HAWKE'S BAY
REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

Meeting of the Risk and Audit Committee

Date: Wednesday 18 October 2023

Time: 9.00am

Venue: Council Chamber
Hawke's Bay Regional Council
159 Dalton Street
NAPIER

Attachments excluded from Agenda

HBRC Insurance Cover

Policy Description	Group	Broker	Insurer	Explanation of Cover	Total Value Covered	Limit for any one claim	Policy Excess	Period of Cover	FY22/23 TOTAL PREMIUM COSTS (GST inc)	Significant Exclusions/ Other notes
Commercial Motor Vehicle	Hawke's Bay Council Group Policy	AON	NZI	Own Damage - MV of the insured vehicle or any agreed value as specific in Schedule Third Party Liability Property Damage - $20m Third Party Liability Bodily Injury - $20m Aggregate Limit - $20m various sub limits apply (see Coverage Summary) HB Group - 581 vehicles - Fleet value $21,496,718	^$9m		$1000 or minimum 1% of of sum insured 21-25yo OR over 25yo and licenpad less than 2yrs +$500 ^21yo +$1,000	1/11/2022-31/10/2023	$ 83,000.79	
Material Damage -Commercial & Residential	Hawke's Bay Council Group Policy Primary Group Limit $600m (annual aggregate) Principal Sub-limit $20m (HBRC's loss limit)	AON	Vertex	Key assets in this policy as follows: •Pump stations $1.7m •Hydro assets $8m •Dalton St Office $20m •Waipawa Rd Depot $4.5m •Waipatiki Farm Park $2m •Regional Parks $2m	$20m		$10k excess	1/11/2022-31/10/2023	$ 230,503.08	
Standing Timber Insurance Policy (Forestry)	Windstorm cover may only be to max cover of $3.5m. Trying to get clarity on this from insurer. TBC Windstorm excess $250k	AON	HDI Global Specialty SE	Standing Timber $12.8m covered Key Forestry Assets •Lake Tutira Forest $5.2m •Tangoio Reserve $5.7m (Crown part owned)	$ 12,823,174.00	$2.5m	Fire, Additional Events & Opt benefits 1.5% of defined event Min $5k. Max $2.5m Windstorm 2% of Policy Total Sum insured Minimum $10k And other Optional Benefits per Quote QL 1139917 Refer to quote for further information	1/11/2022-31/10/2023	$ 35,964.69	Flood exclusion. Contractors are required minimum $5m PL cover
Commercial Marine Hull	HBRC	AON	Vero Ins. Ltd	5 x boats ($232,200 sum insured) Excess $1k 3rd party liability $1m cover. Excess $1k	$ 232,200.00		$1,000 excess $1,000 burglary & theft $250 excess portable equipment	1/11/2022-31/10/2023	$ 4,391.25	
Contract Works	HBRC	AON	QBE Ins. Australia Ltd	All civil works other than those excluded under allowable contracts clause. The less of 6mths or the period in the contract	Limit $250k any on contract	Transit in NZ $50k 5% of contract value for	Protection cost $5k & Earthquake 5% of site value (min of $5k)	1/11/2022-31/10/2023	$ 5,087.61	Adj premium for reduction in declared values with effect 31/10/22
Crime	HB Council Group	AON	Berkshire Hathaway Specialty Insurance Company	Your Statutory Liability, Employers Liability and Crime policies are due to renew shortly. These policies are typically written on a 'Claims Made' basis, and this means that you have a requirement to notify any circumstances that the Council are aware of that may potentially give rise to a claim under one of these policies as soon as you become aware of those circumstances.				1/11/2022-31/10/2023	$ 16,399.19	
Employers Liability		AON	Berkshire Hathaway Specialty Insurance Company		$1m & $4m	Any one claim and in aggregate any one period of insurance $1m	$1k, $10k + $25k relating to H&S	1/11/2022-31/10/2023	$ 4,312.32	Limit of indemnity $2m in aggregate for fines & reparation
Statutory Liability	HBRC Subsidiary and CCTOs etc	AON	QBE & Berkshire		$4m	$4m	$10k excess $25k excess for each claim relating to H&S at Work Act and RMA	1/11/2022 - 31/10/2023	$ 19,092.88	
Personal Accident		AON	AIG Ins. NZ Ltd			Limit A $2m Limit B $1m		1/11/2022-31/10/2023	$ 12,441.87	
Aviation Hull (Drone)	HBRC	AON	Precision Autonomy Pty Ltd	Covers individual Drones - DJI Mavic Pro $2,500 - Yuneec H520 $13,000 Plus $1,000,000 public Liability Named Pilot (Scott Yap)	$15,500 drones plus $1m PL		$500 Drones $2,500 PL	1/11/2022-31/10/2023	$ 2,924.73	
Infrastructure Disaster Damage	Programme Group limit $300m (Primary layer $125m. Secondary layer $175M) Principal Sub-limit $63m (HBRC's loss limit). 40% incurred on total limit only (with assumption all other assets are flood critical and therefore covered by NEMA. Excess $1.5m (40% payable only up - MW IAG)	AON	Refer Schedule of Insurers	Primary Layer Infrastructure Total Sum Insured Value = $284m Key assets Stopbanks $87m Drains $51m Akmon Groynes $74m Pipelines $11m Tree Planting) $21m	$284m			1/11/2022-31/10/2023	$ 384,468.76	
Business Travel	Hawke's Bay Council Group Policy	AON	Chubb Insurance New Zealand Ltd	All employees or Directors of insured travelling overseas on authorised business travel			Nil $100 $250	1/11/2022-31/10/2023	$ 170.60	
Cyber										
Environmental Impairment		Marsh	Channel Syndicate 2019			1,000,000	Sewage/wastewater plants $100,000 Other claims $25,000	1/7/2021-30/6/2022		
Harbour Masters Liability Excess Layer		Marsh						1/7/2021-30/6/2022		
Professional Indemnity		Marsh	QBE	Includes defamation, fraud & dishonesty, loss of documents, maritime functions, continuity	300,000,000	300,000,000	10,000	1/7/2021-30/6/2022		
Public Liability		Marsh	QBE	Extensions: - Property in care $1m - Punitive & Exemplary Damages $1m - Unmanned Aerial Vehicles (Drones) $1m	300,000,000	300,000,000	5,000	1/7/2021-30/6/2022		
Life & Income Protection Insurance		Asteron	Asteron	Refer Liana				1/7/2022/-30/06/2022		

Item No: 6b
Date: 9/10/2023
Report No: 23/24-08b
File No: OMS 11 01

AON

Manawatu-Whanganui Local Authority Shared Services and Hawkes Bay Councils (MWLASS+HB)

DRAFT Report

Earthquake Loss Analysis for Infrastructure Assets

August 2023

AON

Executive Summary

Manawatu-Whanganui Local Authority Shared Services and Hawkes Bay Councils (MWLASS+HB) engaged Aon Global Risk Consulting (Aon) to undertake a high-level estimate of losses from the combined infrastructure portfolio, in consequence of an earthquake event, as declared by the full insurance purchasing group in the 2023-24 insurance renewal.

This analysis will assist MWLASS+HB in understanding their potential losses and assess the adequacy of the existing group insurance policy natural catastrophe loss limit.

MWLASS+HB declared the total sum insured (TSI) for their portfolio to be $4.48b, comprised of three-waters infrastructure ($2.91b), river management and drainage assets ($1.03b), flood protection ($308.3m), and bridges ($238.9m).

This work presents a detailed deterministic study of potential losses resulting from earthquake events at two specific shaking recurrences, 1-in-500 and 1-in-1,000 years. These are considered suitable return periods for informing insurance decision-making and are in line with Aon's standard practice for reporting seismic loss potential. The hazard levels forming the basis of this assessment are informed by the recently released revision of the New Zealand National Seismic Hazard Model (NSHM22).

Median losses for the two scenarios have been presented in the panel to the right. Further breakdown of the loss estimates, including optimistic and pessimistic percentiles, can be found in the body of this report. Losses are presented for the cumulative portfolio only, with individual council sublimit analysis beyond the scope of this work.

The earthquake loss results are calculated considering the post-event inflation on reinstatement cost - with predicted losses scaled to best represent the resource and global economic factors impacting supply immediately following a wide scale event and is therefore considered more likely to represent the 'real-world' cost. Estimates of the insured and retained proportions of the post-event losses are provided.

Aon recommends a conservative approach when selecting insurance policy loss limits. The information provided in this report should not be used in isolation. Limitations to the analysis are outlined in the 'Limitations and Disclaimers' section.

2023-24 Total Sum Insured

$4.48b

Earthquake Median post-Disaster Losses

1-in-500 year Shaking

$596.02m

1-in-1000 year Shaking

$875.04m

AON

Table of Contents

Version	Document Title	Produced By	Reviewed By	Date
Draft	MWLASS – PML EQ 2023 – Rev 1.0	E. Jude	A. Wild	25 August 2023

Aon New Zealand

Level 21, Aon Centre
29 Customs Street West
Auckland, New Zealand

www.aon.com

AON

1 Introduction

Manawatu-Whanganui Local Authority Shared Services and Hawkes Bay Councils (MWLASS+HB) engaged Aon Global Risk Consulting (Aon) to assess the potential damage and loss from a large earthquake event affecting the group portfolio. MWLASS+HB have identified the need to undertake an earthquake loss modelling exercise to evaluate the suitability of their shared natural catastrophe limit, as declared on the group infrastructure policy, prior to the 2023/24 renewal.

This work will provide a high-level assessment of potential losses to assets declared by MWLASS+HB on their group infrastructure insurance policy, in consequence of an earthquake event. The assessment uses the results from the latest seismic hazard understanding from the 2022 version of National Seismic Hazard Model (NSHM). This assessment considers the shaking hazard for the 500- and 1,000-year level of shaking, along with secondary hazards where information is available for the region.

Loss estimates can inform decisions on how much risk to transfer through insurance, and how much to retain, as well as validate that a policy is sufficiently tailored to transfer risk where intended. The analysis results could also be used to set the foundation for future resilience work, such as prioritising assets by criticality to target resilience improvements that will have the most benefit for MWLASS+HB.

1.1 Report Structure

The remainder of the report is structured as follows:

- **Summary of Assets** – Summary of MWLASS+HB assets included in this assessment.
- **High-Level Seismic Risk Analysis** – A screening of seismic exposure across the geographic extent of the infrastructure portfolio (geospatial data provided by some of the member councils), with a high-level risk quantification of potential seismic losses for the portfolio.
- **Loss Estimates** – Presentation and discussion of loss estimates.
- **Determining an Insurance Limit** – Discussion of the factors affecting loss limit decision-making based on the results presented in this report.
- **Future Improvements** – Recommendation following the loss modelling work.
- **References**
- **Limitations and Disclaimers**

AON

2 Summary of Assets

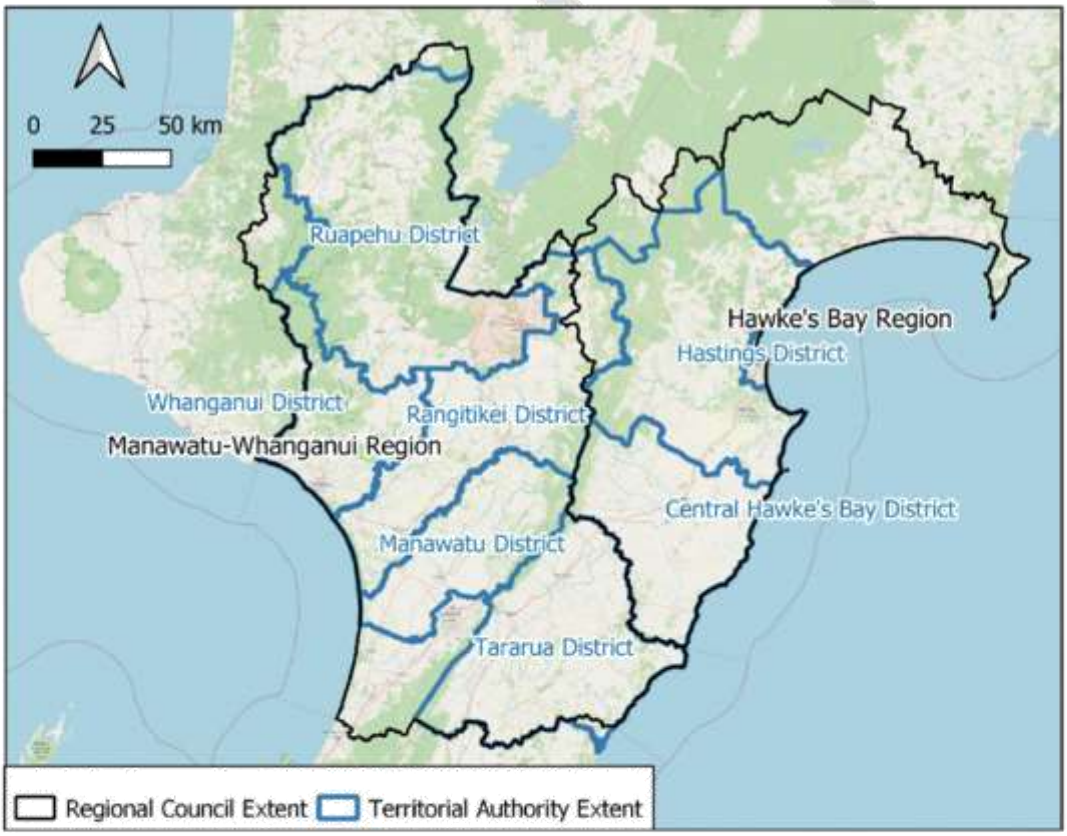
This assessment covers the infrastructure assets listed on the MWLASS+HB group insurance schedule, with supporting replacement value information as declared for the 2023-2024 renewal period provided by the individual member councils.

MWLASS+HB declared the total sum insured (TSI) for their portfolio to be $4.48b, comprised of:

- Three-waters infrastructure ($2.91b)
- River management and drainage assets ($1.03b)
- Flood protection assets ($308.3m)
- Bridges ($238.9m).

The individual member council territorial extents are shown in Figure 1 below, and council declared values for the 2023-24 insurance period summarised in Table 1 overleaf.

Figure 1: MWLASS+HB Council Territories



AON

Table 1: Summary of MWLASS+HB Schedule Assets (Ranked by Value)

Member Council	Asset Type	2023-2024 Schedule Sum Insured	
		Asset TSI ($m)	Proportion of TSI (%)
Whanganui District	Three-Waters Infrastructure	1,546.1	34.5%
	Bridges	100.9	2.3%
	Total	1,647.0	36.7%
Horizons Regional	River Management	1,029.4	23.0%
Manawatu District	Three-Waters Infrastructure	439.1	9.8%
Hawkes Bay Regional	Flood Protection	308.3	6.9%
Central Hawkes Bay District	Three-Waters Infrastructure	253.0	5.6%
Rangitikei District	Three-Waters Infrastructure	241.7	5.4%
Tararua District	Three-Waters Infrastructure	220.9	4.9%
Ruapehu District	Three-Waters Infrastructure	207.5	4.6%
Hastings District	Bridges	138.0	3.1%
Total	**Group Portfolio**	**4,484.9**	**100.0%**

AON

3 Data Sources

The schedule for each member council provided by the Aon broker was the primary source of valuation information for this analysis. Where provided by the member council, geospatial data was used to determine hazard exposure, and support asset classification. In classifying MWLASS+HB assets, the following sources of information were utilised:

- GIS asset information and insurance schedule
- Local Council hazard information
- Google Street Views
- Publicly available information

Table 2: MWLASS+HB Source Data for this Assessment (Ranked Alphabetically)

Member Council	Schedule File Name	Asset Location Source
Central Hawkes Bay	*Water Assets as at 11-07-23.xlsx* Received 12 July	Centre of townships using the *Community* attribute
Hastings	*Bridges for insurance 2023.xslx* Received 17 July 2023	GIS Data provided to Aon for a previous assessment – 91.6% joined based on TSI, with the remaining value is pro-rated
Hawkes Bay	*Infrastructure 23-24_CPI23.xlsx*	Centre of catchment based on the *Activity* attribute.
Horizons	*Horizons_Infrastructure schedule for submission to AON.xlsx* Received 10 July 2023	GIS Data - 94.8% joined based on TSI, where possible remaining value is pro-rated with similar asset types
Manawatu	*Manawatu MWLASS- Infrastructure Renewal Questionnaire 2023.xlsx* Received 6 July 2023	GIS Data - 62.1% joined based on TSI, where possible remaining value is pro-rated with similar asset types
Rangitikei	*RDC 2023 Insurance valuation V1.2.xlsx* Received 26 July 2023	Centre of townships using the *Community* attribute
Ruapehu	*Infrastructure Renewal Questionnaire 2023-24 FINAL.xlsx* Received 28 July 2023	Centre of townships using the *City/Town/Region* attribute
Tararua	*Tararua Infrastructure 2023-4 Insurance Declaration - V1.xlsx* Received 1 August 2023	GIS Data – 79.7% joined based on TSI, where possible remaining value is pro-rated with similar asset types
Whanganui	*Infrastructure Renewal Questionnaire 2023.xlsx*	Centre of township

AON

4 High Level Earthquake Risk Analysis

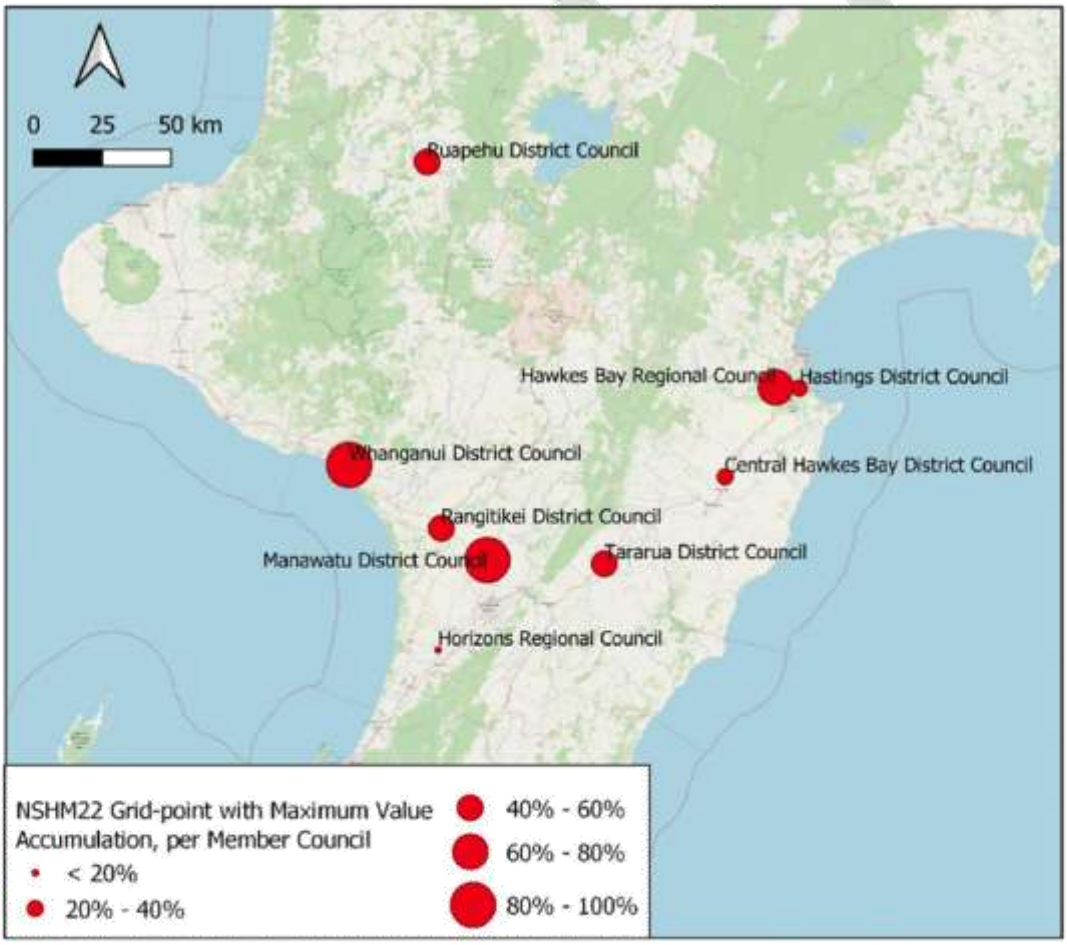
When analysing earthquake risk, it is important to consider, in parallel, the:

- Asset **exposure** (the likelihood and severity of the event that could occur), and the
- Asset **vulnerability** (the level of damage that an event could cause to the assets).

Hazard levels informed by the latest version of the National Seismic Hazard Model (NHSM22) (Gerstenberger et al, 2022), have been utilised to give the most up-to-date picture of the real-world shaking that could be experienced across the portfolio. The NSHM22 hazard is assessed on an approximately 10km resolution grid.

Conservatively, for this high-level assessment, the MWLASS+HB portfolio has been aggregated to a series of NSHM22 grid-points across the region. Councils that did not provide geospatial data have been aggregated to a grid point based on township descriptors in the asset schedule. Figure 2 depicts the point with the highest accumulation of value per member council, where the size of the circle indicates the proportion of the member councils' TSI at that specific grid point.

Figure 2: Location of Maximum Value Accumulation, for each Member Council



Based on the limited disaggregation information available on the NSHM viewer, it is predicted this shaking event could occur as a result of a rupture on the Hikurangi Subduction Interface. It is expected a rupture on the Hikurangi interface would cause widespread regional shaking and, as such, this assumption of aggregating to portfolio to a series of representative points across the region is deemed appropriate for this specific loss analysis.

When the full NSHM22 becomes available for probabilistic modelling, it would be beneficial to rerun the model and undertake a loss disaggregation, to identify the most likely faults to contribute to losses at different recurrence intervals. The losses from a specific event (such as a Hikurangi rupture) may exceed the estimated losses for 500- and 1,000-year deterministic shaking levels.

4.1 Overview of Seismic Modelling Methodology

The loss assessment is high-level, desktop-based and uses the latest earthquake hazard information available (including information on susceptibility to earthquake-induced liquefaction or landslides). This, combined with our understanding of potential vulnerability of the assets to earthquake actions, estimates potential losses associated with each of the chosen events (approximately a 500- and 1,000-year level earthquake shaking recurrence). The following pages provide an overview of the loss estimate methodology.

Data

A high-level review of available data from MWLASS+HB and other sources formed the basis of the loss assessment. The review included a check on the availability of necessary information regarding the characteristics of the assets, and the necessary earthquake hazard and vulnerability data to enable the modelling. Data for the portfolio was collected from the current 2023-24 Insurance Schedule (and GIS spatial data, where available). Assets were then further classified according to their asset type, construction, age, and exposure to secondary hazards (such as liquefaction and landslides).

Hazard Exposure

The latest 2022 version of the National Seismic Hazard Model (NSHM) is used to provide the 500- and 1,000-year shaking hazard for the region. Liquefaction and landslide hazard are accounted for using available datasets from local and regional councils.

AON

Vulnerability

Shaking damage was modelled by classifying assets into appropriate fragility classes and using the corresponding fragility models, based on a variety of sources. A range of vulnerability models are used based on a combination of several key asset attributes, e.g., for buildings, the choice of vulnerability model depends on structural form, height, age (design code level), and building site (presence of soft soils, and susceptibility to liquefaction or landslides). Secondary hazard exposures, such as liquefaction and landslide, were included within these models.

Loss

A spreadsheet model is utilised to subject the assets to the scenario earthquake shaking considered. A consequence model was then used to relate the damage levels to their expected loss ratios to calculate the dollar losses. Losses arising from the event are estimated for each major asset on the sites and summed to arrive at a total loss for the event.

4.1.1 Uncertainty in Seismic Loss Modelling

The loss estimates are specific to the scenarios analysed, e.g., the 500-year scenario modelled have a return period of about 500 years, or an average annual probability of occurrence of approximately 0.2%. It is conceivable that losses of this scale and even exceeding it could be seen, however the return periods of these losses are greater than those which would typically be considered for insurance purposes.

Earthquakes by the nature of the event and the frequency in which they occur create situations where there is large uncertainty in the damage and losses being estimated. This uncertainty increases as the average recurrence interval (ARI) increases. This is due to unfamiliarity with such sized events.

