mechanism of some kind) that would co-fund the non-infrastructure costs of managed retreat, especially property buyouts.

The proposed structural reforms deserve careful consideration. There is a risk, however, that such arrangements will generate significant coordination problems. In effect, three separate central government agencies would be responsible for co-funding the different (but often related) costs associated with climate change adaptation. In regard to managed retreat, these three agencies would need to coordinate their activities with all the relevant regional councils and local authorities, along with their council-controlled organizations, not to mention a plethora other government agencies (e.g. those responsible for schools, hospitals, social services housing, etc.). Each of the public bodies involved would have different governance arrangements, decision-making processes, statutory responsibilities,

capabilities, financial resources, and political imperatives. For small-scale cases of managed retreat involving a few dozen households, such arrangements might be viable. For large-scale cases, especially those where whole suburbs must be relocated, it is possible to foresee a multiplicity of problems. Hence, I rather suspect that more streamlined institutional, decision-making, and funding arrangements will be necessary.

Conclusion

Climate change will generate formidable adaptation challenges as the century progresses. As a maritime state with a long coastline and many low-lying coastal towns and cities, New Zealand will be disproportionately affected by sea level rise. While the precise speed and magnitude of sea level rise during the 21st century remains uncertain, policy-makers need to prepare for a rise of at least of metre by 2100 and, in all likelihood, multi-metre increases by 2200. It will either be too expensive or technically impossible to protect many existing coastal (and other vulnerable) settlements and related public infrastructure, both in New Zealand and elsewhere. Hence, large numbers of people will almost certainly need to be moved to safe locations. The number, scale, and duration of such relocations will exceed anything previously encountered in human history. They will severely test the existing governance arrangements and financial resources of many, if not most, OECD countries.

From the evidence reviewed in this paper, current policy settings in New Zealand and, it seems, most other OECD countries are not well suited to the magnitude and complexity of the adaptation challenges that lie ahead. Indeed, they fall far short of what might be optimal in many crucial respects. As highlighted above, existing policy frameworks are largely reactive rather than pro-active, and ad hoc rather than systematic. Too often they are focused on moving people from at-risk communities *after*, rather than *before*, a natural disaster has occurred. This approach lacks common sense.

To compound matters, there is generally a gross mismatch between the resources required for large-scale, pre-emptive managed retreat and the funding available via existing policy mechanisms. Without funding reforms and commensurate changes to governance and institutional arrangements, spatial planning and regulatory systems, current policy settings are destined to increase risk exposure, encourage moral hazard, exacerbate socio-economic inequalities, and contribute to higher overall adaptation costs. To enable sound anticipatory governance, major policy reforms are essential.

If managed retreat is to be strategic, timely, and competently implemented, it will need to be well funded. One way or another, substantial public funding will be required. About this claim, there is little disagreement, certainly among those with expertise in the field of climate change adaptation.

Against this, there remains disagreement about the issue of compensation, namely whether, to what extent, and on what basis public compensation should be provided for the loss of private property. As argued in this paper, there are powerful arguments – not least those relating to long-term cost minimisation and considerations of fairness – for public compensation. Plainly, however, designing a comprehensive compensatory policy regime – one that commands adequate (and hopefully enduring) public backing and cross-party support – will be difficult. But the task needs tackling. Otherwise, policy-makers in New Zealand (and most other OECD countries) will limp from one unfortunate episode of coastal erosion or serious flooding to another, with resultant inconsistencies, delays, inefficiencies, and inequities.

In developing a strategic policy framework for pre-emptive managed retreat, I would offer the following advice:

1. In a centralized polity like New Zealand, only the central government possesses the revenue raising and borrowing capacity to fund large-scale population relocations. This capacity places the primary obligation – or 'remedial responsibility' – to act squarely on the central government. Acceptance of this responsibility will be fundamental to the design of any comprehensive, effective, and equitable adaptation funding framework.

2. To be sure, it may be feasible for small-scale projects of managed retreat to be funded and administered by regional councils and local authorities. Hence, there may be scope for adaptation funding arrangements to vary depending on the number and scale of the required policy interventions (including whether they have significant implications for public infrastructure and public services – educational, health care, elder care, social, etc.). Against this, there are likely to be advantages (e.g. in terms of consistency, cost-effectiveness, minimising compliance costs, and ensuring equity) in having a *single funder and an integrated administrative structure*, together with nationally-determined eligibility criteria for public assistance, standardized levels and types of public assistance, and so forth. Such arrangements will need to be mandated via a suitable, fit-for-purpose statute.