Every loss estimate produced is influenced by uncertainty. Two different loss estimates produced for the same ARI will indicate different loss levels due to uncertainty but will still be within the overall range of possible damage for a set event. There are two high-level categories of uncertainty:

- **Natural variability** represents variables that are random and unpredictable by nature, these differ from event to event or place to place.
- **Knowledge uncertainty** represents variables that are more or less constant, but we do not know their values.

Specific uncertainties in the modelling include (but are not limited to):

- Earthquake magnitudes, return periods, depths, and locations.
- Ground motion resulting from earthquakes.
- Ground response in terms of liquefaction and lateral spread.

AON

- Damage to assets considering installation quality, condition etc.
- Cost to repair assets considering traffic management, availability of resources and key staff, price of replacement parts, access to assets, repair vs replacement, damage inspection costs, temporary repairs, or equipment etc.

4.2 Modelling Earthquake Exposure

Hazard levels informed by the latest version of the National Seismic Hazard Model (NHSM22) (Gerstenberger et al, 2022), have been utilised to give the most up-to-date picture of the real-world shaking that could be experienced across the portfolio.

To represent the variable subsurface exposure for the MWLASS+HB portfolio assets, the ground shaking at each representative location is extracted for multiple values of Vs30; this is the average shear wave velocity in the top 30m of the ground. Values for Vs30 typically range between 0 and 760m/s but can reach as high as 1500m/s in near-solid ground. A lower Vs30 typically indicates softer soil or deep sediments underlying the asset. This would be expected for assets adjacent to water bodies such as stopbanks and would have a material impact on buried infrastructure. Approximately 95% of MWLASS+HB's portfolio is situated on subsurface materials with a Vs30 of between 225m/s, and 300m/s based on Foster et al (2019), which is consistent with the geomorphology of the region.

For each annual probability of exceedance (likelihood) there is a distribution of potential shaking – that is, a median PGA, as well as a range from 'optimistically low' shaking to 'pessimistically high' shaking. To best represent this real-world variability in the hazard, the full hazard distribution for each ARI is utilised. Table 2 below shows the 1-in-500-year and 1-in-1,000-year hazard levels for the highest proportional Vs30 exposure, for each member council of MWLASS+HB.

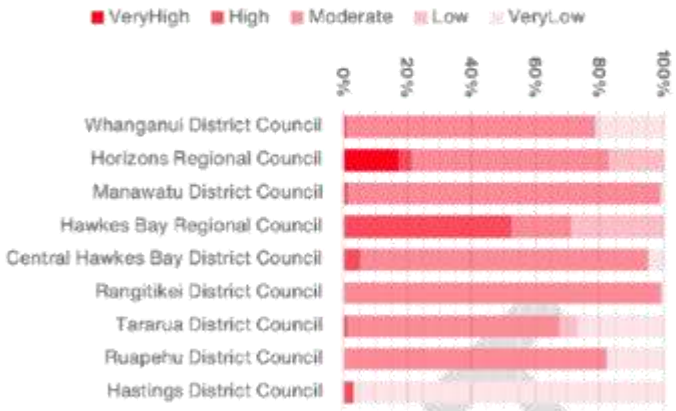
Table 2: NSHM22 Representative PGA by Member Council, for Each Selected ARI (Ranked by Hazard)

Member Council	Vs30	1-in-500-year Shaking			1-in-1,000-year Shaking		
		10th Perc.	Median	90th Perc.	10th Perc.	Median	90th Perc.
Central Hawkes Bay District	300	0.46	**0.75**	1.03	0.61	**1.02**	1.36
Tararua District	225	0.45	**0.75**	0.99	0.58	**0.97**	1.26
Horizons Regional	225	0.42	**0.69**	0.92	0.54	**0.90**	1.16
Manawatu District	250	0.40	**0.65**	0.87	0.51	**0.85**	1.11
Hawkes Bay Regional	225	0.40	**0.65**	0.88	0.51	**0.86**	1.12
Hastings District	225	0.40	**0.65**	0.88	0.51	**0.86**	1.13
Rangitikei District	250	0.37	**0.59**	0.78	0.47	**0.77**	1.00
Whanganui District	300	0.31	**0.50**	0.66	0.41	**0.66**	0.88
Ruapehu District	300	0.18	**0.27**	0.35	0.24	**0.37**	0.48

In an earthquake, assets located in areas susceptible to liquefaction or landslides can experience greater damage. Once the susceptibilities were determined, additional potential losses from liquefaction and landslides were allowed for by scaling the shaking losses.

AON

Figure 3: Proportion of Member Council TSI Split by Liquefaction Exposure (Ranked by Value)



4.3 Modelling Asset Vulnerability

Vulnerability is a function of ground conditions and asset susceptibility to earthquake damage. Damage from an earthquake could be caused by a number of different factors. The majority of damage is expected to be caused by the effects of shaking. However, secondary perils such as co-seismic subsidence of land[1], fault rupture[2], liquefaction/lateral spread, and landslides have the potential to significantly contribute to the damage. Only liquefaction/lateral spreading and landslides were accounted for in the present assessment.

Information on the asset characteristics was sourced from the 2023-24 Aon Insurance Schedule, and associated geospatial data, as available from individual member councils.

Shaking damage was modelled following the approach recommended in Murashev (2006) and Hazus (2020). by classifying assets into appropriate fragility classes and using the corresponding fragility models. The fragility models relate shaking levels (or the resulting response levels, e.g., spectral acceleration) to a set of probabilities of experiencing different levels of damage (None, Slight, Moderate, Extensive and Complete). The equivalent-PGA-based models with necessary modifications for site soil class (Foster, et al, 2019), event magnitude and source to site distance were used. For plant and contents, the appropriate 'spectral acceleration' based models were used.

Damage for pipe assets was determined using the Cousin's break rate methodology (Cousins, 2013) translated into loss ratio models for different classes of pipe (combination of pipe material ductility and service type) and ground conditions. The translation was enabled by assuming a critical break rate of 20 breaks per kilometre to

---

[1] Modelling subsidence of land resulting in gradient changes or resulting in below mean sea level ground elevations (resulting in increased flood risk) requires detailed site-specific information and is beyond the scope of the present study.

[2] Similarly, assessment of loss from fault rupture requires site-specific fault trace mapping data, which was not available.

AON

be effectively equal to a total loss. Loss enhancement factors were then applied to differentiate between different pipe classes and ground conditions.

A range of other sources of vulnerability information, including ATC-13 (1985), combined with engineering judgement was used to determine loss ratios for other asset types present in the MWLASS portfolio.

4.4 Modelling Loss from the Damage

Once the probable damage levels were determined, a consequence model relating the damage levels to their expected loss ratio ranges was applied to calculate the dollar loss.

Determining the loss incurred by the event requires consideration of several key factors: the extent of damage, the economic viability of repairing vs replacing the asset based on the damage observed, as well as post-disaster cost to reinstate.

Given the range of possible shaking inputs, and the probability distribution of damage, it is reasonable to conclude that there is a range of potential losses for any single scenario. For this reason, the consequence model is run stochastically. This model picks a level of shaking from the distribution and calculates the damage and consequent loss based on the chosen level of shaking. This loss is recorded, and the model repeats itself, sampling the input, calculating the damage, and recording the loss. Over thousands of iterations, it is possible to build a loss curve reflecting the range of potential outcomes associated with the scenario.

This analysis has considered the contribution of 10,000 iterations of each simulated earthquake event. Reporting on this loss curve (rather than a single loss value) allows MWLASS+HB to better understand the potential costs that could be incurred when repairing the site after an earthquake – including an 'optimistic' and a 'pessimistic' view to better frame the risk exposure. It also allows for more informed insurance limit-setting discussions by giving different confidence levels for each event.

AON

5 Loss Estimate

Table 3 presents the median post-event losses for the modelled return periods, as well as a range of pessimistic and optimistic losses (up to the 90th percentile, and down to the 10th percentile respectively)[3].

Table 3: MWLASS+HB Deterministic Losses for Modelled Return Periods

Shaking Average Recurrence Interval (ARI)	Post-Disaster Loss Expectancy ($m)		
	Optimistic (10th Perc.)	Median	Pessimistic (90th Perc.)
500-year	454.05	596.02	781.01
1,000-year	691.26	875.04	1,120.40

Immediately after a large natural disaster, there is an observed economic phenomenon where the cost to repair damage to buildings and other infrastructure assets is temporarily significantly greater than the cost to repair the same damage in a smaller disaster (or during typical asset renewals).

When a large event occurs, causing damage to a large number of assets with a large number of owners, there is an increased demand for urgent repair of assets, and reinstatement of services – causing a surge in pricing. The key factors that contribute to demand surge are (but are not limited to):

- Magnitude of damage and size of the affected area; a significant event could impact the majority of NZ.
- Growth stage of the local and natural economy – variation over time and across the region.
- The size of the construction sector - variation over time and across the region.
- Industry wage levels.
- Resource availability – labour and resources.
- Global considerations, such as supply chain disruption and increased costs caused by the pandemic and war/conflict.

This means that the cost to repair damage post-disaster, is notably higher than the cost to repair the same amount of damage, day-to-day, or during typical asset renewals – often of the order of 30-60% higher than the normal reinstatement.

For some highly damaged assets (requiring full replacement), it is possible for the real-world cost to reinstate to exceed the asset sum insured (i.e., an asset loss ratio of 100%+) – in this situation, some of the loss would be retained by MWLASS+HB (or the relevant member council, as appropriate).

[3] A 90th percentile loss signifies that 90% of the time, the loss will fall below this value (and 10% of the time, the loss could exceed the value shown). Similarly, 10th percentile should be exceeded 90% of the time. The median value represents the 50th percentile.

AON

5.1.1 How Might the Policy Respond?

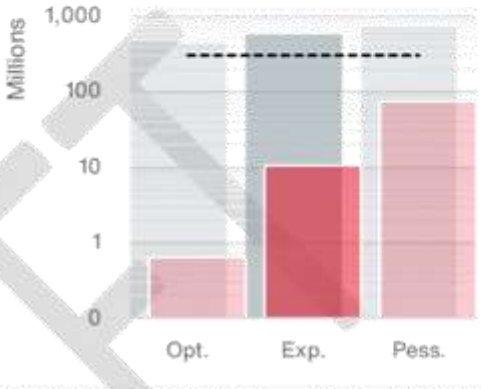
Although accurately predicting economic trends is difficult and highly uncertain, Aon has expertise in predicting the way that MWLASS+HB's group infrastructure policy will respond in an event.

By considering the policy configuration and the maximum pay-out for each individual asset (based on council declared values), we can build a picture of the likely proportions of the losses presented above, that **could be transferred** to insurers, based on MWLASS+HB's current schedule values ("Transfer"), and the proportion of losses that MWLASS+HB **could expect to retain** on their balance sheet ("Retain").

Figure 4: Proportion of Predicted Post-Event Losses Transferrable vs. Retained Losses

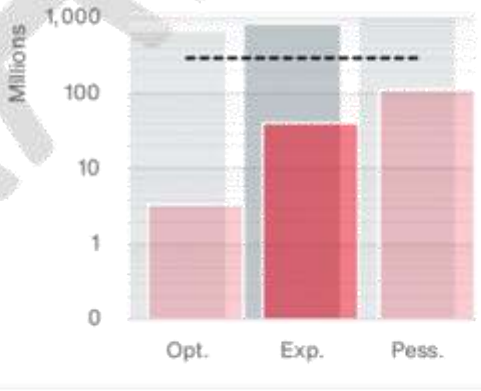
500-year

	Optimistic *10th*	Expected *50th*	Pessimistic *90th*
Post-Event Loss	454.05	596.02	781.01
Transfer	452.27	579.31	717.53
Retain	0.65	10.51	72.70



1,000-year

	Optimistic *10th*	Expected *50th*	Pessimistic *90th*
Post-Event Loss	691.26	875.04	1,120.40
Transfer	680.19	831.08	1,021.85
Retain	3.36	41.96	110.75



The maximum total loss covered by the insurer is determined by the group policy natural catastrophe loss limit, which is currently $300m, shown by the black dotted line on the figures above (noting individual council sublimits are not considered for this high-level analysis). Losses exceeding the declared loss limit will be retained by MWLASS+HB.

Note: Potentially recoverable losses from government funding etc. have been excluded from these figures – Aon brokers can advise further on recovery potential (if any) for the portfolio.

AON

6 Determining an Insurance Loss Limit

Loss modelling provides loss estimates that are a representation of what is the likely consequence (loss or damage) from a given event. The variability of the outcomes, and inherent uncertainty, is considered as part of the statistical analysis. However, there are always unknown factors and complexities that can impact actual loss outcomes compared to a theoretical representation.

It is therefore important that loss estimates are not converted immediately into a loss limit, but instead are used as part of the process to determine policy loss limits (a policy limit is the maximum amount that is payable under the insurance contract).

The following are additional considerations that should be included in the process for defining loss limits:

- Generally, the cost of capital reduces as the likelihood of loss decreases. However, the availability of capacity and the underwriters' view of risk means that this can only be ascertained by asking the insurance markets for either a formal quote, or indicative costs for additional capacity.
- A policy limit, particularly for a group of insured entities, is the maximum amount that is payable under the insurance contract. The limit therefore has to be sufficient for events that impact multiple member councils at the same time.
- There are additional sublimits within the policy. These are for individual council members and also specific coverages (e.g., enablement costs). The overall loss limit should be sufficient to cater for the damage and additional coverages in the total aggregate. This current work will assist MWLASS+HB in determining the adequacy of their policy group loss limit – suitability of the individual member councils' sublimits' should be assessed separately.
- The loss modelling analysis is a deterministic assessment of loss potential – that is, considering a specific shaking level at a specific location (as opposed to the full range of potential shaking from all sources that could affect the site). The events considered in this report are low probability, high consequence events, but more extreme events of lower probability can still occur. Loss limits can be set to cater for these types of events, assuming that this additional insurance capacity is deemed economical.
- Asset values, for asset reinstatement, generally trend upward over time. Loss limits should be set to allow for some value increase over the period of time between loss modelling re-evaluations.

Aon brokers can advise on the practicalities of implementing demand surge into the insurance placement.

6.1 Future Improvements

Aon recommends the following to improve the accuracy of the loss estimates in future:

- Utilizing probabilistic earthquake models with the 2022 NSHM when these become available to determine the full range of probabilistic losses for the MWLASS+HB portfolio. This work could also include a loss disaggregation to identify the seismic sources most likely to result in high losses to the portfolio, with an in-depth analysis for the identified scenario(s).
- Asset valuations, at an asset-by-asset level, are reviewed on a regular basis and are estimated using an insurance-based reinstatement cost, not financial (or depreciation) based valuations (which may not consider costs associated with demolition or inflation costs when reinstating an asset).
- Member councils that do not have geospatial data available for their portfolios should consider collection of this data. This would allow for better modelling of the variability in spatial variability in secondary hazards.

- The MWLASS+HB member councils own and operate a significant value of additional assets, either declared on different insurance policies or self-insured – for example above-ground and property assets. The predicted extent of damage to infrastructure would indicate additional assets outside of this specific schedule would also be damaged – and therefore result in additional losses in consequence of an earthquake event. To fully understand the total loss impacting the member councils' balance sheets, conducting a cumulative loss modelling exercise with *all* MWLASS+HB owned assets (insured and uninsured) is recommended.
- Investigate the impact of more frequent events (i.e., floods), and how that would impact the retention levels (deductibles) that MWLASS would be comfortable holding.
- Undertake detailed council-specific modelling to determine the individual risk exposure for each member council – this would assess the suitability of individual sublimits as declared on the group policy. Undertaking modelling at a greater detail also enables work around resilience and criticality to reduce the risk exposure.
- Undertake individual council loss assessments for premium allocation to ensure an equitable allocation of premiums to member councils.

Aon (and its partner consultants) can assist Manawatu-Whanganui Local Authority Shared Services and Hawkes Bay Councils (MWLASS+HB) with the implementation of the above recommendations and any follow-up extension of the present loss assessment. This would be an additional stage of work, beyond that currently undertaken and would require further engagement with MWLASS+HB. Such work, if undertaken, will also bring cost benefits, i.e., risk mitigation by asset hardening may reduce the loss estimate from a natural hazard – reducing the cost or requirement for risk transfer.

AON

7 References

- ATC-13. (1985). "Earthquake Damage Evaluation Data for California", Applied Technology Council
- Cousins, W. J. 2013. Wellington Without Water – Impacts of Large Earthquakes, GNS Science Report 2012/30. 124 p.
- Cousins, W.J.; Nayyerloo, M.; Deligne, N.I. (2014). Estimated damage and casualties from earthquakes affecting Auckland, GNS Science Consultancy Report 2013/324. 63 p.
- Dellow, G.D.; Abbott, E.R.; Heron, D.W.; Scott, B.J.; Ries, W.F.; Lukovic, B. 2016. Update of hazard Information for 2015 Lifelines Risk & Responsibilities Report, GNS Science Consultancy Report 2016/40. 33 p.
- Dowrick, D.J.; Rhoades, D.A. (2005). Revised models for attenuation of Modified Mercalli Intensity in New Zealand earthquakes, Bulletin of the New Zealand Society for Earthquake Engineering, v.38, no. 4, p. 185-214, December 2005.
- Foster, K.M.; Bradley, B.A.; McGann, C.R.; Wotherspoon, L.M. (2019). A Vs30 Map for New Zealand Based on Geologic and Terrain Proxy Variables and Field Measurements. doi: 10.1193/121118EQS281M
- Gerstenberger MC, Bora S, Bradley BA, DiCaprio C, Van Dissen RJ, Atkinson GM, Chamberlain C, Christophersen A, Clark KJ, Coffey GL, et al. 2022. New Zealand National Seismic Hazard Model 2022 revision: model, hazard, and process overview. Lower Hutt (NZ): GNS Science. 106 p. (GNS Science report; 2022/57). doi:10.21420/TB83-7X19.
- Hazus (2020). Hazus Earthquake Model Technical Manual, Hazus 4.2 SP3, Federal Emergency Management Agency, United States, October 2020.
- Litchfield, N.J.; Van Dissen, R.; Sutherland, R.; Barnes, P.M.; Cox, S.C.; Norris, R.; Beavan, R.J.; Langridge, R.; Villamor, P.; Berryman, K.; Stirling, M.; Nicol, A.; Nodder, S.; Lamarche, G.; Barrell, D.J.A.; Pettinga, J.R.; Little, T.; Pondard, N.; Mountjoy, J.; Clark, K. 2013. A model of active faulting in New Zealand: fault zone parameter descriptions, GNS Science Report 2012/19. 120p.
- McVerry G and Holden C (2014). "Incorporating simulated Hikurangi subduction interface spectra into probabilistic hazard calculations for Wellington". In Proceedings of Conference of the New Zealand Society of Earthquake Engineering, Auckland, New Zealand, 21-23 March 2014, Paper Number 054.
- Murashev, A. K., Davey, R., Brabhaharan, P., & Curley, B. (2006). Earthquake Risk Assessment of Flood Protection Assets in the Wellington Region. In *NZSEE Conference*.
- Pradel, G.J; Lukovic, B.; Dellow, G.D. (2020). Earthquake-induced landslide forecast and hazard assessment, Hawke's Bay Region. Lower Hutt (NZ): GNS Science. 25p. Consultancy Report 2020/46.
- Rojahn C.; Sharpe R.L. (principal investigators) and the expert panel (1985) ATC-13 Earthquake Damage Evaluation Data for California, Report ATC-13, Applied Technology Council, California.
- Rosser BJ, Dellow GD, compilers. (2017). Assessment of liquefaction risk in the Hawke's Bay Volume 1: The liquefaction hazard model. Lower Hutt (NZ): GNS Science. 108 p. (GNS Science Consultancy Report 2015/186).
- Stirling, M.W.; McVerry, G.H.; Gerstenberger, M.C.; Litchfield, N.J.; Van Dissen, R.J.; Berryman, K.R.; Barnes, P.; Wallace, L.M.; Villamor, P.; Langridge, R.M.; Lamarche, G.; Nodder, S.; Reyners, M.E.; Bradley, B.; Rhoades, D.A.; Smith, W.D.; Nicol, A.; Pettinga, J.; Clark, K.J.; Jacobs, K. (2012) National seismic hazard model for New Zealand: 2010 update. Bulletin of the Seismological Society of America, 102(4): 1514-1542; doi: 10.1785/0120110170.
- Wallace, L.M.; Barnes, P.; Beavan, R.J.; Van Dissen, R.J.; Litchfield, N.J.; Mountjoy, J.; Langridge, R.M.; Lamarche, G.; Pondard, N. (2012) The kinematics of a transition from subduction to strike-slip: An example from the central New Zealand plate boundary. Journal of Geophysical Research, VOL. 117, B02405, doi:10.1029/2011JB008640, 2012.

AON

8 Limitations and Disclaimer

8.1.1 Limitations

This report has been produced by Aon (We, we, Our, our) to assist in the understanding and quantification of potential earthquake material damage losses for property assets owned by Manawatu-Whanganui Local Authority Shared Services and Hawkes Bay Councils (MWLASS+HB) (the Client). The loss estimates are considered pragmatic and at an appropriate level and in line with good practice for loss estimations associated with high impact low probability events. The content of this report is only intended to be used for risk transfer and as such has been modelled to the detail required for this purpose. When used for other purposes, such as post-disaster response, land use planning and so forth, it may not be sufficiently robust or detailed. When used for other purposes, it could be useful as a starting point for further work provided the limitations are understood and acknowledged. Limitations are listed below:

- The estimates do not provide for additional damage that could be sustained during large aftershocks, nor does it factor in cascading events (such as fire following earthquake or shaking-induced tsunami) or another major event in the same insurance period.
- The estimates are for potential material damage losses only, and do not include associated costs such as claims preparation, expediting expenses and additional increased cost of working, however these should be considered when determining policy limits.
- Damage estimates (for some perils) have been calculated as a continuous probability distribution and three values are reported from this to give an understanding of the potential variability of the results for any given scenario. These values are based on the thousands of individual damage simulations for each of the selected scenarios.
    - The 10th percentile represents the value for which 90% of the individual damage simulations might be expected to exceed the $ loss given. It represents a low estimate for the loss potential within the simulation, referred to as 'optimistic.'
    - The 90th percentile represents the value for which 10% of the individual damage simulations might be expected to exceed the $ loss given. It represents a high estimate for the loss potential within the simulation.
    - The median represents the 50th percentile.
    - Given the inclusion of probability in the 10th and 90th percentile values the totals are not simply an addition of the numbers.
    - Note that the damage estimates and values provide include modelled conservatism.
- No allowance has been made for enablement costs in the assessment. This should form part of an additional assessment.
- Catastrophe models assume high correlation between characteristics of insured assets and those of the model features (such as vulnerabilities) designed to represent them. Specific individual risks however may have different attributes to those assumed by the catastrophe models. This means that real-life losses from a single risk or small group of risks concentrated at one or more locations could potentially exceed modelled losses calculated using the catastrophe models.
- Without in-depth structural and geotechnical investigations, the actual loss potential cannot be accurately pre-determined. When determining loss limits for insurance purposes, the potential for additional damage

AON

to high-value assets within the portfolio of assets considered can be improved by undertaking more specific and detailed assessment for those assets.

- No site-specific assessment, e.g., landslide or liquefaction potential assessment, has been undertaken as part of the present assessment to evaluate potential implications associated with earthquake actions.
- As natural hazard events are intrinsically highly unpredictable, there is a margin of uncertainty attaching to the results. The results and findings in this report have been reached through a series of qualitative and quantitative assessments in combination with various assumptions and limitations.
- Damage estimates are based on replacement costs estimates provided by the client (or broker). Aon reserves the right but not the obligation to recalculate damage estimates if the information is found to be in error or not suitable to fully replacement the assets in the event of a loss.
- Further detailed assessment is recommended to establish more accurate loss levels.
- Aon recommends that the results presented in this report should not be relied upon in isolation when making decisions regarding policy limits.
- The loss estimates are desktop-based, and their accuracy relies on the information supplied by the Client and/or selected third party sources. We accept no responsibility for the accuracy or completeness of the underlying information provided.
- The modelled losses presented in this report should be interpreted as follows. The '1,000-year ARI' shaking means there is approximately a 1 in 1000 annual probability that this shaking will be exceeded in any given year.
- The loss expectancies do incorporate some consideration for shielding effects however the full benefits of these effects cannot be incorporated into the model. This means the loss expectancies as stated may be overly pessimistic with regards to structural damage projections.

The Client acknowledges the assumptions and limitations noted above and agrees to the following:

- Where this report includes a recommendation or an assessment of risk, this is an expression of our opinion only and not a statement of fact. Any decision to rely upon any such recommendation or assessment will be solely at the risk of the Client, for which we accept no liability, and the Client acknowledges that the analysis provided does not replace the need for the Client to make its own assessment.
- We will not be liable, in any event, for any special, indirect, or consequential loss or damage of any kind (including but not limited to, loss of profit and business interruption, loss of use, loss of revenue, loss of contracts, increased costs and expenses, wasted expenditure, and all special, indirect, and consequential loss or damage suffered by the other party) arising from any use of the information contained in this report.
- We reserve all rights to the content of this report. No part of this document may be reproduced or transmitted in any form or by any means, whether electronic or mechanical, including photocopying, recording or otherwise, without our prior written consent. This document is provided exclusively for the use of the Client.
- No part of this document may be made available to any third party without both (i) Aon's prior written consent and (ii) that third party having first signed a "recipient of report" letter in a form acceptable to us. No responsibility is accepted to any third party for the whole or any part of the content of this document and all liability howsoever arising to any third party is hereby expressly excluded.

The primary aim of the analysis contained in this report, prepared by Aon (we, our) has been to ascertain and determine material damage loss estimates for earthquake events for the Client. The loss estimates provided are considered pragmatic and at an appropriate level and in line with good practice for loss estimations associated with severe earthquake events.

MWLASS
breaking boundaries, building opportunities

Item No: 6
Date: 9/10/2023
Report No: 23/24-08
File No: OMS 11 01

INFRASTRUCTURE INSURANCE LAYERS UPDATE

PURPOSE

1. This report is to inform the Board of the requirement for member councils involved in the pooled MW/HB LASS infrastructure insurance layers to make a decision, at the individual council level, whether or not they elect to opt-in to the purchase of an additional - third insurance layer.

BACKGROUND

2. Selected MW/HB LASS councils currently take part in pooled infrastructure insurance layers. This joint approach is designed to save costs in insurance premiums and helps spread risk. Councils involved in this scheme are - Hawkes Bay Regional Council, Hastings District Council, Central Hawkes Bay District Council, Whanganui District Council, Manawatu District Council, Rangitikei District Council, Horizons Regional Council, Ruapehu District Council and Tararua District Council.

3. Note Horowhenua District Council and Palmerston North City Council are not currently part of this pooled infrastructure insurance policy.

COMMENT

4. The pooled infrastructure insurance policy currently consist of two separate layers. A primary layer of $125 Million, and a secondary layer of $175 Million – the latter for those who elect to be participants in both layers. For those councils who elect to be participants in both layers, there is a total amount of available funds of $300 Million in 100% terms (this model assumes the Government '60/40 rule'). Therefore, for any council to opt in to any potential third layer they would first require to be members of the first two layers. This model is illustrated at Annex A, including identifying the participating councils.

5. The last time this matter was brought to the Board was in 2018, and since that time total infrastructure asset values across participating councils in the Manawatū-Whanganui and Hawkes Bay regions have doubled. In 2018 infrastructure asset values across the member councils were approximately $3.4 Billion. At the time of writing within the current insurance period the regional infrastructure asset valuation is approximately $5.7 Billion. This total figure is likely to exceed $6 Billion for the insurance period starting November 2023.

6. In the event of a wide spread insurance claim that exhausts total pooled funds in either layer, a legal Memorandum of Understanding (MOU) is in place. The MOU provides a funds sharing arrangement for member councils that is based on a percentage loss arrangement.

7. It is noteworthy that regardless of the MOU, in theory it is assumed the government would fund up to 60% of the infrastructure pay out. However in practice this assumption cannot be guaranteed. The other risk is in the event of a widespread natural disaster across the region, regardless of individual council sub-limits, councils will still result in a funds sharing situation in the event total available funds are exhausted.

8. This item is partially supported by a high level Earthquake loss model. Aon will discuss this in person as part of their presentation. Loss model is attached at Annex B.

9. At the time of writing, exact costing of a third insurance layer is not yet available but Aon will be able to brief on this on 9 October. However indicative costing indicates the total cost may be in the vicinity of $800,000 - $900,000 for this insurance period. Please note this estimated cost

would need to be confirmed and it would be split by participating councils. Therefore the more councils that opt-in, the lower the premium for each council.

10. Member councils are requested to confirm in writing or via email, to Craig Grant, no later than 20 October 2023 whether or not they wish to opt in to purchasing an additional infrastructure insurance layer.

11. A copy of the member councils/hypothetical example is at Annex A.

RECOMMENDATIONS

12. It is recommended that the MW LASS member councils

    a. **receive** this report; and

    b. **acknowledges** each participating council will confirm purchase (or otherwise) of a third insurance layer, to MW LASS, no later than 20 October 2023.

Dave Neal
2IC MW LASS

ANNEX

A Example of Pooled Insurance
B Regional Earthquake Loss Model

Item No: 6a
Date: 9/10/2023
Report No: 23/24-08a
File No: OMS 11 01

Council	Council Insurance Sublimit ([illegible])	Participate in Excess Layer	Example Loss Amount - 100%	% Allocation of Overall Loss	[redacted]	Share of Excess Layer $175m cover (100%)	100% Insurers payout	Insurers Total payout (40%)	Total council shortfall	Percentage of under-recovery	Notes
Whanganui District Council	[illegible]	Yes	$41,000,000	14.42%		$ 22,978,339	$41,000,000	$ 16,400,000	$ 24,600,000	-60%	MCDEM to be approached for shortfall
Manawatu District Council	[illegible]	No	$59,000,000	20.75%			$25,853,610	$ 10,373,444	$ 48,626,556	-82%	MCDEM to be approached for shortfall
Hawkes Bay Regional	[illegible]	Yes	$36,040,000	12.67%		$ 20,198,520	$36,040,000	$ 14,416,000	$ 21,624,000	-60%	MCDEM to be approached for shortfall
Rangitikei District Council	[illegible]	Yes	$15,000,000	5.27%		$ 8,406,709	$15,000,000	$ 6,000,000	$ 9,000,000	-60%	MCDEM to be approached for shortfall
Horizons Regional Council	[illegible]	Yes	$48,000,000	16.88%		$ 18,901,470	$40,000,000	$ 16,000,000	$ 32,000,000	-67%	MCDEM to be aproached for shortfall. Note additional shortfall as sub-limit breached
Ruapehu District Council	[illegible]	No	$4,000,000	1.41%			$1,758,211	$ 703,284	$ 3,296,716	-82%	MCDEM to be approached for shortfall
Tararua District Council	[illegible]	Yes	$35,000,000	12.31%		$ 19,615,655	$35,000,000	$ 14,000,000	$ 21,000,000	-60%	MCDEM to be approached for shortfall
Central Hawkes Bay	[illegible]	Yes	$35,640,000	12.53%		$ 14,394,341	$30,000,000	$ 12,000,000	$ 23,640,000	-66%	MCDEM to be aproached for shortfall. Note additional shortfall as sub-limit breached
Hastings District Council	[illegible]	No	$10,700,000	3.76%			$4,703,214	$ 1,881,286	$ 8,818,714	-82%	MCDEM to be aproached for shortfall. Note additional shortfall as sub-limit breached
			$284,380,000	100.00%		$ 104,495,035	$229,435,035	$ 91,774,014	$ 192,605,986		

Notes:

1. The $125m insurance layer will respond first proportionately until this is exhausted
2. For those councils that participate on the additional insurance ($175m) any additional claim amount will be met by this insurance
3. Neither layer will pay more than the council insurance amount

Council	Council Insurance Amount (100%)	Council Share of Group Insurance (100%)	Example Loss Amount - 100%	% Allocation of Overal Loss		Share of additional $175m cover (100%)	Insurers Total payout (40%)	Total council shortfall	Percentage of under-recovery	Notes
Whanganui District Council	$250,000,000	$100,000,000	$41,000,000	20.30%		$ 29,638,719	$ 16,400,000	$ 24,600,000	-60%	MCDEM to be approached for shortfall
Manawatu District Council	$200,000,000	$125,000,000	$59,000,000	29.21%		$ -	$ 14,603,960	$ 44,396,040	-75%	MCDEM to be approached for shortfall
Hawkes Bay Regional	$65,000,000	$100,000,000	$0	0.00%		$ -	$ -	$ -		
Rangitikei District Council	$50,000,000	$100,000,000	$15,000,000	7.43%		$ 5,717,032	$ 6,000,000	$ 9,000,000	-60%	MCDEM to be approached for shortfall
Horizons Regional Council	$40,000,000	$100,000,000	$48,000,000	23.76%		$ 30,297,030	$ 16,000,000	$ 32,000,000	-67%	excess layer did not pay out proportionately as sub-limit breached
Ruapehu District Council	$40,000,000	$125,000,000	$4,000,000	1.98%		$ -	$ 990,099	$ 3,009,901	-75%	MCDEM to be approached for shortfall
Tararua District Council	$40,000,000	$100,000,000	$35,000,000	17.33%		$ 13,341,524	$ 14,000,000	$ 21,000,000	-60%	MCDEM to be approached for shortfall
Central Hawkes Bay	$30,000,000	$100,000,000	$0	0.00%		$ -	$ -	$ -		
Hastings District Council	$10,000,000	$125,000,000	$0	0.00%		$ -	$ -	$ -		
			$202,000,000	100.00%		$ 44,583,149	$ 67,994,059	$ 134,005,941		

Notes:

1. The $125m insurance layer will respond first proportionately until this is exhausted
2. For those councils that participate on the additional insurance ($175m) any additional claim amount will be met by the insurance
3. Neither layer will pay more than the council insurance amount

Council	Council Insurance Amount (100%)	Council Share of Group Insurance (100%)	Example Loss Amount - 100%	% Allocation of Overal Loss		Share of additional $175m cover (100%)	Insurers Total payout (40%)	Total council shortfall	Percentage of under-recovery	Notes
Whanganui District Council	$250,000,000	$100,000,000	$0	0.00%		$ -	$ -	$ -		
Manawatu District Council	$100,000,000	$125,000,000	$0	0.00%		$ -	$ -	$ -		
Hawkes Bay Regional	$65,000,000	$300,000,000	$36,040,000	43.75%		$ -	$ 14,416,000	$ 21,624,000	-60%	MCDEM to be approached for shortfall
Rangitikei District Council	$50,000,000	$300,000,000	$0	0.00%		$ -	$ -	$ -		
Horizons Regional Council	$40,000,000	$300,000,000	$0	0.00%		$ -	$ -	$ -		
Ruapehu District Council	$40,000,000	$125,000,000	$0	0.00%		$ -	$ -	$ -		
Taranua District Council	$40,000,000	$300,000,000	$0	0.00%		$ -	$ -	$ -		
Central Hawkes Bay	$30,000,000	$300,000,000	$35,640,000	43.26%			$ 12,000,000	$ 23,640,000	-66%	additional under-recovery as sub-limit breached
Hastings District Council	$10,000,000	$125,000,000	$10,700,000	12.98%		$ -	$ 4,000,000	$ 6,700,000	-63%	additional under-recovery as sub-limit breached
			$82,380,000	100.00%		$ -	$ 30,416,000	$ 51,964,000		

Notes:

1. The $125m insurance layer will respond first proportionately until this is exhausted
2. For those councils that participate on the additional insurance ($175m) any additional claim amount will be met by this insurance
3. Neither layer will pay more than the council insurance amount


MŌHIO
AUT
ADAPTATION FINANCE:
RISKS AND OPPORTUNITIES FOR
AOTEAROA NEW ZEALAND
NOVEMBER 2022

Lead author: Dr David Hall, School of Social Sciences and Public Policy, AUT (Auckland University of Technology) and founder of Mōhio's Climate Innovation Lab. With support from Dr Tongyu (Melody) Meng, School of Social Sciences and Public Policy, AUT (Auckland University of Technology).

Suggested citation: D. Hall (2022). *Adaptation finance: Risks and opportunities for Aotearoa New Zealand*. Concept paper prepared for the Ministry for the Environment. Auckland: Mōhio Research and AUT. https://doi.org/10.24135/10292/15670

Methodology: This report was developed through the co-design process of Mōhio's Climate Innovation Lab, a fixed-term initiative which works with stakeholders to envision financial instruments to mobilise capital for climate-aligned projects and activities. A working paper was prepared through international market scanning and a review of primary and secondary literature on climate adaptation. This working paper became the basis for a workshop with local experts and stakeholders to test the viability of potential instruments in light of Aotearoa New Zealand's unique cultural, biophysical and regulatory context. The workshop included participants from finance services, insurance, institutional investment, academia and local and central government observers. These insights were reincorporated into this final concept paper. Mōhio would like to thank the workshop participants for their time and expertise.

Image credit: Josh Withers via Unsplash.

Table of Contents

List of abbreviations

BNZ	Bank of New Zealand
CIX	Climate Impact X
CRP	Climate Resilience Principles
EECA	Energy Efficiency & Conservation Authority
EbA	Ecosystem-based Adaptation
EBRD	European Bank for Reconstruction and Development
EIB	Environmental Impact Bond
EQC	Earthquake Commission / Toka Tū Ake
ETS	Emissions Trading Scheme
GBP	Green Bond Principles
GIDI	Government Investment in Decarbonising Industry
GSS	Green, Social, Sustainability bonds
ICMA	International Capital Market Association
IFC	International Finance Corporation
ILS	Insurance-Linked Securities
IPCC	Intergovernmental Panel on Climate Change
IPRP	Insurance Premium Reduction Programme
KPIs	Key Performance Indicators
LENs	Landscape Enterprise Networks
MRV	Monitoring, Reporting and Verification
NAP	National Adaptation Plan
NCCRA	National Climate Change Risk Assessment for Aotearoa New Zealand
PFP	Pay-for-Performance
PICAP	Pacific Insurance and Climate Adaptation Programme
SBG	Sustainability Bond Guidelines
SBP	Social Bond Principles
SIBs	Social Impact Bonds
SLBs	Sustainability-Linked Bonds
SLLs	Sustainability-Linked Loans
SPTs	Sustainability Performance Targets
SPV	Special Purpose Vehicle
TNC	The Nature Conservancy
TCFD	Taskforce for Climate-related Financial Disclosures
TNFD	Taskforce for Nature-related Financial Disclosures
WFP	World Food Programme
NZU	New Zealand Unit

Executive summary

Adaptation finance refers to financial flows which improve the adaptive capacity of human and natural systems to adjust to actual or expected climate-related impacts, and thereby improve a society's alignment to climate resilient development.

Aotearoa New Zealand has a large, unquantified adaptation gap where the need for investment in adaptation greatly exceeds the volume of actual adaptation finance. Closing that gap is critical to climate resilient development. This will require not only increasing the volume of existing financial flows, but also diversifying the sources of funding and financing.

This report explores the potential of financial innovation to overcome barriers to investment and lending for climate adaptation. The primary focus is the instrument level to encourage diversification of the sources of finance, to enhance cross-sectoral coordination, and to overcome the barriers that otherwise impede investment. However, this report has a secondary focus on the system level, especially to improve the enabling environment for the development of an investment-ready pipeline of adaptation projects.

To diversify the sources of adaptation finance, it is critical to activate a combination of allocative principles. Key principles for allocating duties to pay for adaptation are:

- **The polluter-pays principle** holds that those who contribute to global heating and/or maladaptation should bear the costs of managing it.
- **The beneficiary-pays principle** holds that the cost of producing goods should be borne by those who benefit from those goods.
- **The public-pays principle** holds that the costs of adaptation should fall generally on taxpayers or ratepayers.
- **The ability-to-pay principle** holds that duties vary with ability, so more abled (i.e. wealthier) agents have greater duties to bear the cost of climate adaptation than less abled agents.

This report's methodology involves a scan of international best-practice and academic literature to identify viable financial instruments, which are subsequently adapted to local circumstances by engaging with Māori experts and key stakeholders in central and local government, finance sector, business and civil society. Options were screened against the following criteria:

- **The instrument must diversify the sources of funding and finance beyond central and local government.** This is to align with overlapping allocative principles and to reduce the total burden on public funds.
- **The instrument must do no harm to Māori and should instead be optimised for the active protection of Māori interests.** This is to recognise the risk that climate finance instruments may exacerbate existing inequalities if poorly designed.
- **The instrument should be technically feasible, but not constrained by economic or political feasibility.** This is to strike a balance between encouraging innovation and avoiding moral hazard.

There are a diverse range of potential instruments for adaptation finance, each of which has unique strengths and challenges. Each also varies in its implications for who ought to pay, and its applicability in the current context. These are summarised in the table overleaf.

Instrument	Description	Applicability
2.1. Insurance premium reduction programme	Insurance premium reduction programmes involve a discount on insurance premiums which reflect actions undertaken to reduce the risks that are being insured.	Highly applicable for specific hazards where granular risk reduction is possible (e.g. floods and storms, not coastal inundation or wildfire).
2.2. Parametric insurance	Parametric insurance involves an agreement to make a payment upon the occurrence of a triggering event, as distinct from traditional insurance which indemnifies actual loss incurred.	Applicable as a complement to private indemnity insurance. Also applicable to public insurance as a transparent, less ad hoc, means of disaster relief.
2.3. Microinsurance	Microinsurance is characterised by low premiums and low caps (or coverage limits), typically with the purpose of extending risk transfer opportunities to low-income groups and microenterprises.	Applicable for certain sectors, such as agriculture and horticulture, or groups facing financial exclusion. Strong potential as public scheme to enhance social resilience.
2.4. Insurance-linked securities	Insurance-linked securities (e.g. catastrophe bonds and resilience bonds) are reinsurance instruments which enable insurers to transfer risk to private capital markets in return for interest payments, thereby protecting insurers against losses from impacts of natural disasters.	Limited applicability. Likely only Toka Tū Ake (EQC) has sufficient scale of assets to warrant issuance.
2.5. Pay-for-performance contracts	Pay-for-performance contracts involve an agreement from an outcome funder (e.g. a government, iwi or large corporation) to pay an agreed-upon return if impact performance targets are met, which enables the raising of capital to undertake activities that produce the outcomes (i.e. environmental impact bonds).	Applicable to improve effectiveness of funding and finance for resilience and reduce project risk for funders. Will require step-change in public finance innovation from outputs to outcomes.
3.1. Green, social and sustainability bonds	Green, social, and sustainability bonds are use of proceeds bonds which aim to fund projects with dedicated environmental and/or social benefits.	Highly applicable insofar as issuers have willingness and capability to take on debt. Value capture mechanisms may improve applicability.
3.2. Sustainability-linked debt	Sustainability linked debt (e.g. bonds and loans) involves interest rates tied to the achievement of sustainability performance targets.	Highly applicable, with growing issuance already for climate mitigation. Adaptation-related issuance may increase with improved data and clarity on metrics and indicators.
3.3. Resilience credits	Resilience credits are a carbon-plus-resilience credit where a carbon credit in voluntary or compliance markets is earmarked with additional, verified adaptation impact.	Limited applicability due to exclusion of many nature-based sinks from ETS eligibility. Best suited to voluntary carbon markets.
3.4. Adaptation markets	Adaptation markets (voluntary or compliance) enable the exchange of climate-related risk reductions, where the owners of resilience-enhancing projects can sell that value on to purchasers, thus matching supply and demand for resilience.	Highly applicable for voluntary adaptation markets, especially as climate risk becomes increasingly material. Compliance adaptation markets are a significant regulatory undertaking.
3.5. Adaptation equity	Adaptation equity involves taking ownership stakes in companies that produce adaptation and resilience benefits as part of their business strategy, alongside financial returns.	Highly applicable, especially with a culture change in equity financing and shared ownership.
3.6. Blended finance	Blended finance uses public or philanthropic money to improve the risk-return profile or commercial viability for a private investor, allowing it to invest in places and projects where it would not otherwise go.	Highly applicable, but important that public funding drives additionality by catalysing, not only derisking, private capital.
3.7. Systemic investment fund	A systemic investing fund is a pooled vehicle which combines public, private and philanthropic finance, as well as non-financial interventions, to implement system-level change through a portfolio approach.	Applicable as a niche option, given complexity and novelty, but well-suited to community-oriented interventions where social co-benefits are significant.

The public sector has a critical role in creating the right enabling environment for private finance to better align with adaptation and resilience goals. This can be achieved through a policy mix that shapes and steers financial markets toward enhancing climate adaptation and resilience. The elements of a coherent and effective policy mix are *objectives and targets* backed by credible plans and strategies; *policy processes* that improve information flows, standards and best practices, and intermediation; and a *policy instrument mix* which includes economic, regulatory and information-based instruments whose impacts are mutually reinforcing.

Critical shifts in the enabling environment to encourage adaptation finance include:

- **The development of an investment-ready pipeline of adaptation projects** which facilitates the coordination of public/private investment strategies by aligning with relevant allocative principles.
- **The creation of standards, metrics, and indicators to assess adaptation alignment**, ideally to underpin the creation of economic instruments that incentivise and enable risk reduction activities.
- **Improving knowledge and research** to enable financial innovation, especially by prioritising data access and targeted research on instrument-specific informational needs.
- **The use of sustainability intermediaries** who work between relevant stakeholders to reduce the transaction costs of instrument development and overcome barriers to investment.
- **Improve financial inclusion and literacy**, so that voluntary opportunities for risk transfer and risk reduction are intelligible to marginalised groups who stand to benefit most, because they are disproportionately exposed to climate impacts.

Going forward, this report can contribute to the development of a portfolio approach where government, insurers and financial sector actors get clarity on what they can, and should, finance. This report confirms that there are multiple options available, some already feasible, others feasible with further innovation or changes to the enabling environment. However, because these instruments often involve public-private coordination, or specific research and innovation needs, a major obstacle to progress is the *first-mover dilemma* where relevant parties – government, market, researchers – each wait for another to move, or at least to signal a commitment to move. This can be overcome by building infrastructure pipelines and/or plans for managed retreat, then overlaying these project-level proposals with allocative duties and appropriate instruments that clarify who should pay and how. This type of portfolio-level systemic investing is discussed in §3.7, but a comprehensive analysis by relevant agencies which builds upon actual infrastructure needs would help relevant actors to take steps toward a more resilient future.