3. Some form of public compensation for private property losses resulting from programmes of managed retreat (and other impacts of, or policy responses to, climate change) will be unavoidable. Every effort should be made to reach a durable cross-party agreement on the principles, criteria, and administrative procedures governing such compensation. I strongly suspect it will be necessary to provide levels of compensation for residential properties (and probably non-residential properties) which reflect monetary losses based on suitably determined market valuations.

4. US evidence highlights the complications and sub-optimal outcomes that can arise when buyouts of at-risk properties are co-funded by multiple levels of government. This evidence must be taken seriously in designing adaptation funding arrangements in New Zealand.

5. There is a good case, based on considerations of inter-generational fairness, for pre-funding some of the expected costs of managed retreat later in the century.

6. If pre-emptive managed retreat is to be competently implemented, well-designed governance, institutional, planning, and regulatory arrangements will be essential. This must include proper monitoring, evaluation, and feedback in order to facilitate effective policy learning and innovation.

7. Decision-making for pre-emptive managed retreat must be properly integrated and coordinated with other aspects of climate change adaptation, including spatial planning, the funding of protective structures, the climate-proofing of public infrastructure, and the provision of public assistance to cover loss and damage arising from other climate-related impacts.

Appendix 1: Acknowledgements

This paper draws on various sources, including feedback from attendees at two workshops hosted by the NZCCRI and IGPS in Wellington on 24 February and 21 July 2017, and a seminar on climate change adaptation funding at Edinburgh University on 17 September 2019. While on study leave in the UK since early July 2019, I have benefitted greatly from conversations with a range of people with expertise in the areas of climate change adaptation and risk management, including: Kathryn Brown (Climate Change Commission), Professor Jim Hall (Environmental Change Institute, Oxford University), Tim Reeder (Senior Consultant, Trioss), Rumtin Sepasspour (Centre for the Study of Existential Risk, Cambridge University), Dr Mike Steel (Environment Agency), and Professor Swenja Surminski (Grantham Research Institute on Climate Change and the Environment, LSE).

Appendix 2: A brief comment on the possible use of covenants

In its draft report on *Local Government Funding and Financing*, the Productivity Commission (2019, p.221) proposed the idea of crafting some form of covenant that would make consents by local councils subject to an assumption of risk by the owner and be attached to the title of the property. The goal would be to reduce the long-term fiscal liability of councils (and potentially the Crown).

I lack the legal expertise to assess such a proposal properly. But I have the following reservations.

Interdependencies and externalities: private dwellings or businesses that are constructed in areas that are likely to be at increasing risk from coastal erosion or flooding as the century progresses may end up generating costs and risks for non-owners even if the owners receive no public compensation for their losses. For instance, if the structures have to be removed (in the face of coastal erosion) and the owners lack the resources to undertake such action, the burden will fall on ratepayers and/or taxpayers. Also, private dwellings require infrastructure (e.g. transport services, water services, electricity, etc.). Unless such infrastructure is fully-funded by the owners, which is unlikely under current policy frameworks, the costs (and eventual losses) will fall on ratepayers and/or taxpayers. More generally, whether or not the risks/liabilities are privatized or socialized, there will be costs for society as a whole. Large private costs often have significant (and damaging) public consequences.

The contents of the covenants: There is question as to whether the proposed covenants could be drafted in such a way as to take account of all possible future risks associated with climate change, including those unknown unknowns.

The decisions of the courts: The events in Christchurch following the major earthquakes in 2010-11, not least the decisions of the country's senior judges, surrounding public compensation for properties located in 'red zoned' areas are salutary. They suggest that it would be unwise to predict how the courts in the future will interpret such covenants and assess their implications for public policy. Note that the courts decided, in relation to 'red-zone' properties, that the owners of properties which were uninsured should nevertheless receive (some form of) compensation because the losses they suffered were deemed to be caused not by the earthquakes, but by the zoning decisions of the relevant public authorities. Government decisions in the future may likewise be seen to override the provisions of covenants.

Political economy: It would be unwise to ignore the political economy of a situation where there might in the future be significant numbers of property owners with covenants of the kind suggested. Such people are also voters. They will exercise their democratic rights. Governments can, and do, override privately-agreed arrangements; they change laws (sometimes the same law regularly); and they abandon long-standing conventions.

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