1. Introduction

1.1. The adaptation challenges

The world around us is changing. The mean global temperature is already more than 1.1°C above pre-industrial levels. The recent Intergovernmental Panel on Climate Change (IPCC) report on adaptation notes 'observed increases in the frequency and intensity of climate and weather extremes, including hot extremes on land and in the ocean, heavy precipitation events, drought and fire weather'. This has resulted in significant impacts to people, settlements, and infrastructure; as well as 'substantial damages, and increasingly irreversible losses, in terrestrial, freshwater and coastal and open ocean marine ecosystems'.[1]

Climate scientists estimate that, on current trends, the remaining carbon budget for 1.5°C will be exceeded 'sometime during the period of 2027 to 2033 in the absence of marked decreases in emissions'.[2] Currently implemented policies have the world on track for 2.9–3.2°C of global heating by 2100. Climate action can reduce the likelihood of such scenarios. The collective pledges submitted to the Paris Agreement are consistent with 2.4–2.9 °C of global heating. Additionally, if national net-zero emission targets are fully implemented, global heating might be held to 2.0–2.4°C.[3]

However, even under these more optimistic scenarios, the impacts on earth systems will be profound. For example, direct flood damages are projected to be 1.4 to 2 times higher at 2°C than 1.5°C. Similarly, very high extinction risk for endemic species in biodiversity hotspots is projected to at least double if global heating rises from 1.5°C to 2°C, or at least tenfold at 3°C.[4] Also, as the mean global temperature increases, so too does the likelihood that climatic impacts will become self-perpetuating through the triggering of tipping points. Even within the Paris Agreement range of 1.5 to <2°C warming, such tipping points include collapse of the Greenland and West Antarctic ice sheets, die-off of low-latitude coral reefs, and widespread abrupt permafrost thaw.[5]

Therefore, it is critical to begin preparing for the impacts that can no longer be avoided. Aotearoa New Zealand is expected to see further warming and sea-level rise, more hot days and heatwaves, less snow, more rainfall in the south, less rainfall in the north, and more extreme fire weather in the east.[6] These climatic changes will result in various impacts which include coastal inundation, more severe droughts and disruptions to water supply, more frequent and intense flood events, more severe wildfires in some areas, accelerated loss of biodiversity, novel biosecurity threats, and changing human disease vectors. This, in turn, will have major socio-economic impacts through lost economic productivity, losses and damages to public and private infrastructure, and increased demand for public health and social services to manage human impacts. To indicate just some of the costs:

[1] IPCC (2022). Summary for Policymakers. *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf
[2] ETH Zurich (2021). Scientists call for more ambition in climate negotiations. https://ethz.ch/en/news-and-events/eth-news/news/2021/11/scientists-call-for-more-ambition-in-climate-negotiations.html
[3] Höhne, N., Gidden, M.J., den Elzen, M. et al. (2021). Wave of net zero emission targets opens window to meeting the Paris Agreement. *Nature Climate Change* 11, pp.820–822. https://doi.org/10.1038/s41558-021-01142-2
[4] IPCC (2022). Summary for Policymakers. *Climate Change 2022: Impacts, Adaptation and Vulnerability*.
[5] McKay, D., Staal, A., Abrams, J. et al. (2022). Exceeding 1.5°C global warming could trigger multiple climate tipping points, *Science* 377(6611). https://doi.org/10.1126/science.abn7950
[6] Lawrence, J., Mackey, B., Chiew, F., et al. (2022). Australasia. *Climate Change: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FinalDraft_Chapter11.pdf

- Sea level rise of three meters in Aotearoa New Zealand is expected to affect over 280,000 people, over 166,000 buildings with a replacement cost of NZ$52 billion, and nearly 3,000 km of roads and 154 km of railway.[7]
- Weather-related hazards between 2000–2017 cost Toka Tū Ake (formerly EQC) NZ$450 million, 40% of which were due to extreme rainfall.[8]
- Insured losses for the 12 costliest floods from 2007-2017 exceeded NZ$470 million, of which NZ$140 million could be attributed to anthropogenic climate change.[9]
- The costs of weather events to the land transport network have increased in the last 10 years from about NZ$20 million per annum to over NZ$90 million per annum.[10]
- The direct cost of wildfire in 2020 was NZ$142 million, with indirect costs estimated at 2-3 times greater, and social impacts and losses of ecosystem services up to 30-60 times greater. By 2050, direct costs could increase by 400% (NZ$547 million per annum) due to increased global heating.[11]

Climate change also has particular implications for Māori. The 2021 *He Uringa Āhuarangi, He Huringa Ao* report identifies four domains of interest to Māori: He Kura Taiao – Living Treasures, Whakatipu Rawa – Māori Enterprise, He Oranga Tāngata – Healthy People, Ahurea Māori, Tikanga Māori – Māori Culture and Practices (see Figure 1).[12]

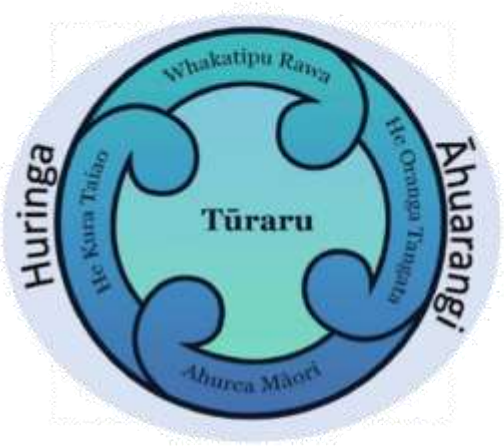


Figure 1: Four domains of interest to Māori (Awatere et al. 2021).

In terms of financial impacts, the most relevant domain is Whakatipu Rawa. Māori enterprise is significantly weighted toward the management of natural resources through agriculture, horticulture, farming, fishing, and forestry.[13] These primary sector industries are all directly exposed to climatic effects. For instance, the increase of drought and fire risk on the east coast is also where most Māori-owned forestry is located, about 40% of Aotearoa's total commercial forest, which means that Māori assets are disproportionately exposed to climate-related risks.[14] This has implications for future revenue for the Māori economy, as well as fixed capital assets of forests and farms.

---

[7] Bell, R., Paulik, R. & Wadhwa, S. (2015). *Coastal Hazard and Climate-Change Risk Exposure in New Zealand: Comparing Regions and Urban Areas.*

[8] Pastor-Paz, J., Noya, I., Sin, I., et al. (2020). Projecting the effect of climate change on residential property damages caused by extreme weather events. *Journal of Environmental Management*, p.276. https://doi.org/10.1016/j.jenvman.2020.111012

[9] Frame, D.J., Rosier, S.M., Noy, I. et al. (2020). Climate change attribution and the economic costs of extreme weather events: a study on damages from extreme rainfall and drought. *Climatic Change* 162, pp.781–797. https://doi.org/10.1007/s10584-020-02729-y

[10] Gardiner, L., Firestone, D., Waibl, G., et al. (2008). Climate change effects on the land transport network volume one: literature review and gap analysis. NZ Transport Agency Research Report 378. https://www.nzta.govt.nz/assets/resources/research/reports/378/docs/378-v1.pdf

[11] Scion (2022). *Are We Ready for Extreme Wildfire?* Rural Forest Research, Scion. https://www.ruralfireresearch.co.nz/__data/assets/pdf_file/0011/83747/ExtremeWildfireInfosheet.pdf

[12] Awatere, S., Reid, J., Masters-Awatere, B. et al. (2021). *He huringa ā huarangi, he huringa ao: A changing climate, a changing world.* Prepared by Manaaki Whenua – Landcare Research for Ngā Pae o te Māramatanga. https://www.landcareresearch.co.nz/assets/researchpubs/He-huringa-ahuarangi-he-huringa-ao-a-changing-climate-a-changing-world.pdf

[13] Reserve Bank of NZ (2021). *Te Ōhanga Māori 2018*. Wellington: Reserve Bank of NZ and BERL, p.82.

[14] King, D. N., Penny, G., & Severne, C. (2010). The climate change matrix facing Māori society. In Nottage R.A.C., Wratt D.S., Bornman J.F., Jones K. (eds.) *Climate change adaptation in New Zealand: Future scenarios and some sectoral perspectives.* Wellington: New Zealand Climate Change Centre, pp.100–111.

Native biodiversity and taonga species will face greater stress from climate change, which is likely to precipitate further extinctions and changes to local ecosystems (He Kura Taiao). Cultural infrastructure, such as marae and urupa, as well as cultural traditions, such as tangihanga and kapa haka, will be impacted by climate-related disruptions (Ahurea Māori, Tikanga Māori). Finally, global heating will increase the incidence of adverse health impacts (He Oranga Tāngata), which will be borne disproportionately by Māori (and other groups) who already experience inequitable health outcomes.[15] As such, the inequities caused by colonisation are at risk of being amplified and intensified by the stresses of climate change. To improve climate resilience at the societal level, it is vital that the specific needs of Māori are addressed; otherwise, the intensification of inequality may undermine the social cohesion that underpins society-level resilience.[16]

Turning now to the subject of this report, these myriad impacts on the environment, society and the real economy – for Māori and non-Māori – have implications for the financial system.

The National Climate Change Risk Assessment for Aotearoa New Zealand (NCCRA) highlights that 'New Zealand's financial system is highly exposed to climate change through local changes and international markets'.[17] Financial instability could result from a single shock or a series of events (such as cyclones, fires, or floods), which trigger a revaluation of assets in Aotearoa New Zealand or indirectly via international markets. Additionally, the pricing of ongoing, gradual changes (such as sea-level rise) might precipitate sudden reappraisals, such as insurance retreat from coastal assets, new debt limits, or interest rate hikes.

Consequently, '[c]limate change presents a systemic risk to the financial system'.[18] The growing appreciation of this fact is prompting the incorporation of climate-related considerations into financial regulation and risk management. The Reserve Bank of New Zealand | Te Pūtea Matua recognises that '[u]nderstanding climate change and climate risks is of critical importance to financial stability' and therefore its own mandate to promote and maintain a sound and efficient financial system.[19] More broadly, the New Zealand Government has introduced mandatory disclosure requirements for climate-related risks to improve risk management among firms.

Beyond ensuring its own resilience and stability, however, the financial system also plays a critical role in enabling adaptation by providing access to capital and debt to undertake risk reductions, as well as opportunities for risk transfer to reduce exposure to climate impacts. This role of financing the transition, specifically toward climate resilient development, is the focus of the next section.

[15] Jones, R., Bennett, H., Keating, G., & Blaiklock, A. (2014). Climate change and the right to health for Māori in Aotearoa/New Zealand. *Health and Human Rights Journal* 16(1), pp.54–68.
[16] Spoonley, P., Gluckman, P., Bardsley, A., et al. (2020). *He Oranga Hou: Social cohesion in a post-covid world.* https://informedfutures.org/wp-content/uploads/Social-Cohesion-in-a-Post-Covid-World.pdf
[17] Ministry for the Environment. (2020). *National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa: Pūrongo whakatōpū.* https://environment.govt.nz/assets/Publications/Files/national-climate-change-risk-assessment-main-report.pdf
[18] Ibid.
[19] Reserve Bank of New Zealand. (2021). *Climate Changes and Beyond.* https://www.rbnz.govt.nz/-/media/1d802cc9ff70476ba52c4eb5caef69a7.ashx

1.2. Financing adaptation

1.2.1 Bridging the adaptation gap

Much can be done to reduce the manage the risks associated with climate change. However, much of what needs to be done needs to be paid for.

Adaptation is defined as 'the process of adjustment [in human systems] to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities.' As such, it is 'a process of iterative risk management' which can be distinguished into various types including 'anticipatory versus reactive, autonomous versus planned and incremental versus transformational adaptation.' In terms of actions, adaptation encompasses a wide range of responses from 'hard engineering interventions to nature-based solutions, social policy and social safety nets to disaster management and capacity building, raising or relocation of settlements and combinations of such measures sequenced over time.'[20]

The funding and financing needs of these actions varies considerably. Large-scale infrastructure will require significant capital investment, potentially through complex public-private partnerships. At the other end of the spectrum, local communities, Indigenous peoples and civil society may establish social safety nets through voluntary labour, in-kind support and/or crowdfunding. Each funding and financing arrangement will have its advantages, disadvantages and limitations. But what is clear is that, to enable climate resilient development, a significant increase in the quantity and quality of funding and financing is required across this investment spectrum.

Globally, the scale of adaptation finance is insufficient to meet the scale of demand. UNEP's *Adaptation Gap Report 2021* estimates that, for developing countries only, the costs of adaptation are likely at the higher end of US$140-300 billion per year by 2030 and US$280-500 billion per year by 2050.[21] Yet, in 2019, climate finance flowing to developing countries for mitigation and adaptation only reached US$79.6 billion.[22] Positively, adaptation finance is increasing over time: Climate Policy Initiative has estimated a 53% increase in the financial years from 2017/2018 to 2019/2020, when the annual average rose from US$30 billion to US$46 billion. However, adaptation still accounts for just 7% of global climate finance based on available data, with the majority allocated toward climate mitigation.[23]

There is no analysis of the adaptation finance gap in Aotearoa New Zealand; however, it is generally understood that there is a significant, if unquantified, deficit. The NCCRA notes that '[t]here are currently no dedicated funds for adaptation to reduce exposure to climate change-related risks', only funding for recovery from hazard events such as the Natural Disaster Fund and Adverse Events Fund for the primary sector.[24] The NCCRA also identifies funding shortages for the purposes of compensation, research, new infrastructure, upgrades for existing infrastructure, building capacity, participation and engagement, mātauranga Māori, and the protection of the taonga and the natural environment. In response, the National Adaptation Plan has signalled its intention to address these funding gaps, particularly under the system-wide objective (SW4) of unlocking investment in climate resilience.[25]

---

[20] Pörtner, H.-O., et al. (2022): Technical Summary. *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg2/

[21] United Nations Environment Programme (2016). *The Adaptation Finance Gap Report*. https://unepdtu.org/publications/the-adaptation-finance-gap-report/

[22] United Nations Environment Programme (2021). *Adaptation Gap Report 2021: The gathering storm – Adapting to climate change in a post-pandemic world*. https://www.unep.org/resources/adaptation-gap-report-2021

[23] Climate Policy Initiative (2021). *Global Landscape of Climate Finance 2021*. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2021/

[24] Ministry for the Environment. (2020). *National Climate Change Risk Assessment for Aotearoa New Zealand*, p.95.

[25] Ministry for the Environment (2022). *Aotearoa New Zealand's first national adaptation plan*. https://environment.govt.nz/publications/aotearoa-new-zealands-first-national-adaptation-plan/

However, to increase financial flows toward adaptation, various barriers must be overcome. Central among these is the budgetary constraints – real or self-imposed – of the public sector.

Local government is at the forefront of adaptation, given its legislated responsibilities for natural hazard management, as well as the localised nature of adaptation infrastructure. Yet as the NCCRA states: 'Already local governments are struggling to finance infrastructure for housing, tourism and regional development, provide safe drinking water, and develop resilient infrastructure... For some councils, further investment is constrained because they are approaching covenanted debt limits.'

Central government is in some senses less constrained. The NCCRA notes that: 'Central government finances are relatively strong, but fiscal pressures are projected to increase as an ageing population slows revenue growth and increases expenses'.[26] Public expenditure is also highly politicised – and likely will remain so in coming years if future governments commit to reducing the debt-to-GDP ratio in the wake of the Covid-19 pandemic. Finally, there are problems of moral hazard for a broad-based, publicly-funded adaptation response, which may incentivise risky behaviours (e.g. construction in low-lying or flood prone areas), or disincentive private investment into risk transfer, self-insurance and risk reduction activities (see §1.4.3 for further discussion).

To compound these constraining factors, the NCCRA observes that the financial capacity of governments to fund adaptation could decrease as climate change intensifies, because governments will face 'economic costs associated with lost productivity, disaster relief expenditure and unfunded contingent liabilities due to extreme events and ongoing, gradual changes.'[27] This highlights the importance of pre-emptive action, because the fiscal headroom of governments may recede at the same moment that adaptation is needed most.

1.2.2 Diversifying finance

To address the adaptation gap, there is a strong case for diversifying the sources of adaptation funding and financing, in particular by mobilising capital and debt markets. Global fixed-income markets are US$127 trillion and rising.[28] If governments can 'crowd in' private capital and debt to contribute to long-term value creation through climate adaptation, then private financing can do some of the heavy lifting, while public funding can play a more strategic role in catalysing investment, addressing distributional issues, and protecting disadvantaged groups.

To be clear, this leveraging of private finance is not for the purposes of 'privatising' adaptation. Rather, it is to complement public funding and therefore to increase the volume and resilience of total financial flows to adaptation. Crucially, it is also to recognise that the duties and interests to invest in adaptation are not held solely by government, but shared among a range of actors which include business and civil society. Non-state actors may have duties to pay for adaptation because they are (partially) responsible for the causes of climate change and maladaptation (see §1.4 for further discussion). Non-state actors may also have interests in adaptation because it reduces material risks to privately or communally owned assets. Furthermore, those interests may only be satisfied by supporting activities that sit beyond a non-state actor's usual sphere of influence. This reflects the fact that resilience is generally a property that belongs to systems, rather than only a system's components. To improve resilience, private actors therefore have an interest in improving adaptive capacity across the whole system – whether an ecosystem, a local economy, or a financial system. For example, many companies are coming to understand that, to future-proof their own assets

[26] Ibid., p.70.
[27] Ibid.
[28] Kolchin, K. & Podziemska, J. (2022). Research Quarterly: Fixed Income – Outstanding. SIFMA Research. https://www.sifma.org/resources/research/research-quarterly-fixed-income-outstanding/

and activities, it is necessary to take a system-level approach and drive change across the entire value chain.[29] Consequently, the private sector is increasingly motivated to engage in adaptation finance, in response to various market and strategic drivers (see Table 1 below).

Table 2: Market and strategic drivers for adaptation finance (from Mortimer et al. 2020).

Market drivers	• Insurance premiums (reducing or increasing due to changing climate risk exposure). • Assets becoming insurable/uninsurable due to changing climate risk exposure (adding or removing assets from the insurance market). • Risk to underlying mortgage-value of assets. • Ratings agencies and reinsurance increasingly requiring investors and other financial actors to demonstrate climate resilience. • Exposure to climate risk may lead to a risk to credit ratings, i.e., threat to Treasury AAA rating. • Pension and superannuation funds increasingly seek investments with long-term time horizons consistent with those of adaptation projects. • There are examples of natural disasters undermining local government ability to repay loans, i.e., rate-paying base moving elsewhere. • Demands for sustainable investment portfolios from shareholders and superannuation funds.
Strategic drivers	• Knowledge of the importance of climate risk is increasing across both the public and private sector. • Modelling of financial impact of some climate-related risks is becoming more robust. • For institutional investors, adaptation represents a diversification of their portfolio. • Investors seeking a first leader advantage are willing to move quickly to invest in projects. • The impacts of social disruption and exacerbated disadvantage of the most vulnerable, due to physical impacts of climate risk, are already occurring, and there are clear financial impacts. • There is a spectrum of political risk of a 'business-as-usual' approach, whilst community and citizen sentiment for action on climate change grows. • Sovereign risks, as the number of climate refugees increases. • Litigation risks, e.g., governments and private sector being brought to account for failing their duty of care, or not disclosing. • Environmental values at risk of being irreversibly lost, e.g., coastal squeeze of coastal ecosystems.

However, private finance for adaptation faces barriers and constraints.

The fundamental challenge for adaptation finance is to improve adaptive capacity while also meeting the risk and return requirements of creditors and investors. In other words, adaptation finance faces a 'dual requirement to address both vulnerability and profitability [that] complicates the design of financial instruments.'[30] This implies a trade-off where private finance must either limit its exposure to adaptation objectives, or accept lower than usual rates of financial return: 'The design of market-based instruments to finance resilience may require subordinating the goal of efficiency (or profitability) to the fostering of other characteristics of redundancy, diversity, and the accumulation of capital in nonmonetary forms'.[31]

[29] Amado, J-C., & Adams, P. (2012). Value Chain Climate Resilience. A guide to managing climate impacts in companies and communities. Partnership for Resilience and Environmental Preparedness (PREP). https://www.oxfamamerica.org/explore/research-publications/prep-value-chain-climate-resilience/

[30] Bose, S. (2021). Adaptation Finance: A Review of Financial Instruments to Facilitate Climate Resilience. In R. Brears (ed.), *The Palgrave Handbook of Climate Resilient Societies*. https://doi.org/10.1007/978-3-030-32811-5_15-1

[31] Ibid.

The public good characteristics of adaptation are central to this challenge. Many, if not most, adaptation projects have diffuse benefits. In theory, adaptation occurs along a continuum ranging from a pure private good (e.g. protecting a clearly delimited real estate property against flooding), to a club good (e.g. improving flood regulation in a hydrological catchment through ecosystem-based adaptation), to a global public good (e.g. innovation in plant genetics for drought-resistant cultivars). In reality, however, even private actions tend to have spillover effects, either negative (e.g. a seawall which accelerates coastal erosion for neighbouring properties) or positive (e.g. riparian buffer zones on one farm which reduces flooding in downstream farms). Accordingly, the value of adaptation is often non-rival and non-excludable, which is characteristic of public goods.[32]

Consequently, it is challenging to capture and commercialise the total value of adaptation actions, especially in terms of cashflows which enable repayment, interest payments, or residual benefit. Additionally, the primary value of adaptation, especially pre-emptive risk reductions through preparedness and prevention, is the avoided costs of loss and damages, often over long timeframes. This value is significant: for local government, it is estimated that every dollar spent on risk reduction saves at least three dollars in future disaster costs.[33] However, avoided costs are not easy to directly monetise. Instead, adaptation projects may need to pursue indirect revenue sources; for example, the monetisation of co-benefits such as a constructed wetland that attracts fees for recreational use, or a seawall that integrates paid parking. The challenge of commercialisability is further complicated by the current structure of the economy, which still gives priority to 'shareholders and short-term shareholder returns to the detriment of other stakeholders, including the environment and society'.[34]

Another key issue is 'the absence of a metric of adaptation performance beyond monetary investment'.[35] This makes it difficult to use standard cost-benefit calculations on where to invest most efficiently. It also makes climate adaptation quite different to climate mitigation, where methodologies and frameworks are well-established. So, while the Paris Agreement contains commitments to limit heating to 2°C or 1.5°C above pre-industrial levels, there is no comparable quantifiable goal for climate adaptation. Similarly, while there is consistent monitoring, reporting and verification (MRV) protocol for greenhouse gas accounting, there is no standard, methodology or metric for assessing climate risk. There are, moreover, inherent complications to the quantification of adaptation value, due to the context and site-specific nature of adaptation, the heavy dependence on assumptions and scenarios in future projections of climate impacts, and the highly complex nature of resilience as a product of multiple factors across interconnecting physical and human systems.

In light of these difficulties, the OECD has recently proposed an approach to developing assessment frameworks for adaptation alignment – that is, finance that aligns with Article 2.1 of the Paris Agreement by making financial flows consistent with a pathway towards climate-resilient development.[36] The immediate focus of assessing alignment, drawing on the success of the Taskforce for Climate-related Financial Disclosures (TCFD) process, is a set of simple process-based metrics on governance, risk management, strategy, and metrics and targets. Over the longer run, a set of outcome-based metrics could be developed to monitor, report and verify adaptation alignment – with an initial focus on adaptation-relevant sectors of

[32] Bisaro, A., & Hinkel, J. (2018). Mobilizing private finance for coastal adaptation: A literature review. *Wiley Interdisciplinary Reviews: Climate Change*, 9(3), e514.
[33] Deloitte Access Economics. (2013). *Building Australia's resilience to natural disasters*. https://www2.deloitte.com/rs/en/pages/about-deloitte/articles/access-economics-report-australia-resilience.html
[34] Sustainable Finance Forum (2020). *Roadmap for Action: Final Report*. The Aotearoa Circle. https://static1.squarespace.com/static/60c02ff322ae60116ad716c7/t/61009e4e8b6e030fac13e49c/1627430516907/20207-000234_Sustainable%2BFinance%2BForum%2BFinal.pdf
[35] Bose, S. (2021). Adaptation Finance.
[36] Mullan, M. & Ranger, N. (2022). *Climate-resilient finance and investment: Framing paper*. Environment working paper no. 196. OECD. https://www.oecd-ilibrary.org/environment/climate-resilient-finance-and-investment_223ad3b9-en;jsessionid=xdOd91TRnA7NUdv90BdpvwDV9PR_8P9qhfl-lh7n.ip-10-240-5-122

infrastructure, agriculture and natural capital. In the meantime, assessments of adaptation alignment might draw on market-driven principles, such as the Climate Bond Initiative's Climate Resilience Principles [37] or the Institutional Investors Group on Climate Change (IIGCC)'s investor expectations of companies.[38] The approach is sensible, but does not resolve the indeterminacy in the short- to mid-term.

Adaptation finance faces various other barriers, including the challenge of achieving commercialisable scale, legal barriers to mechanisms like value capture, and incoordination among stakeholders. Table 2 below highlights the key barriers by combining Australian analysis by the Investor Group on Climate Change (IGCC)[39] with local insights from the stakeholder workshop.

Table 2: Barriers to adaptation finance and solutions.

Barriers to finance	Potential solutions
A lack of revenue streams and commercial investment returns for adaptation improvements.	• Creation of new revenue streams for adaptation, such as value capture and payments for resilience-enhancing activities. • Use of blended finance to adjust risk-return factors by combining public, private and philanthropic funds.
A lack of agreed-upon impact assessment frameworks for adaptation.	• Identification of metrics and indicators to enable monitoring, reporting and verification (MRV) of adaptation alignment through research, stakeholder engagement and integration of mātauranga Māori.
Uncertainty about the materiality and value of future risk reductions.	• Continue support for climate risk reporting and disclosure. • Targeted hazard-specific research on risks, risk reductions, and cost-benefit ratios.
High transaction costs for development of contracts or instruments.	• Aggregation of supply and/or demand for adaptation projects to increase scale of issuance. • Mission-oriented research funding which is oriented toward specific adaptation challenges or hazards. • Use of intermediaries to bring parties together to achieve common outcome.
A lack of clearly defined project scopes where adaptation gains are explicit.	• Creation of an investment-ready infrastructure pipeline for adaptation which covers grey and green infrastructure.
Lack of clarity and capability among project proponents and/or counterparties.	• Allocation principles are used to overlay the adaptation infrastructure pipeline to identify relevant duties to pay. • Use of intermediaries to lead contracting and product development. • Building education and capability in sustainable finance.

Further insights emerge from Climate-KIC Australia's Adaptation Finance Project (2018–2020). Climate-KIC Australia led a market scan for investment-ready adaptation projects in Australia and found that no such projects existed.[40] The lesson drawn from this exercise was that adaptation projects were unlikely to emerge spontaneously from the current context, because the highly complex nature of adaptation is ill-matched to the linear, single-asset approach that characterises most investors and infrastructure providers. Consequently, Climate-KIC Australia recommends a paradigm shift from a single-asset approach to 'a systems

[37] Climate Bonds Initiative (2019). *Climate Resilience Principles A framework for assessing climate resilience investments.* https://www.climatebonds.net/files/page/files/climate-resilience-principles-climate-bonds-initiative-20190917-.pdf

[38] Institutional Investors Group on Climate Change (2021). *Building Resilience to a Changing Climate: Investor Expectations of Companies on Physical Climate Risks and Opportunities.* https://www.iigcc.org/download/building-resilience-to-a-changing-climate-investor-expectations-of-companies-on-physical-climate-risks-and-opportunities/?wpdmdl=4902&refresh=62f0aa5a2bd5c1659939418

[39] Investor Group on Climate Change (2017). *From risk to return: Investing in climate change adaptation.* https://igcc.org.au/wp-content/uploads/2020/06/Adaptation_FINAL_compressed.pdf

[40] Mortimer, G., Whelan, B & Lee, C. (2020). *Adaptation Finance: Emerging approaches to solve the climate adaptation finance gap.* Climate-KIC Australia. p.16. https://climate-kic.org.au/wp-content/uploads/2020/11/Adaptation-Finance_300ppi.pdf

view [which] assesses a portfolio of connected interventions or innovations, and poses the question: *how do these enhance the value of each other?*'[41]

This report builds on these system-level insights to explore the role of financial innovation at the instrument level to overcome barriers to investment and lending for adaptation. Innovative financial instruments can help to diversify the sources of finance, to enhance cross-sectoral coordination, and to overcome the barriers that otherwise impede investment. Crucially, by envisioning new forms of investment into adaptation and resilience, even forms of investment that are uneconomic in the current context, it is possible to 'backcast' to articulate what needs to be true for such an investment to occur. In other words, an analysis of what financial instruments are possible can help to shed light on which aspects of the enabling environment are currently preventing their realisation. This thought dictates the structure of this report: Sections 2 and 3 provides an overview of possible instruments and enablers, while Section 4 provides a discussion of what the New Zealand Government might do to improve the enabling environment to promote innovation in adaptation finance.

1.3. Scope and purpose of this report

The focus of this report is adaptation finance – that is, financial flows which improve the adaptive capacity of human and natural systems to adjust to actual or expected climate-related impacts, and thereby improve a society's alignment to climate resilient development.

As critical as finance is, however, it is important to emphasise that this is not the only lever for improved climate resilience. A comprehensive adaptation strategy will involve coordination among a variety of actors – central and local government, Māori, the private sector, the research and science sector, communities and individuals – to pull a multitude of levers, which includes changing mindsets and attitudes, research and knowledge sharing, capability building, regulatory innovation, environmental legislation, cross-sectoral cooperation, technological development, compensation schemes, and shaping incentives through economic instruments such as taxation. Much of this territory is covered by the National Adaptation Plan (NAP), so this report does not offer a comprehensive view, even while it recognises that financial innovation must occur concurrently with change in many other domains.

The primary purpose of this report is options identification at the level of the financial instrument. In general, the report takes a wide view of potentially applicable instruments in order to stimulate innovation and new thinking. However, to give some prioritisation, its scope is narrowed by applying the following criteria:

- **The instrument must diversify the sources of funding and finance beyond central and local government.**
  - *Rationale*: Government faces multiple demands on public expenditure which cannot all be satisfied. Mobilising private capital helps to address the financing gap. Also, given the dispersed benefits of adaptation, there is a strong ethical and prudential case to diversify the sources of finance and funding in accordance with familiar allocative principles of polluter-pays, beneficiary-pays, ability-to-pay and public-pays (see §1.4 below).

- **The instrument must do no harm to Māori and should instead be optimised for the active protection of Māori interests.**
  - *Rationale*: It is well understood that Māori will be disproportionately exposed to climate impacts because of existing health inequities and economic disadvantages

[41] Ibid.

that stem from colonisation.[42] Consequently, financial instruments should be designed to avoid exacerbating inequities and to maximise co-benefits for Māori. A failure to align adaptation financing with Māori interests and aspirations is likely to result in maladaptation by undermining social cohesion and therefore community resilience.

- **The instrument should be technically feasible, but not constrained by economic or political feasibility.**
  - *Rationale*: In order to encourage innovation, a wide scope should be taken to potential financing options. Some of the instruments discussed in this working paper might be economically or politically infeasible, but the final assessment of feasibility ought to lie with democratically elected decision makers. However, a requirement of technical feasibility will reduce the moral hazard of creating false expectations for financing opportunities are unrealistic in the practical sense.

Two further clarifications are necessary. Firstly, this report is agnostic on the types of adaptation activity that might be financed. In particular, this report is agnostic on debates over grey versus green/natural infrastructure, or hard versus soft engineering. Grey infrastructure, or hard engineering, refers to the construction of fixed infrastructure using materials like concrete and steel, such as seawalls, levees, breakwaters, stop banks, tunnels, and so on. Green or natural infrastructure, or soft engineering, refers to the restoration or construction natural or semi-natural ecosystems to achieve adaptation outcomes. This might involve a broad suite of nature-based solutions including mangroves, reefs, dunes, estuaries, wetlands, peatlands, grasslands, forests and so on. This report acknowledges that both might play a role in short- and long-term responses to climate change, but these are technical questions which involve site-specific knowledge and other types of expertise, and therefore beyond the scope of this report.

Second, this report understands adaptation to refer to *ex ante* and *ex post* responses to climate-related risks. This is consistent with the IPCC AR6 WG3 definition of adaptation as 'the process of adjustment to *actual* or *expected* climate and its effects, in order to moderate harm or exploit beneficial opportunities.'[43] As such, adaptation finance refers to finance that enables activities across the spectrum of risk management from preparedness, to prevention, response and recovery. The instruments discussed in Sections 2 and 3 variously cover the breadth of these adaptation stages.

Finally, this report uses a decision tree framework from Satyajit Bose[44] to organise the adaptation financing instruments, as per Figure 2 on the following page.

[42] Awatere, S. et al. (2021). He huringa ā huarangi, he huringa ao.
[43] IPCC (2022). Summary for Policymakers. *Climate Change 2022: Impacts, Adaptation and Vulnerability*.
[44] Bose, S. (2021). Adaptation finance.

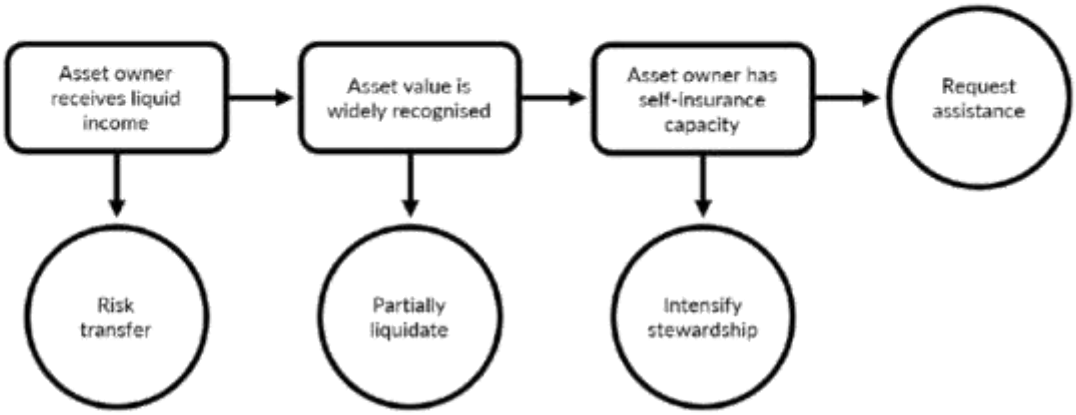


Figure 3: Adaptation decision tree (adapted from Bose, 2021).

This decision tree takes the perspective of an asset owner who is considering how to respond to a future climate risk. The owner could be an individual person, a household, a whānau or hapū, a small or medium-sized enterprise, a large corporation, a regional council, or a national government.

The first class of instruments relates to *risk transfer* (the focus of Section 2). If the owner has access to liquid income which can fund the payment of insurance premiums, then insurance cover is available to transfer risk of loss or damages onto insurers. However, for a variety of reasons, this can only partially fulfil a society's needs for risk management. Firstly, insurance markets are unlikely to be able to absorb the expansion of risks over coming decades.[45] [46]Secondly, in an unequal society, not everyone has sufficient liquid income for private insurance (although public insurance might supplement). Thirdly, some risks are uninsurable because the risk is too great or the payouts too costly. Therefore, a climate resilient society cannot rely on risk transfer alone.

The second class of instruments relate to *partial liquidation* (the focus of Section 3). If there are common expectations of future value from an asset, particularly when it is futureproofed for climate-related risks, then the owner may share the risk of ownership, and/or the value of future cashflows, by either selling shares in the asset or issuing debt. As already discussed, however, many adaptation assets lack clear revenue streams or commercialisable returns, which means that a climate resilient society cannot wholly rely on partial liquidation either, at least not without changes to the enabling environment such as payments for resilience.

The next two stages of the decision tree relate to funding mechanisms that are beyond the scope of this report, but critical to the wider context of adaptation. If the asset owner has the capacity for self-insurance, then the owners can *intensify stewardship* of the asset. This does not necessitate access to finance, because the costs of stewardship can be carried by the asset owner's balance sheet, or by voluntary actions. However, access to finance could enhance an asset owner's capacity to exercise stewardship (this potential is explored in §3.7).

Finally, the asset owner can *request assistance*. This is where the asset owner turns to a third party for financial or non-financial support, an option of last resort where no other risk

[45] Kunreuther, H. & Lyster, A. (2016). The role of public and private insurance in reducing losses from extreme weather events and disasters. *Asia Pacific Journal of Environmental Law* 19, pp.29–54.
[46] Storey, B., Noy, I., Townsend, W. et al. (2017). *Insurance, Housing and Climate Adaptation: Current Knowledge and Future Research*. Motu note 27. Motu Economic and Public Policy Research.

mitigation is possible. Government has special responsibilities to provide citizens with assistance in the event of natural disasters. However, it is worth noting that local communities and civil society play a critical role in pre- and post-disaster adaptation, and even some businesses participate in disaster response and recovery by donations of goods, services or even cash.

Two final general points on this framework. Firstly, it is important to note that the key actors – i.e. government, business and communities – can play a role at any point along this decision tree. As noted above, these actors can all contribute to providing assistance before or after a climate-related disaster. At the other end of decision tree, risk transfer can be provided by a private insurance company, a public insurer such as Toka Tū Ake (EQC), or even by the community (for example, Ngāti Whātua Ōrākei and Waikato-Tainui have both underwritten health insurance for their whānau). Similarly, public-private partnerships and blended finance enable diverse actors to invest in assets.

Secondly, arrangements made at one point along the decision tree can influence the asset owner's decisions at another point. For example, if a government makes expansive commitments to provide assistance, this can result in moral hazard by incentivising asset owners to reduce spending on risk transfer and risk reduction, therefore increasing the total costs on society when disaster strikes. On the flipside, if a society has high private insurance density, this might encourage actors such as government to reduce its preparations to provide assistance, which could have equity implications for the minority who cannot afford insurance premiums. In sum, resilience is produced dynamically through the interactions of decisions made at each step along the chain.

These considerations raise the issue of how responsibilities should be allocated, which is the focus of the next subsection.

1.4. Allocative principles for adaptation costs

A key question which sits behind *who* should pay is *why* they should pay. The justification for expecting or requiring payment is critical to the practicability and legitimacy of any payment scheme.

Within climate policy, there are a number of well-established principles which are used to allocate responsibilities to various parties. Each principle helps to identify a set of duty-bearers who hold the responsibility to bear costs – in this case for climate adaptation.[47] While normative debate often focuses on which single principle should be applied, it is likely that a combination of principles is the most effective approach, because each principle has different strengths and limitations which suit it to different applications. A pluralistic approach is also likely to diversify the sources of financing and funding, because different principles create different duties for different parties, therefore spreading the costs of adaptation.

1.4.1. Polluter-pays principle.

The polluter-pays principle holds that those who produce pollution should bear the costs of managing it to prevent damages to human health or the environment. This principle of 'just deserts' is commonly applied in climate mitigation; for example, it is the basis of emissions pricing where emitters are expected to pay a price for their emissions. But it is also commonly invoked on behalf of climate adaptation, especially in the international arena, by creating the expectation that developed countries should provide adaptation finance to developing

[47] Farber, D. (2007). Adapting to Climate Change: Who Should Pay. *Journal of Land Use & Environmental Law* 23(1), pp.1-37.

countries, because the countries that have done the most to cause climate change should be expected to bear a greater proportion of the costs of responding.

In domestic policy, the polluter-pays principle might require emitters to pay for adaptation costs, or require parties responsible for maladaptation and increased vulnerability to invest in remediation and risk reduction. Such requirements are underutilised in Aotearoa New Zealand as a source of adaptation finance. However, a decision needs to be made on the NAP's proposal to fund adaptation from the Climate Emergency Response Fund, which is capitalised by emitters via ETS auctioning revenue and therefore exemplifies a polluter-pays approach. However, this approach might be applied more directly to tax activities that contribute to climate change or maladaptation, such as deforestation or toxic hazards.

Policy instrument design for polluter-pays can be relatively simple via a tax, levy or penalty. These economic instruments have the advantage of creating disincentives for emissions or maladaptive activities; spreading the losses among diverse parties; and might also serve distributive goals through smart design by transferring wealth from companies that benefit from climate-misaligned outcomes to poorer communities who are exposed to the consequences. However, for reasons of political economy, these economic instruments can be challenging to implement.

1.4.2. Beneficiary-pays principle.

This principle holds that the cost of producing goods should be borne by those parties who benefit from those goods. On this view, it is the beneficiaries of adaptation who should carry the cost. User-pays approaches are a subset of this approach, but focused narrowly on fees for users of particular goods and services. Beneficiary-pays tends to capture a wider set of stakeholders, including those who gain from the non-excludable value of projects with diffuse benefits or spillover effects (i.e. positive externalities).

In terms of climate adaptation, beneficiary-pays implies special responsibilities for funding; for example, the costs of coastal adaptation should be borne primarily by coastal communities or authorities. It also appeals to intuitions of self-responsibility, where people – whether individuals, households or communities – carry the costs of risks that they have chosen to accept.

Given the intrinsic motivation for self-protection, beneficiary-pays approaches will emerge spontaneously as people respond to climate impacts. However, due to various barriers, such as bounded rationality or the need for large-scale infrastructure, beneficiary-pays approaches will sometimes need to be implemented by governments. Because policy instruments for beneficiary-pays are necessarily targeted, they are potentially more challenging to design. Nevertheless, value capture mechanisms are already in use in Aotearoa New Zealand, such as targeted rates and the infrastructure levy enabled by the Infrastructure Funding and Financing Act 2020. Table 3 on the following page, which identifies value capture mechanisms for transport infrastructure in the US, shows that many other options are available.[48]

[48] U.S. DOT (2019). *Value capture: Capitalizing on the value created by transportation.* https://www.fhwa.dot.gov/ipd/pdfs/value_capture/value_capture_implementation_manual_2019\.pdf

Table 3: Overview of value capture categories, techniques, and definitions (from US DOT, 2019).

Category	Technique	Definition
Developer contributions	Impact fees	Fees imposed on developers to help fund additional public services, infrastructure, or transportation facilities required due to the new development.
	Negotiated exactions	Negotiated charges imposed on developers to mitigate the cost of public services or infrastructure required as a result of the new development.
Transportation utility fees	Transportation utility fees	Fees paid by property owners or building occupants to a municipality based on estimated use of the transportation system.
	Special assessment districts	Fees charged on property owners within a designated district whose properties are the primary beneficiaries of an infrastructure improvement.
Special taxes and fees	Business improvement districts	Fees or levies charged on businesses within a designated district to fund or finance projects or services within the district's boundaries.
	Land value taxes	Split tax rates, where a higher tax rate is imposed on land than on buildings.
	Sales tax districts	Additional sales taxes levied on all transactions or purchases in a designated area that benefits from an infrastructure improvement.
Tax increment financing	Tax increment financing	Charges that capture incremental property tax value increases from an investment in a designated district to fund or finance the investment.
Joint development	At-grade joint development	Projects that occur within the existing development rights of a transportation project.
	Above-grade joint development	Projects that involve the transfer of air rights, which are development rights above or below transportation infrastructure.
	Utility joint development	Projects that take advantage of the synergies of broadband and other utilities with highway right-of-way.
Naming rights	Naming rights	A transaction that involves an agency selling the rights to name infrastructure to a private company.

By contrast to polluter-pays, beneficiary-pays does not create incentives to reduce climate-misaligned activity, nor spread losses or serve redistributive goals. Rather, a beneficiary-pays approach 'leaves the costs where it finds them'.[49] As such, beneficiary-pays is not prone to rent-seeking, moral hazard or over-investment in adaptation. However, the identification of beneficiaries can be complicated, especially where adaptation projects have a strong public good element or positive spillovers for others. Moreover, while the beneficiary-pays principle appeals to self-responsibility, it can be argued that beneficiary-pays is unfair, given that public understanding of climate change was limited until recent years, and the extent of climate-related impacts were highly uncertain.

1.4.3. Public-pays principle.

This principle holds that the costs of adaptation should fall on taxpayers or ratepayers in a general rather than targeted way. Consequently, this approach entails the maximum level of loss spreading and social solidarity. It makes climate adaptation simply a matter of public expenditure and, consequently, has relatively low transaction costs.[50] Insofar as the tax system is progressive, a public-pays approach can also contribute to redistributive goals by transferring resources from high- to low-income people.

[49] Ibid.
[50] Ibid.

However, a public-pays approach has significant risks. Firstly, it increases the potential for moral hazard – that is, where the prospect of publicly funded adaptation discourages people from investing in protection or prevention of climate-related risks, or allocating resources to post-disaster response and recovery. Secondly, there is a risk of rent-seeking where particular constituencies lobby for new infrastructure or social support, potentially gaining priority over communities in greater need. Finally, a public-pays approach fails to create appropriate disincentives for emissions and/or maladaptation. On the contrary, it can be a subsidy for polluters, because the costs of damages are spread across society instead of being internalised into the costs of production.

To some extent, these risks can be managed through policy design, such as fine-grained risk assessments of actual adaptation need, or restricting public investment to adaptation projects for which there are no alternative sources of funding. But these issues also suggest a strategic deployment of limited public funding to where it can make the most difference, especially supporting economically disadvantaged communities.

1.4.4. Ability-to-pay principle.

This principle holds that duties vary with ability, so that the more abled (i.e. wealthier agents) have greater duties to bear the cost of climate adaptation than less abled agents. For example, this principle might be applied to those whose wealth or income is over a certain threshold.

As a standalone principle, ability-to-pay has various shortcomings. It is prone to moral hazard, has minimal loss spreading by targeting the affluent minority, and creates no direct incentive for polluters (because not all wealth is gained by emissions and/or maladaptation).

However, ability-to-pay is potentially a useful supplementary principle to address the limitations of other principles, especially the distributional implications.[51] For example, if we combine beneficiary-pays principle and ability-to-pay principle, then the duty-bearers will both benefit from adaptation and sit above a designated threshold of well-being, thereby reducing the risk that low-income groups will bear costs that they are unable to afford.[52]

[51] Caney, S. (2010). Climate change and the duties of the advantaged. *Critical Review of International Social and Political Philosophy* 13(1), pp.203-228. https://doi.org/10.1080/13698230903326331

[52] Heyward, C. (2021). Is the beneficiary-pays principle essential in climate justice? *Norsk filosofisk tidsskrift*, 56(2-03), pp.125–136. https://doi.org/10.18261/issn.1504-2901-2021-02-03-07

2. Risk transfer instruments

Risk transfer instruments involve the reallocation of risk through insurance coverage, or the accumulation of asset pools whose value and revenue streams are not correlated with those of the asset being insured.

2.1 Insurance premium reduction programme

Insurance premium reduction programmes	
Insurance premium reduction programmes involve a discount on insurance premiums which reflect actions undertaken to reduce the risks that are being insured.	
Strengths	**Challenges**
• Creates a long-run financial incentive for risk reduction. • Profitability can be sustained if the reduction to premiums earned is matched by reduction to adjusted claims (i.e. the claims ratio is unchanged).	• High transaction costs to design and verify risk reductions. • Hazard-specific applicability depending on the granularity of the risk reductions. • The premium reduction improves cashflow *ex post*, but not *ex ante* when upgrades need to be paid for.
Enablers	
• Targeted, hazard-specific research to improve the ability of insurers to quantify risk and to anticipate the value of risk reduction activities. • The use of aggregation to reduce transaction costs, or coordination with policy initiatives such as subsidies for home upgrades or resilience projects. • Intermediation between relevant parties (i.e. insurers, banks, research organisations) to reduce upfront transaction costs of instrument design.	

Adaptation gap

One of the challenges of climate change is people's inability to respond appropriately to climate-related risks. It is well understood that climate mitigation is challenging because people are psychologically distant from the long-term consequences (global heating) of present-day actions (greenhouse gas emissions). Similarly, people are prone to underprepare for climate adaptation, which is reflected in low levels of homeowner investment into risk reduction. This can be explained by a lack of risk awareness, underestimation of risk, difficult computations for cost-benefit trade-offs, and budget constraints.[53]

Financial incentives can influence behaviour by making invisible risks visible. Emissions pricing, for example, produces a present-day disincentive to emit, even for actors who will not experience the direct impacts of climate change. Similarly, insurance creates incentives through the mechanism of the premium – at least in theory. But empirical research on insurance reveals a mixture of possible influences on behaviour.[54, 55, 56] On the one hand, insurance can create moral hazard by incentivising risky behaviour. On the other hand, the price of insurance can encourage investments into risk reduction. The key takeaway is that the design and implementation of an insurance scheme is critical to which behavioural

[53] Kunreuther H., Meyer, R. & Michel-Kerjan. E. (2009). *Overcoming Decision Biases to Reduce Losses from Natural Catastrophes*. Risk Management and Decision Processes Center, The Wharton School of the University of Pennsylvania.
[54] Suarez, P. & Linnerooth-Bayer, J. (2011). *Insurance-related instruments for disaster risk reduction*. Global Assessment Report on Disaster Risk Reduction. http://www.preventionweb.net/english/hyogo/gar/2011/en/bgdocs/Suarez_&_Linnerooth-Bayer_2011.pdf
[55] Kleindorfer, P.R., Kunreuther, H.C., & Ou-Yang, C. (2012). Single-year and multi-year insurance policies in a competitive market *Journal of Risk and Uncertainty*, 45(1), pp. 51-78. 10.1007/s11166-012-9148-2
[56] Poussin, J.K., Botzen, W.J.W. & Aerts, J.C.J.H. (2014). Factors of influence on flood damage mitigation behaviour by households *Environmental Science and Policy* 40, pp.69-77. 10.1016/j.envsci.2014.01.013

outcomes are most likely. Such insights have been incorporated into risk-adjusted health insurance, but there is an opportunity to enhance the linkages between risk transfer and risk reduction for climate-related hazards.[57] Indeed, in Aotearoa New Zealand where insurance ratings are largely standardised, insurance premiums are not necessarily reflecting the relative vulnerability or resilience of individual houses, so potentially not sending the right signals to incentivise risk reduction.

Financial instrument

An insurance premium reduction programme (IPRP) uses risk-adjusted insurance to apply a discount on premiums that reflect actions undertaken to reduce the risks that are being insured. In other words, verified risk reductions enable insurers to adjust the claims ratio (C/R), which measures the adjusted claims (C) as a ratio to premiums earned (R) (see Figure 3 below). A claim ratio of less than 100 per cent means that premiums earned are sufficient to cover claims and therefore remain above the breakeven point, so that the insurer will stay solvent without drawing on its capital buffer.

Compared to conventional insurance, an IPRP reduces the returns earned from collected premiums, but also reduces the insurer's payouts on claims by reducing material risks. Therefore, the IPRP needs to ensure that the claims ratio does not exceed 100 per cent and become loss-making for the insurer. This includes accounting for underwriting expenses, which are likely to be higher because of the costs of verifying risk reductions.

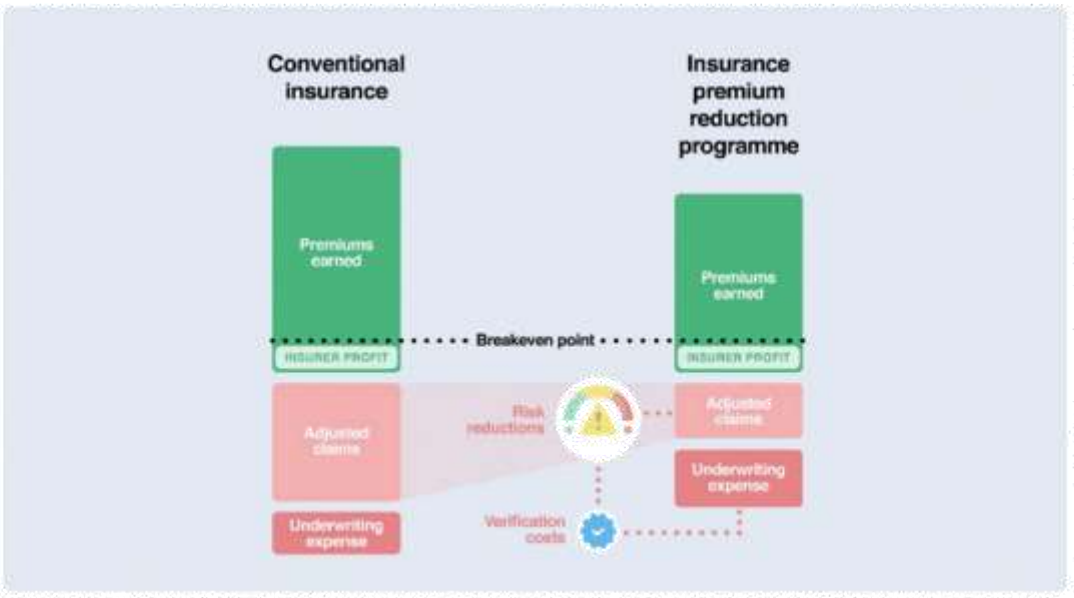


Figure 3: Risk-adjusted insurance claims ratio to support an insurance premium reduction programme.

[57] Surminski, S. & Oramas-Dorta, D. (2013). Do flood insurance schemes in developing countries provide incentives to reduce physical risks? *International Journal of Disaster Risk Reduction* 7, pp.154–164.

Case Study: Suncorp's Cyclone Resilience Benefit program

The occurrence of disasters such as Cyclone Larry (2006) and Cyclone Yasi (2011) challenged Suncorp's profitability by resulting in higher claims cost, increased reinsurance costs, and subsequent increases to customer premiums. Research on the housing stock found that, while severe damage from structural failure was relatively rare (3% of claims), it accounted for a large proportion of total claims cost (27%). Moreover, many houses experienced water ingress (resulting in loss of amenity) and component failures (i.e. doors, windows, soffits, guttering).[58]

Subsequently, the Cyclone Resilience Benefit (CRB) was released in early 2016 to promote risk mitigation by reducing premiums to homeowners who reduce their vulnerability to cyclone damage through home improvements (roof replacement, exterior window shutters, etc.) and cyclone preparation plans. Reductions varied between 1-20% of the property's total premium, with the largest reductions going to improvements older homes (pre-1982) with higher structural vulnerability and therefore higher initial premiums. Suncorp's commitment to experimenting with risk-adjusted insurance was justified by its 'shared value' approach which treats positive social impact and Suncorp's economic success as intertwined.

On the demand side, the IPRP promotes risk mitigation by rewarding the efforts of homeowners who make their homes less vulnerable to climate-related damages (e.g. flooding, ex-tropical cyclones) through home improvements and preparation plans. This enables risk-adjusted pricing which encourages investment in mitigation by homeowners and also frees up cashflow to pay back the costs of risk mitigation. Experimental evidence suggests that an insurance premium discount can increase investments in damage reduction.[59]

Opportunities for Aotearoa New Zealand

In Aotearoa New Zealand, a shift toward risk-adjusted insurance, such as an IPRP, is a viable option to incentivise risk reduction against some hazards. The feasibility will depend somewhat on the type of hazard, because not all climate-related natural hazards are amenable to being priced on a granular risk basis (e.g. wildfire and coastal inundation). It will also depend on the nature of the risk reduction, because not all actions will be material or easy to quantify given existing limitations of data, systems and validation frameworks.

One potential application (following the Suncorp example) is home protection against extreme storm events and ex-tropical cyclones. Extreme rain and wind events are expected to increase in frequency and intensity as global heating increases, albeit with significant scientific uncertainty. The east coast of the North Island is especially exposed to ex-tropical cyclones, which are forecasted in current modelling to reduce in frequency but increase in intensity.[60]

The IPRP model might also be applied to flood risk to incentivise preparedness among homeowners in flood-prone areas. Risk reduction activities might include investments into watertight windows and doors, backflow preventers for utility conduits, waterproofing electrical connections, home elevation, and an up-to-date flood plan.

One potential barrier to uptake for IPRPs relates to the sequencing of costs and benefits. In short, the IPRP will improve a homeowner's cashflow *ex post* once upgrades are undertaken, but not *ex ante* when upgrades need to be paid for. This financial burden may reduce uptake of an IPRP because homeowners cannot afford to pay upfront for improvements and therefore access the discount on their insurance premium. However, this could be overcome by the creation of a loan facility which improves access to finance for upgrades and can be repaid using the cost-savings from reduced insurance premiums (see **Concept Proposal: Hybrid insurance premium reduction and loan facility programme** on p.24).

[58] Harwood, J., Smith, D. J., & Henderson, D. (2016). Building community cyclone resilience through academic and insurance industry partnership. *Australian Journal of Emergency Management*, 31(4), pp.24–30.
[59] Jantsje M., Mol, W. J., Wouter Botzen & Blasch J. E. (2020). Risk reduction in compulsory disaster insurance: Experimental evidence on moral hazard and financial incentives. *Journal of Behavioral and Experimental Economics*, 84. https://doi.org/10.1016/j.socec.2019.101500
[60] IPCC (2022). Australasia. Table 11.1.

A major enabler for risk-adjusted insurance is knowledge and research. The Suncorp programme (see **Case Study: Suncorp's Cyclone Resilience Benefit program** on p.22) was developed in collaboration with James Cook University in Queensland, drawing on extensive data from damage investigations by the Cyclone Testing Station, following cyclones Larry (2006) and Yasi (2011). By identifying the factors associated with structural and non-structural damage, it was possible to estimate the cost-benefit ratio of various cyclone mitigation strategies, then re-evaluate the claims ratio by reducing both the premiums earned and the probability of payouts. It follows that, in Aotearoa New Zealand, targeted research into risk reduction factors for homes and buildings in storm and flood events could enable insurers to innovate. Knowledge requirements for robust risk-pricing may also differ among insurance companies, depending on their access to accurate, localised information. Insurance companies with a long history in Aotearoa New Zealand may possess sufficient information, but new entrants, especially those with headquarters overseas, might lack adequate data.

Concept proposal: Hybrid insurance premium reduction and loan facility programme

Flood risk is expected to increase in Aotearoa New Zealand due to greater frequency and intensity of extreme rain events, exacerbated further by rising sea levels in low-lying areas. If homeowners do not undertake flood risk reduction activities, this puts insurers at risk of major losses, which encourages insurance retreat. This, in turn, exposes local and central government to greater levels of assistance when flood events occur.

To incentivise risk reduction by homeowners, the government could convene a stakeholder group around the development of an IPRP, thereby reducing the underwriting expenses for product development. In the initial stages, product development could be supported by targeted, challenge-led research from universities and/or Crown Research Institutes, in cooperation with insurers. This research would need to assess risks and damages, identify effective risk reduction strategies, and estimate the cost-benefit ratio of interventions. Building on this research, a risk-adjusted premium could be structured, complemented by a verification framework to help insurers confirm that risk reduction activities are undertaken.

One challenge for IPRPs is the *ex post* nature of the incentive – i.e. the discount only applies *after* risk reductions are undertaken. Potentially, this leads to inequitable outcomes where low-income households cannot afford the upfront costs of risk reductions and therefore access the risk-adjusted premium. To overcome this problem, the IPRP could be designed as a hybrid instrument, issued in partnership with a commercial lender or publicly funded loan facility, that offers debt to policy holders. This could be structured as a pay-as-you-save scheme which means that the debt will be paid back at a lower rate than the insurance premium reduction, thereby preserving the overall financial incentive for the IPRP. For instance, if the insurance premium reduction is set at 15%, then the homeowner might save NZ$25 per month on insurance costs. Consequently, the minimum repayment rate could be set at NZ$20 per month, which improves the household's financial position as soon as risk reductions are verified. Once the debt is repaid, the policy holder will enjoy the full discount.

However, the high information requirements of product development entail high underwriting expenses. Also, the verification of risk reduction activities undertaken by policy holders will further increase the expenses for insurance companies. Even if the claims ratio remains the same, these higher costs may render the IPRP uneconomic.

One way to reduce underwriting expenses could be to align an IPRP to large-scale adaptation projects with large aggregate impacts. Consider, for example, the construction of a seawall which reduces flood risks to a large number of houses and therefore reduces the probability of payouts for insurers. Alternatively, consider a home retrofit scheme which increases the flood and storm resilience of housing to a specified standard with a well-established cost-benefit ratio. All things being equal, these public works will improve profits for private insurers. However, if an IPRP could be agreed to in advance with relevant insurance companies, then households could benefit from a risk-adjustment to future insurance premiums. Not only might insurance companies benefit from improved resilience through better risk management, policy holders might also be increasingly motivated to support public works to enjoy premium reductions. This could improve public acceptance of value capture mechanisms, such as targeted rates, to fund risk reductions (see Table 3 in §1.4.2). On the downside, this approach increases the complexity of the instrument design. It may, for instance, require a coordinated

approach among multiple insurance companies; or the adaptation project could even disincentivise homeowners from purchasing private insurance, thereby rendering the IPRP redundant.

Concept proposal: Resilient marae programme

A 2009 report by Te Puni Kokiri found that many marae struggle to arrange insurance for their buildings and taonga.[61] Only 51% reported that they had an annual income sufficient to cover normal operating costs. While over half of marae were insured for replacement or full replacement of buildings and facilities (66%) or contents (57%), more than half have no or limited insurance for artworks and taonga, either fixed (59%) or moveable (64%).

Efforts have been made to address this issue. For instance, Willis Towers Watson have sought to reduce the costs of insurance premiums for marae by taking a more tailored approach with improved loss prevention guidelines.[62] Alternatively, Waikato-Tainui iwi initiated a self-insurance approach in 2014 by providing free insurance to marae.[63] However, not all iwi or hapū are as well-capitalised as post-settlement Waikato-Tainui, so this option is not available to all, especially pre-settlement iwi or hapū.

To improve the physical resilience of marae, an insurance premium reduction programme (IPRP) could be implemented to offer risk-adjusted premiums which reflects risk reductions from building upgrades and the integration of ecosystem-based adaptation in surrounding areas (e.g. revegetation of nearby waterways to reduce flood risk). Te Puni Kokiri's report suggests that there is significant scope for improvements. 66% of marae reported that one or more of their buildings required a major upgrade. Furthermore, 70% of marae reported that the oldest structure was more than 50 years old. By monetising risk reduction, an IPRP could relieve financial stress for marae, while also encouraging upgrades that increase adaptive capacity. The programme could also be equipped with a loan facility, so that marae have guaranteed access to loans for resilience-enhancing upgrades, which can be repaid with cash savings from reduced premiums (see **Concept Proposal: Hybrid insurance premium reduction and loan facility programme** on p.24). Improving the resilience of marae would also have positive spillover effects for the resilience of local communities because marae often function as shelters in time of crisis – for non-Māori as well as Māori – with one-third of marae designated as a Civil Defence Centre.

[61] Ministry of Māori Development (2009). *The Status of Marae in 2009 – Te Ora o te Marae i 2009*. https://www.tpk.govt.nz/en/o-matou-mohiotanga/marae-development/the-status-of-marae-in-2009--te-ora-o-te-marae-i-2
[62] Willis Towers Watson (n.d.). Marae Insurance. https://www.wtwco.com/en-NZ/Solutions/products/marae-insurance
[63] RNZ (2014). Marae insurance scheme announced. https://www.rnz.co.nz/news/te-manu-korihi/247974/marae-insurance-scheme-announced

2.2 Parametric insurance

Parametric insurance	
Parametric insurance involves an agreement to make a payment upon the occurrence of a triggering event, as distinct from traditional insurance which indemnifies actual loss incurred.	
Advantages	**Challenges**
• Swift settlement and reimbursement. • Low administrative and underwriting costs. • Potentially lower insurance premiums. • Flexibility for the insured, because pay-out can be used for anything, including relocation. • Reduces moral hazard problem.	• Complex process of setting trigger and pay-out. • Potentially high underwriting expenses for customisation of scheme. • High variance on whether event triggers pay-out, or whether pay-out meets needs.
Enablers	
• Government can support monitoring and evaluation of parametric triggers. • New technologies which enable efficient measuring and verification of triggering events. • Potential applications for private or public insurance.	

Adaptation gap

The Canterbury Earthquake Sequence of 2010–2011 is the world's second-costliest insured earthquake loss in history.[64] Seven years after the event, EQC (now Toka Tū Ake) had dealt with over 167,000 residential building claims related to the quakes, but nearly 3,000 claims remained on its books. Private insurers had almost 2,700 outstanding claims on their books too.[65] New Zealand's high insurance density, combined with the extraordinary scale of damages, contributed to the delays. But it reveals an inherent drawback of the traditional insurance system: if processes take a long time to complete, then the payout may not occur when people need it most, immediately after the disaster event.

Traditional indemnity insurance is based on a loss adjuster assessment, where an insurance professional impartially investigates the extent and cause of damage done to a property, in order to determine the amount the policy holder is reimbursed. Insurers also need to apportion losses to each event, which includes determining the cost share between the insurer and the re-insurer(s), the number of excesses the claimant has to pay, and business interruption coverage. The strength of indemnity-based approach is that there is a non-arbitrary relationship between the payout and the magnitude of loss. However, loss adjustment processes can be time-consuming, depending on the complexity of the loss. Large-scale events amplify the administrative burden.

As global temperatures increase, Aotearoa New Zealand will be exposed to extreme weather events with greater frequency and intensity. Ensuring a swift resolution to insurance claims for other large-scale events can support community resilience in the response and recovery phases by creating financial liquidity.

Financial instrument

Parametric insurance covers the probability of a predefined event happening instead of indemnifying actual loss incurred. As such, parametric insurance is detached from an underlying physical asset or infrastructure. Irrespective of the magnitude of actual physical

[64] Barksby, L. (2021). Preparing for a 1-in-1,000 year loss: Insurance resilience 10 years after the Christchurch earthquake. *PreventionWeb*. https://www.preventionweb.net/news/preparing-1-1000-year-loss-insurance-resilience-10-years-after-christchurch-earthquake

[65] Hayward, M. (2018). Nearly seven years on, thousands of Christchurch earthquake insurance claims remain. *Stuff*. https://www.stuff.co.nz/national/101036282/nearly-seven-years-on-thousands-of-christchurch-earthquake-insurance-claims-remain

loss sustained, a pre-agreed pay-out is transferred if the parameter or index threshold is reached or exceeded by a particular event. In practice, this event could be an earthquake, tropical cyclone, or flood where the parameter or index is the magnitude, wind speed or precipitation respectively. In the context of climate adaptation, there is potential to apply parametric triggers to an even broader set of events including drought events, crop yields, power outages, market indices, and more.

Setting the trigger for parametric insurance involves two design considerations. Firstly, the trigger must be fortuitous in the sense that the loss or damage must be unexpected at the time the policy is issued. Secondly, the trigger event must be capable of being modelled. The threshold is typically set in accordance with the client's continuity plan and risk tolerance. For example, a business might be prepared for a flood event of a particular magnitude, but wish to transfer risks beyond that threshold. Therefore, the premium will reflect the probability of these threshold levels being triggered. Any parameter or index that is used as the basis for a parametric solution must be objective (i.e. independently verifiable), transparent, and consistent.

Case study: UN Capital Development Fund-led Pacific Insurance and Climate Adaptation Programme (PICAP)

In September 2021, UN Capital Development Fund-led Pacific Insurance and Climate Adaptation Programme (PICAP) launched a pilot of the Pacific region's first climate risk parametric micro-insurance product (see §2.3 on microinsurance). The product offer covers for cyclones and floods, with both carrying a maximum coverage of FJ$1,000, which will be paid out within 14-21 days following a tropical cyclone. The premium is set at $FJ100 per annum and exempt from Fiji's 9% value added tax (VAT). The product aims to initially cover 500 small holder farmers, fishers and market vendors, with more than 400 already registered when it launched. The aim is to scale it up to reach 1,000 people in Fiji, before being expanded to other sectors, as well as Vanuatu and other communities in the region. The product is underwritten by FijiCare and Sun Insurance as private insurer partners. It is also supported by the Consumer Council of Fiji to deliver financial training and insurance awareness programmes in local communities.[66]

The major benefit of parametric insurance over traditional indemnity insurance is its capacity for quick settlement. By contrast to traditional indemnity insurance, parametric insurance does not involve loss adjustment. Rather, parametric triggers are designed to be easily measured and quickly reported by a third-party to ensure prompt pay-out. Accordingly, parametric insurance enables swift settlements and therefore rapid access to finance in the response and recovery to climate-related hazards. Parametric insurance also has no restrictions on how the payment can be used, including for relocation costs, which provides flexibility in post-disaster recovery.

Parametric insurance can be applied to a range of outcomes that relate to adaptation. Public disaster relief might be dispensed via parametric triggers, which creates transparency for the circumstances in which payouts are provided. Parametric insurance is also a feature of private insurance markets. For example, in the US, parametric insurance is used to insure solar PV panels against severe hail storms, where the trigger for coverage and payout is determined by the size of the largest hail that falls on the solar project site.[67] Other proposed usages are to insure wind energy assets from extreme weather events, or to compensate for losses due to lack of wind.[68]

[66] UNDP Pacific Office (2021). New insurance product to aid fight against climate change in the Pacific. https://www.undp.org/pacific/news/new-insurance-product-aid-fight-against-climate-change-pacific
[67] Pickerel, K. (2020). Renewable Guard Insurance Brokers introduces new hail policy for solar developers, *Solar Power World*. https://www.solarpowerworldonline.com/2020/04/renewable-guard-insurance-brokers-introduces-new-hail-policy-for-solar-developers/
[68] Drewing, B. & Lanavère, F. (2021). When the wind blows; the role of parametric insurance in renewable energy. *AXA*. https://axaxl.com/fast-fast-forward/articles/when-the-wind-blows-the-role-of-parametric-insurance-in-renewable-energy

As a consequence of its speed and efficiency, private parametric insurance might offer lower premiums than traditional indemnity insurance in some cases, because it reduces transaction costs and uncertainty.[69] This might improve access to opportunities for risk transfer for people for whom traditional insurance is too expensive. It also fills the protection gaps left by indemnity insurance like deductibles, excluded perils, scarce capacity or pure financial risks where the insured has no control over the underlying asset, such as contingent business interruption. Rather than being reimbursed for actual losses, parametric insurance simply provides a pre-agreed pay-out based on the event parameter or index value.

The efficiency of parametric insurance, however, may come at the expense of proportionality and matching compensation with need. Parametric insurance is modelled against expected consequences – the economic losses or response costs – of a specific hazard. Therefore, if the chosen parameters do not duly reflect the actual post-hazard consequences, the pay-outs may not be proportional with actual costs of loss or response.[70] For instance, the February 2011 earthquake which devastated Christchurch was not very high in terms of magnitude (M6.2), but destructive because it was very shallow and within 10 kilometres of the city centre. If parametric triggers had been set at, say, an M7 earthquake within 100 kilometres of the city, it would not have resulted in disbursement. This highlights the importance of calibrating the parametric triggers at the optimal level, but the lottery-like aspect might be hard to remove entirely.

The speed of parametric insurance may also result in the misallocation of resources in situations where post-disaster retreat or relocation is eventually required. For instance, a household might receive a payout shortly after a disaster event, which is spent immediately on recovery and betterment, only for local or central government to subsequently decide to implement managed retreat from the affected area. Consequently, those repairs or upgrades could be forfeited.

In light of these various attributes, parametric insurance might not be treated as a substitute for indemnity insurance, rather as a possible complement. In post-disaster circumstances, parametric insurance can provide rapid liquidity and flexibility, whereas indemnity insurance can provide proportionality to losses incurred. Resilience might best be achieved by overlapping risk transfers of both types.

Opportunities for Aotearoa New Zealand

As the frequency and intensity of extreme weather events increases, there is likely to be a greater demand for risk transfer in Aotearoa New Zealand.

Parametric products may emerge from the private market in response to changing needs and demand. A likely driver of product development is technology, especially new or improved tools for modelling and forecasting climate-related risks, as well as reductions to the costs and uncertainties of monitoring and verification.

Parametric triggers could also be integrated into public insurance schemes, potentially as an option for Toka Tū Ake (EQC) as it broadens its future mandate as the Natural Hazards Commission. This could be particularly useful to overcome the arbitrary approach to financial assistance for natural disasters, where one flooding event (such as Edgecumbe in 2017) receives disaster funding, whereas other similar flooding events might not. This ad hoc approach to disaster relief funding is at risk of unfairness and uncertainty, whereas parametric approach to public insurance might enable a more consistent, even-handed approach with transparent triggers. Such a scheme could be backed by an insurance-linked security, such as

[69] Patton, J. (2019). Everything you need to know about parametric insurance. *FloodFlash*. https://floodflash.co/everything-you-need-to-know-about-parametric-insurance/

[70] Broberg, M. (2020). Parametric loss and damage insurance schemes as a means to enhance climate change resilience in developing countries. *Climate Policy* 20(6), pp.693-703. https://doi.org/10.1080/14693062.2019.1641461

a catastrophe bond or resilience bond (see §2.4), to recapitalise Toka Tū Ake (EQC) in the event of disaster.

The possible applications for parametric insurance are diverse, but agriculture stands out as a major opportunity, given the sector's high exposure to weather-related damages. For instance, public or private parametric insurance could support farmers through drought events by providing immediate payouts to help with supplementary feed and other measures. The New Zealand Government already provides drought relief packages on an *ad hoc* basis – the 2019-2020 drought is a recent example [71] – but parametric triggers could increase transparency and reduce uncertainty about future disbursements across successive governments.

[71] New Zealand Government (2020). Government steps up with major drought relief package. *Beehive.govt.nz*. https://www.beehive.govt.nz/release/government-steps-major-drought-relief-package

2.3 Microinsurance

Microinsurance	
Microinsurance is characterised by low premiums and low caps (or coverage limits), typically with the purpose of extending risk transfer opportunities to low-income groups and microenterprises.	
Advantages	**Challenges**
• Extends risk transfer opportunities to groups which otherwise lack insurance coverage. • Reduces cascade effect where disasters trigger foreclosures, defaults, bankruptcies etc. for financially stressed people. • Microinsurance may reduce poverty and stabilise economic wellbeing in disadvantaged communities.	• Limited demand due to lack of trust, or poor understanding of product. • High administrative costs for insurers. • Microinsurance might crowd out the role of intensified stewardship, social assistance and social solidarity.
Enablers	
• Technological innovation, such as service provision via mobile phones. • Strong data protection and regulation to increase confidence among potential beneficiaries. • Improved financial inclusion and literacy to increase trust and understanding of product.	

Adaptation gap

It is well understood that the poor are disproportionately harmed by disasters.[72] As the impacts of climate change increase, poor and vulnerable communities will often be highly exposed to losses and damages. These communities may be resilient in critical ways through strong networks and traditions of social solidarity. However, a lack of financial resources can heighten vulnerability to shocks and also limit access to risk transfer opportunities. In Aotearoa New Zealand, like other countries, there is a disaster insurance gap among low-income households. Consequently, families and individuals on low incomes can struggle to recover financially post-disaster. In worst-case scenarios, this results in a cascade effect where disasters trigger foreclosures, defaults and bankruptcies for financially stressed people.

Economic inequality correlates with unequal climate resilience. In Aotearoa New Zealand, this also corresponds to disadvantages for Māori who have significantly lower insurance coverage than other New Zealanders. The New Zealand Financial Capability Survey 2021 by Te Ara Ahunga Ora | Retirement Commission showed that only 33% of Māori had general insurance compared to the average of 54% of non-Māori, 21% had life insurance / income protection policy compared to 27%, and 21% had health insurance compared to 27%.[73] This means that, in the event of a disaster, existing inequities may intensify, especially if risk management relies solely, or heavily, on private insurance.

Financial instrument

Microinsurance enables the financial protection of low-income people and microenterprises against specific risks using low-priced, targeted products.[74] It is characterised by low premiums and low coverage limits (or caps), which increases access to low-income customers. Internationally, a wide variety of microinsurance products exist to provide coverage for health, term life, death, disability, property risks, theft or fire, natural disasters, and risks to crops and livestock. Potentially, microinsurance is an effective way to reduce the vulnerabilities of

[72] Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Bangalore, M. & Beaudet, C. (2020). From Poverty to Disaster and Back: A Review of the Literature. *Economics of Disasters and Climate Change* 4, pp.223-247. https://doi.org/10.1007/s41885-020-00060-5

[73] Retirement Commission (2021). *New Zealand Financial Capability: Focus on Māori*. https://assets.retirement.govt.nz/public/Uploads/Research-2020/TAAO-_NZ-financial-capability_maori.pdf.

[74] Schoenmaker, D., & Willem S. (2019). *Principles of Sustainable Finance*. Oxford: Oxford University Press.

individuals to climate shocks, enabling them to better absorb and recover from the financial burden of extreme weather events.[75]

Developing countries often use microinsurance products, especially for smallholder farmers who are vulnerable to climate-related risks. A recent World Food Programme (WFP) analysis found that, between 2011 and 2021, the microinsurance products in its portfolio delivered a total of US$3.5 million in payouts for a quarter of the subscribed policies.[76] For an average premium value of US$15 per household, beneficiaries received an average payout of US$25 per household. These payouts enabled households to absorb the effects of failed agricultural seasons through food purchases, or investments in agricultural or livestock inputs.

Case study: The R4 Rural Resilience Initiative

World Food Programme (WFP) and Oxfam America launched the R4 Rural Resilience Initiative (R4) in 2011 to enable vulnerable rural families to increase their food and income security by managing climate-related risks. Through its innovative integrated climate risk management approach, R4 enables the poorest farmers to access crop insurance by participating in risk reduction activities. Assets built through such activities – including WFP's Food Assistance for Assets programmes – promote the resilience of farmers and their families by steadily decreasing vulnerability to disaster risks over time. R4's integrated approach involves four risk management strategies: improved resource management through asset creation or improved agricultural practices (risk reduction); index-based microinsurance (risk transfer); increased investment, livelihoods diversification and microcredit (prudent risk taking); and savings (risk reserves). These combined strategies have improved the adaptive capacity of participants. In Malawi, after three years of R4 implementation, the percentage of participants with acceptable food consumption increased from 56% to 89%, along with the increase of households not resorting to negative coping strategies from 40% to 72%.[77]

The potential of microinsurance is to help people, especially in developing countries, out of the poverty trap by improving their capacity to cope with unexpected shocks. A systematic review of empirical literature found that microinsurance supports people to overcome poverty by, firstly, improving access to healthcare services and, secondly, indirectly improving their economic situation by moderating risk vulnerability and improving income stability.[78] In other words, microinsurance contributes to the capacity for risk-pooling (*ex ante*) and shock-absorbing (*ex post*), which reduces vulnerability to shocks by stabilising income and consumption. Consequently, microinsurance contributes to the general finding that insurance market activity contributes to economic growth by allowing different risks to be managed more efficiently and by mobilising domestic savings.[79]

Opportunities for Aotearoa New Zealand

Given the inequalities of insurance coverage in Aotearoa New Zealand, microinsurance could plausibly play a role in increasing access to risk transfer opportunities. While Aotearoa New Zealand is not part of the developing world, which is where most microinsurance programmes are active, there are significant wealth and income inequalities. This means that low-income households lack risk transfer opportunities, which disproportionately impacts on groups such as Māori who have historically faced financial exclusion.

For similar reasons, microinsurance is being explored as an option in other developed countries to reduce the inequitable impacts of disasters. Notably, US experts at the Wharton

[75] Tharia, Y. (2020). The Third Wave of Microinsurance. *InsuranceAsia News*, https://insuranceasianews.com/the-third-wave-of-microinsurance/
[76] World Food Programme (2021) *Does climate insurance work? Evidence from WFP-supported microinsurance programmes.* https://docs.wfp.org/api/documents/WFP-0000131314/download/?_ga=2.159045369.2113081347.1657668379-1441116919.1657419666
[77] Ibid.
[78] Apostolakis, G.E., Dijk, G.V., & Drakos, P. (2015). Microinsurance performance: A systematic narrative literature review. *Corporate Governance* 15, pp.146-170.
79 Arena, M. (2008). Does insurance market activity promote economic growth? A cross-country study for industrialized and developing countries. *The Journal of Risk and Insurance* 75(4), pp.921–946. https://doi.org/10.1111/j.1539-6975.2008.00291.x

Risk Center have proposed a parametric microinsurance scheme to improve the financial resilience of low-income households (for more on parametric insurance, see §2.2). They propose four delivery models through (1) an aggregator, (2) a mobile-based application, (3) a joint product or joint sale, or (4) a public-sector disaster insurance program.[80] Firstly, in the aggregator model, an intermediary (the aggregator) purchases a single large policy, then disburses the claim payment to individual households. Secondly, in the mobile-based model, an insurer offers policies directly to households through a mobile application which allows policies to be purchased, premiums paid, claims received, and also enables consumer communication and education. Thirdly, in the distribution model, an insurer partners with another firm to couple the sale of insurance to another product automatically, or to simply make insurance available as a voluntary add-on to another product. Fourthly and finally, the public sector model builds on existing disaster insurance programmes, such as the National Flood Insurance Program in the US, but structures the programme as a parametric microinsurance policy.[81]

The emergence of these products will depend partly on market drivers. For example, the spread of mobile phones expands opportunities for mobile-based insurance products such as microinsurance. Essentially, mobile phones serve as the infrastructure that enables the uptake of low-cost, low-caps products, building on the development of mobile-based financial transactions.

However, government can play important roles in market shaping and regulatory oversight. The Wharton Risk Center analysis[82] highlights a number of preconditions for parametric microinsurance: firstly, more fine-grained research on the specific financial costs faced by various households for risks, risk reduction and post-disaster financing; secondly, improved financial and insurance literacy among potential consumers; and third, a rigorous regulatory architecture. Because microinsurance, like other types of microfinance, is targeted toward low-income consumers, it is especially important to monitor and regulate predatory practices. Indeed, the New Zealand Government recently strengthen regulation of high-interest lending through the Credit Contracts Legislation Amendment Act 2019. Regulatory oversight of microinsurance is prudent to ensure that it delivers on the promise of reducing, rather than reinforcing, inequalities.

Finally, it is worth highlighting that microinsurance may extend a broader trend toward the privatisation and individualisation of climate-related risks. Some scholars have warned that insurance-based approaches shift the management of climate risks from governments to private actors, thereby placing the burden of risk on the shoulders of individuals and/or households.[83] Arguably this undermines the capacity for collective responses, whether by central or local government, or other collective institutions such as iwi and hapū. However, this critical view of insurance is contested. Others argue that the tools and techniques of insurance are increasingly central to the constitution of climate change as a public problem, thereby heightening its salience among key institutions and decision makers.[84] In other words, entities like government agencies and local councils are increasingly learning to think like insurers, and consequently to manage and mitigate risks that are otherwise outside of concern. On this view, microinsurance (along with activities such as climate-related risk reporting) might serve to strengthen the actuarial capabilities of the public and the public sector, resulting in improved social resilience.

[80] Kousky, C., Wiley, H., & Shabman, L.A. (2021). Can Parametric Microinsurance Improve the Financial Resilience of Low-Income Households in the United States? *Economics of Disasters and Climate Change* 5, pp.301–327.
[81] Ibid.
[82] Ibid.
[83] For example, O'Hare, P., White, I., & Connelly, A. (2015). Insurance as maladaptation: Resilience and the 'business as usual' paradox. *Environment and Planning C: Politics and Space* 34(6), pp.1175–1193.
[84] Collier, S. J. & Cox, S. (2021). Governing urban resilience: Insurance and the problematization of climate change. *Economy and Society*, 50(2), pp.275-296. https://doi.org/10.1080/03085147.2021.1904621

2.4 Insurance-linked securities

Insurance-linked securities	
Insurance-linked securities (e.g. catastrophe bonds and resilience bonds) are reinsurance instruments which enable insurers to transfer risk to private capital markets in return for interest payments, thereby protecting insurers against losses from impacts of natural disasters.	
Advantages	**Challenges**
• Transfers risk to private capital markets. • Simple settlement process based on pre-agreed triggers (parametric, index-based or indemnity). • Resilience bonds create incentives for risk reduction.	• High transaction costs which requires large-scale issuance. • Issuance requires strong capabilities, especially risk analysis, from issuing entities.
Enablers	
• Government can play a role in supporting monitoring and evaluation of parametric triggers. • Pooling risk at regional level might improve scale, but raises complications over allocating the disbursement.	

Adaptation gap

There are limits to the volume of risk that private and even public insurers can expose themselves to. The domestic insurance sector cannot bear all the costs of likely climate-related damages in Aotearoa New Zealand. Insurance retreat occurs when a private insurer declines an application for insurance coverage, or stops offering renewal for existing coverage, because of a property's exposure and vulnerability to an escalating hazard.[85] Partial retreat refers to situations where an insurer introduces terms that transfer a significant proportion of a property's risk back onto the policy holder.

One analysis conservatively estimates that, by 2050, full insurance retreat is likely to occur for at least 10,000 homes in Auckland, Wellington, Christchurch and Dunedin.[86] Partial retreat is likely to occur from 2030 for dwellings in Wellington and Christchurch which currently have a 1% probability of coastal inundation, with homes in similarly exposed locations in Auckland and Dunedin following only a few years later.

To mitigate insurance retreat, work can be undertaken to reduce risk exposure, or improve resilience to climate-related events. Still another option is for insurers to spread risk and therefore reduce their exposure to catastrophic events. Reinsurance is one way to do this, although reinsurance, like insurance, does not always pay out. For example, modelling for the Deep South National Science Challenge found that Toka Tū Ake EQC's reinsurance contracts are unlikely to be triggered by a 0.2% annual exceedance probability (1 in 500 year event) cyclone event hitting Tauranga and the Bay of Plenty region. Estimated insured residential damage to dwellings would likely be in the range of NZ$100–600 million, which falls short of Toka Tū Ake EQC's reinsurance deductibles of NZ$1.75 billion.[87] This leaves a gap for reinsurance that covers clearly defined events.

[85] Storey, B. (2017). *Conversion to Leasehold as Methodology to Price Sea Level Rise Risk*. Thesis submitted 6 March 2017 to the University of Canterbury in completion of the Masters of Disasters.
[86] Storey, B., Owen, S., Noy, I. & Zammit, C. (2020). *Insurance Retreat: Sea level rise and the withdrawal of residential insurance in Aotearoa New Zealand*. Report for the Deep South National Science Challenge.
[87] Ibid.

Financial instrument

Insurance-linked securities (ILS) can be used by insurers to protect themselves against losses from impacts of natural disasters, including those related to climate change. Basically, ILS enable insurers to transfer risk to private capital markets in return for interest payments.

Catastrophe bonds (or cat bonds) are the best-known type of ILS. Cat bonds are issued to diversify insurance liabilities and thereby reduce the financial risks associated with very low-probability and high-consequence natural disasters. They emerged in the US in the 1990s following a series of costly catastrophes, including Hurricane Andrew in 1992, which drove some insurers out of business. Cat bonds can enable a country, a company, or any organisation to access funds from investors if a severe disaster produces large-scale damage.

Structurally, cat bonds are more akin to insurance policies than traditional bonds (hence their inclusion in Section 2 on risk transfer instruments). In a typical deal, private or public insurers will first create a special purpose vehicle (SPV) to issue the cat bond. Investors will place capital with SPV and, in return, will receive an annual coupon which is calculated by the relative likelihood of the catastrophe occurring in addition to a market interest rate. If no disaster strikes during the bond term (typically 3–5 years), then the principal is also returned to investors. If, however, during the bond term, a disaster strikes that does reach a predetermined threshold (e.g. the occurrence of a 0.2% annual exceedance probability cyclone event, or >US$2 billion in losses), the issuer retains the full value of the bond to pay off disaster losses, and investors lose part or all of their invested principal. There are various approaches to setting the threshold, the most common being indemnity (nearly 60% of outstanding risk capital), industry loss index (25%) and parametric triggers (5.5%).[88] In terms of coupons, nearly half of outstanding cat bond and IRL risk capital pays above 6% interest.[89]

Catastrophe bond issuance in 2021 reached a record-high with more than US$12.8 billion of new issuance.[90] This growth came as insurers reacted to growing costs from worsening weather events and investors sought high yields in (what was previously) a low-interest-rate environment.[91] In the second-quarter of 2022, issuance of new catastrophe bonds reached US$5.2 billion,[92] ranging in size from US$45 million to US$473.6 million (including 144 property cat bonds, private cat bonds, and mortgage ILS transaction).[93]

Resilience bonds[94] are a proposed extension of the cat bond structure, which use a resilience rebate to turn avoided damages into a revenue stream, thereby providing a reimbursement for risk reductions. In other words, if the issuer can demonstrate that specific interventions have reduced the likely damages from a catastrophic event (e.g. implementation of resilience-enhancing infrastructure), then the interest rate is adjusted downwards to reflect improved risk management. This structure is attractive because it incentivises the proactive mitigation of risk, rather than merely insure losses when they occur. As such, the resilience bond is an example of transitional finance which targets climate-misaligned assets in order to proactively improve their alignment.[95]

---

[88] Artemis (2022). Catastrophe bonds & ILS outstanding by trigger type. https://www.artemis.bm/dashboard/cat-bonds-ils-by-trigger/

[89] Artemis (2022). Catastrophe bonds & ILS outstanding by coupon pricing. https://www.artemis.bm/dashboard/cat-bonds-ils-by-coupon-pricing/

[90] Artemis (2022). Catastrophe bonds & ILS issued by type and year. https://www.artemis.bm/dashboard/catastrophe-bonds-ils-issued-by-type-and-year/

[91] Reyes, M. (2022). Catastrophe-Bond Market Hits a Record $12.8 Billion as Extreme Weather Worsens. *Bloomberg*. https://www.bloomberg.com/news/articles/2022-02-03/catastrophe-bond-market-hits-record-at-12-8-billion-in-issuance

[92] Evans, S. (2022). Catastrophe bond market hits new record size of $38.2bn. *Artemis*. https://www.artemis.bm/news/catastrophe-bond-market-hits-new-record-size-of-38-2bn/

[93] Artemis (2022). *Q2 2022 Catastrophe Bond & ILS Market Report*. https://www.artemis.bm/wp-content/uploads/2022/06/catastrophe-bond-ils-market-report-q2-2022.pdf

[94] Vaijhala, S., & Rhodes, J. (2018). Resilience bonds: A business model for resilient infrastructure. *Field Actions Science Reports* 18, pp.58-63.

[95] Piemonte, C. et al. (2019). *Transition Finance: Introducing a new concept*. OECD Development Co-operation Working Paper No. 54. https://doi.org/10.1787/2dad64fb-en

As a new proposal, no resilience bonds have been issued at the time of writing, although there are pilots under development. One of the challenges for resilience bonds is the need to credibly model and price the reduction of risk within a narrow margin of uncertainty. This increases the likely underwriting expenses, which means the issuance must be very large to absorb related costs and limited to relatively tractable problems: 'Resilience bonds only work for some projects where risk reductions are readily measurable and targeted'.[96] As a result, resilience bonds will potentially be biased toward particular types of intervention. For example, for flood mitigation, there is likely to be a bias toward grey infrastructure (e.g. pipes and pumping stations) over green infrastructure (e.g. afforestation and wetland restoration), because models are easily available to quantify the impacts of the former but less so the latter. Furthermore, green infrastructure involves systems that are inherently complex and reflexive, which defies attempts to model and predict outcomes, even though this adaptive capacity is exactly what underpins their resilience. Consequently, the viability of resilience bonds may depend on significant improvements to research and innovation to overcome knowledge gaps, and to create new models and technologies to forecast future risks and put a price on mitigation.

Opportunities for Aotearoa New Zealand

Presently, there are no cat bonds issued from Aotearoa New Zealand. Also, the near-term prospects of such an issuance are slim. A 2018 article on cat bonds[97] quotes Tim Grafton, chief executive of the New Zealand Insurance Council, who argues that the difficulty of establishing the right parametric triggers is a major barrier to issuance. Further, Jean-Louis Monnier of Swiss Re argues that cat bonds carry high fixed costs for issuance, and because the liabilities of New Zealand insurers are small by global standards, risks are most efficiently retained within the balance sheet of reinsurers instead. Moreover, yields would likely be too low to meet the expected returns from the market.

It is likely that the only entity in Aotearoa New Zealand with enough assets to issue a cat bond is Toka Tū Ake (EQC). It would be prudent to explore these options, in particular to track developments in the resilience bond market as a means to incentivise risk reductions.

One way to increase exposure to ILS markets more viable is to bundle risks from Aotearoa New Zealand with risks from elsewhere. Specifically, if a cat bond is heavily weighted toward disasters in the northern hemisphere in Europe and the US, then diversification into southern hemisphere countries like Aotearoa New Zealand could help to spread risks across the portfolio, especially for seasonal risks like cyclones/hurricanes.

[96] Vaijhala, S., & Rhodes, J. (2018). Resilience Bonds: A business model for resilient infrastructure. *Field Actions Science Reports* 18, pp.58–63.
[97] Coughlan, T. (2018). The changing world of catastrophe insurance. *Newsroom*. https://www.newsroom.co.nz/summer-newsroom/the-changing-world-of-catastrophe-insurance

2.5 Pay-for-performance contracts

Pay-for-performance contracts	
Pay-for-performance contracts involve an agreement from an outcome funder (e.g. a government, iwi or large corporation) to pay an agreed-upon return if impact performance targets are met, which enables the raising of capital (i.e. environmental impact bonds) to undertake activities that produce contracted outcomes.	
Advantages	**Challenges**
• Transfers project and execution risk to private capital markets. • Reduces political risks for public funders of outcomes. • Facilitates innovation by contracting for outcomes rather than outputs. • Creates opportunities for co-funding of outcomes.	• Pay-for-performance creates *ex post* payments, which may not help with *ex ante* financing constraints. • High cost of capital for environmental impact bonds due to complex contracting (but this reduces over multiple issuances). • Environmental impact bonds are a complicated arrangement for funding activities that might be undertaken directly by the outcome funder.
Enablers	
• A paradigm shift in public finance from outputs to outcomes, from grants to results-based payments. • In principle commitments by government and/or local councils to pay for specified outcomes, in order to stimulate the coordination which underpins pay-for-performance contracting. • The creation of template contracts which can be replicated elsewhere to reduce overall transaction costs across multiple issuances.	

Adaptation gap

Policy makers typically understand the need for pre-emptive action to build resilience to climate-related shocks. The long tail risks of climate adaptation fall within the purview of forward-thinking regulators.

However, political constraints mean that actual policy is rarely equivalent to the scale of the problem. Contemporary governments are under intense pressure to deliver policies cost-effectively. To avoid criticism from inside government and beyond, a culture of risk aversion is produced where policy makers are compelled to steer away from ambitious, innovative or experimental approaches to public problem solving. Novel policies are deemed to carry too much execution risk – that is, the risk of not effectively executing a policy and delivering the intended outcomes. Furthermore, government agencies are not always well-positioned for project delivery because of a lack of project-specific capabilities, as well as high levels of compliance and due diligence by comparison to service deliverers in the private sector or civil society. Consequently, novel strategies for achieving policy objectives are overlooked in favour of familiar strategies that are easy to execute but practically suboptimal. The risks of policy process may overshadow the risks of not achieving outcomes.

Consequently, there is a gap for funding and financing arrangements that enable government agencies to use their balance sheets to ambitiously pursue social and environmental benefits, or to encourage new, more effective strategies for achieving an outcome. Other large organisations, such as iwi and large corporations, may also face similar constraints.

Financial instrument

Pay-for-performance (also known as pay-for-results, results-based or outcomes-based) contracts involve a payment for pre-agreed outcomes, rather than contracting for outputs or activities. By paying only for successful outcomes *ex post*, the outcome funder (such as a government agency) can transfer execution risk onto private sector or civil society entities.

In its most basic form, this is an effective way to contract payment schemes. As a tangible example, the revenue that forest-owners access through the New Zealand Emissions Trading Scheme is based on a pay-for-performance structure, insofar as NZUs are issued to foresters only on the basis of verified carbon removals. Similar approaches are applied to adaptation; for example, some water funds (see **Case Study: TNC Water Funds** in §3.4) will only release payments for upstream improvements to land-use practices (e.g. improved farming practices and water management) if downstream water quality improvements are achieved against pre-agreed impact targets. The drawback of such arrangements, however, is that while an *ex post* payment does create an incentive to achieve particular outcomes, it does not resolve upfront capital constraints that landowners may face.

Case study: Burren Programme, Ireland

Co-designed with farmers in Counties Clare and Galway, the Burren Programme adapted research on historical agricultural management into a pay-for-performance programme which provides results-based payments for biodiversity outcomes. Farmers participate via five-year contracts, with their farms scored on biodiversity improvements in registered grasslands. The scorecards track the presence of key indicators species, grazing levels, water quality, and presence (or not) of invasive species. The higher the score, the higher the results-based payment that the farmer receives. The Burren Programme is also designed as a hybrid scheme with a grant facility which farmers can access to undertake activities. The grant facility is complemented by technical support and knowledge extension on how to achieve outcomes effectively, thereby improving the likelihood of success. The Burren Programme is credited with strong compliance among participants, relatively streamlined operations, and supporting farmer autonomy to achieve results in whatever way they like.[98] This is one example of a turn to result-based agri-environmental schemes in Europe which reframe environmental improvements as 'a new form of [agricultural] production', which farmers are duly paid to provide.[99]

To resolve this challenge, a more sophisticated type of pay-for-performance contract is the environmental impact bond (EIB). The impact bond structure originated in the social sector as Social Impact Bonds (SIBs), subsequently adapted to environmental objectives by David Nicola in 2013. He describes EIBs as: 'a "pay-for-performance" (PFP) contract that addresses an environmental issue. The PFP mechanism inherent in EIBs will be similar to that of SIBs, whereby the government (or another contracting entity) pays an agreed-upon return if impact performance targets, as specified in the investment contract, are met. EIBs tend to represent a "monetization" of future costs savings, whereby investors are paid a return based on the amount of cost savings generated by a particular project.'[100]

What follows is a generic EIB structure applied to climate adaptation. Firstly, a payor of outcomes (e.g. a government, iwi or public-private consortium) makes a promise to pay for successful interventions that deliver pre-agreed impacts. For example, the contracted outcome might be to reduce flood impacts in a particular catchment (e.g. stream gauge level, sedimentation concentration) in the event of a storm event of a particular magnitude (e.g. millimetres of rain, maximum wind speed). This guarantee to pay for outcomes is formalised through a pay-for-performance contract between the outcome-payors and an intermediary (e.g. if flood impacts do not reach a certain threshold during a storm of a certain magnitude, then payment is triggered). This provides the intermediary with the commercial conditions required to raise investment capital from private sector investors by issuing a bond. Typically, the intermediary is also tasked with coordinating and structuring the deal and managing performance of contractors. By purchasing the bond, the investors provide a loan (the

[98] O'Rourke, E. & Finn, J. (2020). *Farming for nature: The Role of Results-based Payments*. Teagasc and National Parks and Wildlife Service.
[99] Wynn-Jones, S. (2013). Connecting payments for ecosystem services and agri-environment regulation: An analysis of the Welsh Glastir Scheme. *Journal of Rural Studies* 31, p.77.
[100] Nicola, D. (2013). *Environmental Impact Bonds*. Casei3 Working Paper #1. Duke University Fuqua School of Business. https://centers.fuqua.duke.edu/case/wp-content/uploads/sites/7/2015/01/Report_Nicola_EnvironmentalImpactBonds_2013.pdf

principal) to the intermediary which is used as up-front capital for flood mitigation measures (e.g. hard engineering solutions like stopbanks or nature-based solutions like afforestation and wetland remediation). The investors also expose themselves to the risk that the intermediary will not achieve the agreed-upon impacts, so compensated for that risk by a coupon payment. Once the intervention is undertaken, an evaluator assesses whether the impact targets are successfully met. If the targets are met, payment is triggered from the outcome-payors by the intermediary, as per the pay-for-performance contract, with a coupon for overperformance. If the targets are not met, then investors may face a penalty.

The first ever EIB was issued on 29th September 2016 by Washington DC Water and Sewer Authority (see **Case Study: DC Water Bond** below). The project manager, Quantified Ventures, is providing advisory services to other cities to replicate the EIB model elsewhere, including Louisiana to restore wetlands, Atlanta to enhance flood resilience, Baltimore to address water pollution, and Hampton VA to fund nature-based flood mitigation.

Case study: DC Water Bond

The first ever EIB was issued on 29th September 2016 by Washington DC Water and Sewer Authority. The US$25 million tax-exempt EIB was sold privately to Goldman Sachs and the Calvert Foundation in September 2016, in order to fund a pilot green infrastructure project to control storm-water runoff and improve water quality.

Using water-modelling software, DC Water calculated that its green infrastructure installation would reduce stormwater runoff by about 30%. The agency conducted 12 months of baseline stormwater runoff measurements at the site, in order to quantify the impacts of the intervention. If the green infrastructure reduces runoff from 18.6–41.3% as expected with a 95-percent confidence interval, investors would receive a 3.43% coupon rate and the principal at maturity, which is equivalent to a conventional 30-year municipal bond. However, if the results over- or under-perform, then a performance-based payment or penalty would apply. If the green infrastructure reduced stormwater runoff by less than 18.6% (an estimated 2.5% probability), this would trigger a 'Risk Share Payment' of US$3.3 million from investors to DC Water, which would almost cover the entire cost of DC Water's interest payments over the first five years. If stormwater runoff reductions are greater than 41.3% (an estimated 2.5% probability), then it triggers a US$3.3 million 'Outcome Payment' from DC Water to investors in addition to the coupon and principal payments. However, this outcome would still be a fiscally positive for DC Water, because such effective outcomes would mean that DC Water needed to manage less infrastructure to reduce stormwater volume.

Ultimately, the stormwater runoff reductions were nearly 20% and within the expected range, so neither the 'Risk Share Payment' or 'Outcome Payment' was triggered.

The empirical record is still emerging, given that few EIBs have been issued, still fewer reaching maturity. However, drawing from the longer record of SIBs, the theoretical advantages of EIBs are:

- *Crowding in private finance*: The outcome-payor which underwrites the EIB could be a public-private consortium, which crowds in businesses that benefit from the outcomes. This opportunity to diversify the funding pool may, however, add complexity to the contracting which increases transaction costs.
- *Transferred risk*: Because the results-based payment is contingent upon the quality of the outcomes achieved, risk is transferred onto the EIB purchaser and contractors to achieve those results. Political risks of project failure to governments are correspondingly reduced.
- *Promotes innovation*: Depending on how impact triggers are set, there can be multiple ways to achieve outcomes, either by established methods, novel methods, or the application of established methods in new settings or combinations. Contracting for outcomes, instead of outputs, enables experimentation.
- *Incentivises good performance*: By structuring the contract around the successful achievement of pre-agreed outcomes, EIBs encourage rigorous management of service delivery.

Case Study: Forest resilience bond

Increased incidence and ferocity of wildfires in California results in significant damages to public and private infrastructure and assets. However, intensive forest management, such as the clearance of forest litter, can reduce the risk and/or severity of forest fires. This, in turn, results in avoided damages to infrastructure, such as the depreciation of water assets from increased sedimentation into watersheds which follows catastrophic fire and forest loss.

In 2017, Blue Forest Conservation proposed an EIB structure (see Figure 4 below) which would finance present-day forest management by monetising avoided damages to water and electricity utilities, as well as avoided costs of fire fighting for the US Forest Service.[101] Accordingly, the bond appealed to a forward liability logic where present-day expenditure could significantly reduce public liabilities over the long run. In 2018, Blue Forest Conservation signed an agreement with the US Forest Service to document their shared commitment to landscape-scale restoration. Later that year, the Tahoe National Forest and Blue Forest Conservation partnered to launch their first Forest Resilience Bond (FRB) which provides US$4 million in private capital from four investors to finance the Yuba Project, an ecological restoration of 15,000 acres of national forest. The California Department of Forestry and Fire Protection and the Yuba Water Agency are repaying investors at contracted rates as restoration work is completed, with the Tahoe National Forest providing in-kind support and funding for project planning, development and execution.

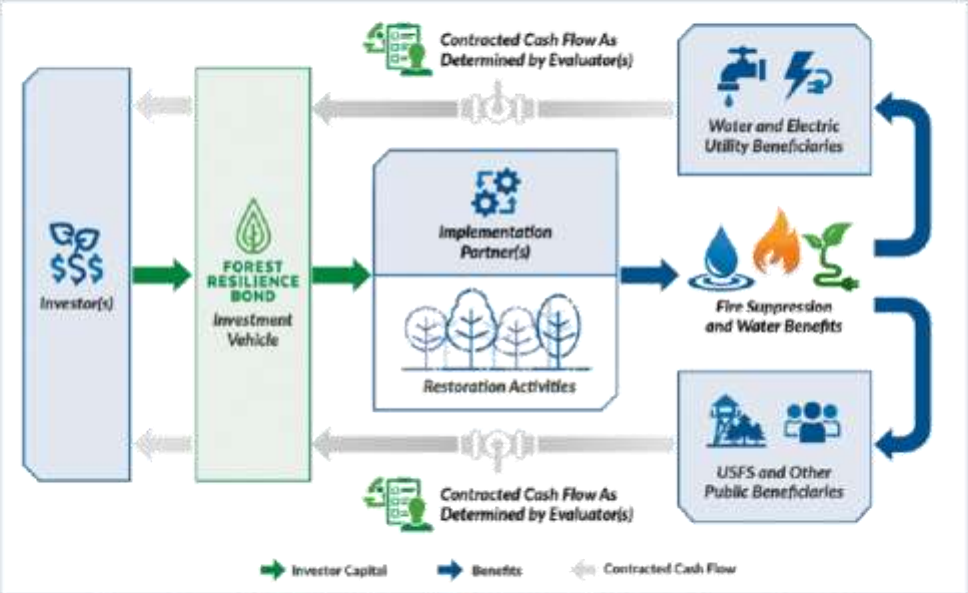


Figure 4: Financial flows for forest resilience bond (from Blue Forest Conservation, 2017).

Opportunities for Aotearoa New Zealand

In terms of climate adaptation, the potential applications of pay-for-performance or results-based contracting are numerous, limited only by what outcome-payors are willing to pay for and at what price.

Catchment-scale integration of nature-based solutions (e.g. wetland restoration, revegetation of erosion-prone slopes) is an obvious candidate for pay-for-performance contracts. To overcome the barriers of upfront cost, Mōhio Research has already explored an EIB structure through the Native Forest Bond Scheme, adapted to the unique context of

[101] Blue Forest Conservation (2017). *Fighting Fire with Finance: A Roadmap for Collective Action.* https://www.blueforest.org/forest-resilience-bond

Aotearoa New Zealand.[102] This instrument could be tailored to catchment-scale adaptation by incorporating impact targets for flood risk, such as discharge flows, water levels in water bodies, incidence of failure of flood protection structures (see **Concept proposal: Natural infrastructure bond** below). Careful design would be necessary to ensure that these targets were not arbitrary, but rather causally linked to land-use activities.

A similar approach could be applied to stormwater management in urban settings, following the example of the DC Water Bond (see **Case study: DC Water Bond** on p.40). Local or central government could make a pre-commitment to pay for particular outcomes; for example, the attenuation of stormwater load to a pre-agreed volume, or the reduction of concentrations of pollutants in waterways (e.g. nitrates or heavy metals) to a specified level. Project developers could then compete to provide solutions, such as the integration of grey and/or green infrastructure into urban environments, or the remediation of brownfield sites which are known to contribute pollutants and toxins to waterways.

A potential advantage of pay-for-performance financing is the competitive element, which may help to encourage corporate and community engagement in developing and supporting solutions. The notion of a 'prize' – that is, the coupon payment for overperformance – may stimulate interest among key stakeholders, especially investors, contractors and the wider public. Because the risks of failure are shared with the bond holder, this risk transfer might also increase the willingness of ratepayers and/or taxpayers to commit public money to outcome-based payments, and therefore to invest in the public good of adaptation.

Aotearoa New Zealand does not have experience with EIBs. However, New Zealand Treasury has advised that these structures have 'the potential to drive innovation' and 'widen the pool of available capital' for environmental remediation.[103] Also, the New Zealand Government does have experience with SIBs through the Social Bonds pilot programme. In February 2017, Ministry of Health issued New Zealand's first social impact bond which focused on getting more people with mental health issues into employment. In September 2017, a second pilot was launched with the aim of reducing youth reoffending in South Auckland.

Although pay-for-performance arrangements can, in theory, be applied to any outcome, there are critical design and logistical constraints to consider. Firstly, impact triggers need to have a high level of certainty and transparency, to avoid disagreements among contracting parties over whether impacts were achieved. For climate adaptation, this requires careful consideration of metrics and indicators (see §4.2 for further discussion). Secondly, EIBs can involve high transaction costs, so the size of issuance may need to be relatively high (e.g. >NZ$300 million). Potentially, this constraint can be overcome by developing a pilot programme that enables the creation of contract templates, which can be used over multiple iterations. Finally, while pay-for-performance arrangements create opportunities for crowding in finance from private sector beneficiaries, there is a trade-off in terms of contracting complexity among multiple parties. EIBs enable the formation of public-private consortiums to jointly pay for outcomes (see, for example, **Case study: Forest resilience bond** above), but this may increase the cost of capital by increasing the transactional load.

[102] This draws on the following analysis: Hall, D. & Lindsay, S. (2018). *Indicative Business Case: Native Forest Bond Scheme*. Report prepared for Foundation North's GIFT Fund. Möhio Research.
[103] New Zealand Treasury (2018). *Aide Memoire: Advice on the Native Forest Bond Scheme Proposal*. T2018/1221 SH-12-2-3.

Concept proposal: Natural infrastructure bond

One of the core functions of nature-based solutions, such as forests and wetlands, is their capacity to provide structural engineering functions, including regulation of water flows, prevention of soil erosion, and slope stabilisation. Alongside these natural infrastructure functions come a variety of co-benefits, including the filtration of pollutants from air, water or soil; restoration of biota for soil health; carbon sequestration; biodiversity enhancement; and ecological connectivity.[104] The greater integration of nature-based solutions through rural and urban landscapes would help to ameliorate some of Aotearoa New Zealand's major environment challenges, including sedimentation and soil loss into freshwater and marine ecosystems. Pay-for-performance contracting could incentivise farmers to significantly upscale the ecosystem restoration projects that some farmers are already undertaking throughout the country, often in spite of time and resource constraints. However, some farmers may be so time and resource constrained that even an incentive will not be sufficient, because the scale of need is too large and the upfront costs too great, or because farmers lack the technical knowledge to ensure the success of ecosystem restoration.

An environmental impact bond (EIB) structure could be used to overcome these challenges. Central and local government, as well as corporate beneficiaries of improved catchment resilience, could form consortiums to pay for ecosystem-based adaptation (EbA). This guarantee would be used to raise upfront capital for a bond, to be dispersed to contractors who provide professional delivery of nature-based solutions, such as wetland restoration, riparian buffers, slope stabilisation planting, pest and predator control, and so on. This professionalisation of EbA relieves demands on farmers, improves the likelihood of success, and creates regional job opportunities. Impact targets could be set against metrics that matter most to stakeholders in the catchment, such as discharge flows, sedimental levels, water levels in water bodies, and incidence of failure of flood protection structures. To demonstrate improvements against metric like this, a whole-of-catchment approach will be required, to reduce the influence of confounding factors in establishing causality. However, a catchment scale also better aligns with the bond size needed for commercial issuance.

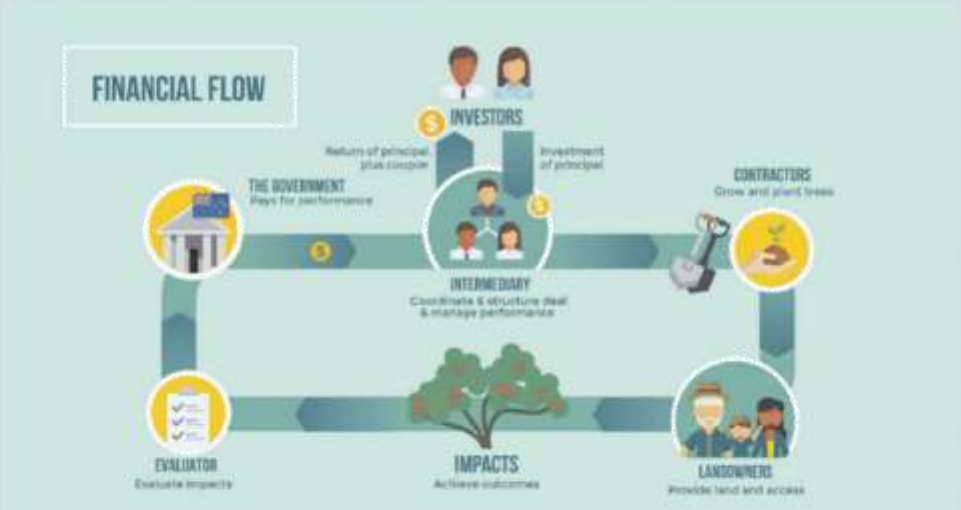


Figure 5: Financial flows for environmental impact bond for natural infrastructure (from Hall and Lindsay, 2018).

[104] Simelton, E., Carew-Reid, J., Coulier, M. et al. (2021). NBS Framework for Agricultural Landscapes. *Frontiers in Environmental Science* 9. https://doi.org/10.3389/fenvs.2021.678367

3. Partial liquidation instruments

When there is sufficient marketable value in existing adaptation assets or future sources of cash flow, private financial investments are a feasible source of funding for adaptation activities. Achieving marketable value for adaptation can be challenging, given that the primary objective is avoided future damages and losses. However, marketable value can be created through the collection of taxes or rates, value capture mechanisms, or payments for ecosystem services.

3.1 Green, social, and sustainability bonds

Green, social, and sustainability (GSS) bonds	
Green, social, and sustainability (GSS) bonds are use-of-proceeds bonds which aim to fund projects with dedicated environmental and/or social benefits.	
Advantages	**Challenges**
• Strong market demand so generally oversubscribed which diversifies the capital pool. • Attracts new capital market investors interested in environmental projects. • Potential for a green bond premium and therefore lower cost of capital. • Relatively easy to issue and therefore to socialise the concept of green finance. • Improving bond issuers' environmental performance and enhancing bond issuers' reputation for environmental sustainability.	• Slightly higher transaction costs than a conventional bond. • The bond purchaser takes on reputational risks (i.e. greenwashing) of non-compliance. • GSS taxonomies may be too inclusive, permitting too much issuance with questionable additionality. • Challenges for use-of-proceeds for adaptation due to common lack of revenue streams. • GSS bonds often lack additionality because it involves labelling investment that would already have been made.
Enablers	
• Aggregation of multiple projects under a single issuance to improve tenor and ticket size. • A clear investment framework which reduces greenwashing risk by sharply focusing on use-of-proceeds that satisfy the additionality principle. • Articulation and confirmation of clear revenue streams, either by user-pays for utilities, or by value capture mechanisms where adaptation benefits are more dispersed.	

Adaptation gap

Globally, the scale of adaptation financing does not match the scale of need. For developing countries alone, adaptation financing ought to increase to the higher end of an estimated US$140-300 billion annually by 2030.[105] Additionally, clean energy investment in emerging and developing countries ought to increase to over US$1 trillion per year by 2030.[106] Yet, in 2019, climate finance flowing to developing countries for mitigation and adaptation only reached US$79.6 billion.[107] Developed countries like Aotearoa New Zealand not only have responsibilities to contribute climate finance to developing countries, but also to increase investment in their own adaptation and mitigation challenges.

Bridging the global climate finance gap requires a momentous shift in capital allocation, not only toward climate mitigation and adaptation, but also away from economic activities that contribute to greenhouse gas emissions and maladaptive practices, such as intensive land-uses and biodiversity degradation. Global bond markets, at about US$120 trillion outstanding, are

[105] UNEP (2016). *The Adaptation Finance Gap Report.*
[106] IEA (2021). *Financing Clean Energy Transitions in Emerging and Developing Economies.* https://www.iea.org/reports/financing-clean-energy-transitions-in-emerging-and-developing-economies
[107] UNEP (2021). *Adaptation Gap Report 2021.*

potentially a major lever, particularly as a source of medium- to long-term financing (which tends to match the tenor of adaptation and infrastructure projects). An important aspect is the government bond market due to its size, liquidity and relative security. If bond markets can be oriented toward the sustainability challenge, then there is sufficient capital available to fund the global transition to low-emissions, climate-resilient development.

However, to drive real change, investors and portfolio managers need to be able to efficiently determine whether the underlying assets are aligned with sustainability objectives. As the risks of greenwashing become increasingly acute and material, through reputational damage and litigation risk, the integrity of themed debt issuance also becomes increasingly critical.

Financial instrument

Green, Social, and Sustainable (GSS) bonds can play a role in achieving scale to bridge the financing gap. Bonds are certificates of debt issued by a government or corporation that promise payment of the borrowed amount, plus interest, by a specified future date. GSS bonds share these characteristics, but also require that bond proceeds are used for projects with positive environmental and social outcomes across various sectors, including energy, transport, built environment, waste, water, land use, agriculture, adaptation and resilience.

In 2021, Climate Bonds Initiative recorded more than 16,000 GSS debt instruments globally with a cumulative volume of US$2.8 trillion.[108] Nearly half (44%) of green issuance comes from financial and non-financial corporates. Sovereign issuance – that is, GSS bond issuance by national governments – is smaller at 10% of cumulative issuance, but increased dramatically by 103% in 2021. European governments are by far the largest source of sovereign issuance, accounting for about three-quarters of all GSS issuance.[109] Other issuances come from government-backed entities, local governments (i.e. state and municipal level), development banks and multinational institutions.

The defining feature of GSS bonds – the exclusive use of proceeds for green, social or sustainable proceeds – is achieved through standards and certification. There are a variety of frameworks and definitions – such as Climate Bonds Initiative and the World Bank's International Finance Corporation (IFC) – but the global standard is the International Capital Market Association (ICMA) Principles, launched in January 2014, which applies four common criteria across GSS themes:

1. **Use of Proceeds**: designated projects should provide clear environment benefits.
2. **Process for Project Evaluation and Selection**: eligibility criteria for projects should be transparent, with external review recommended.
3. **Management of Proceeds**: net proceeds should be ring-fenced and allocated to eligible projects.
4. **Reporting**: information on use-of-proceeds should be readily available, with KPIs for impact measurement encouraged.

For green bonds, the ICMA Green Bond Principles applies the above criteria to raise funds for new and existing projects with environmental or climate-related benefits. By encouraging transparency and disclosure by issuers, the framework enables investors, banks, underwriters, arrangers, placement agents and others to understand its use-of-proceeds. Social bonds are use-of-proceeds bonds that raise funds for new and existing projects with positive social outcomes. The global standard is ICMA's Social Bond Principles (SBP).[110] Sustainability bonds

[108] Climate Bonds Initiative (2022). *Sustainable Debt: Global State of the Market Report 2021*. https://www.climatebonds.net/resources/reports/sustainable-debt-global-state-market-2021
[109] Ibid.
[110] ICMA (2021). *Social Bond Principles*. https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/social-bond-principles-sbp/

are use-of-proceeds bonds for financing or re-financing a combination of green and social projects. The ICMA's Sustainability Bond Guidelines (SBG) facilitate transparency and disclosure for the sustainability bond market.[111]

Case study: Korea Water Resources Corporation (K-water)

Korea Water Resources Corporation (K-water) is the only government agency in South Korea specialising in water. K-water aims to protect public safety from disasters such as drought and flood, to improve the public livelihood, and enhance public welfare by providing public access to water resources. [112] K-water's green financing framework in 2022 directs use-of-proceeds to the development of nature-based waterways and adjoining waterfront areas to achieve flood prevention and control, and preservation of aquatic biodiversity for flood mitigation including the Waterfront City projects in Busan Eco-Delta City, Sihwa Multi-Techno Valley, and Songsan Green City. The use-of-proceeds also includes research and development of climate change adaptation technology, including climate modelling and disaster response systems.

K-water issued two rounds of green bonds in both 2018 and 2022. In May 2018, K-water issued US$300 million fixed-rate green bonds with a coupon rate of 3.875%. As of 30 May 2019, a total of US$300 million of proceeds were raised through the K-water Green Bond, of which the full amount has been allocated to Eligible Projects. During the reporting period, K-water allocated an amount totalling US$ 387.2 million equivalent to four Eligible Project categories: Sustainable Water Supply, Water Management, Climate Change Adaptation and Renewable Energy. [113] For example, under the Sustainable Water Supply category, two projects were financed: Establishment of Water Supply Ecosystem at Hangang River Downstream Areas Ⅲ (2014-2019) and Yeongnam Inland Ⅱ Large-area Waterworks (2016-2019).[114]

Green bonds are the largest theme of GSS bonds, at 49% of total cumulative issuance (US$523 billion). The green theme has also experienced rapid expansion at an average growth rate of 54% over the five years to 2021.[115] The markets for social and sustainability bonds are relatively less developed but growing in size at US$223 billion and US$200 billion respectively.

Case Study: EU SURE social bond

A recent example of a sovereign social bond is the EU SURE (temporary Support to mitigate Unemployment Risks in an Emergency) programme, aiming to finance short-term employment schemes across the EU and keep people in jobs during the coronavirus pandemic. To finance SURE, the Commission is issuing up to €100 billion of social bonds, which has made the Commission – on behalf of the EU – the world's biggest social bond issuer.[116] The funds raised are being provided to EU member states in back-to-back funding. EU countries have used the funds to finance short-time work schemes and other measures to preserve employment and support incomes.

The Commission started issuing social bonds in October 2020, following the adoption of an independently evaluated Social Bond Framework, which is compliant with SBP. The first SURE transaction attracted an order book of €233 billion, the largest order book globally. Between October 2020 and May 2021, the Commission issued a total of €89.64 billion of social bonds in seven issuances. SURE has thus become the world's largest social bond scheme.[117] The Commission reports twice a year on the results achieved by SURE. There are three reports so far: the first report was published on 22 March 2021, the second report was published on 22 September 2021, and the latest report was published on 24 March 2022.[118]

GSS themes are suited to raising capital for climate adaptation and resilience. However, use-of-proceeds for adaptation and resilience is relatively uncommon. Up to 2018, only 3-5% of

[111] ICMA (2021). *Sustainability Bond Guidelines*. https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/sustainability-bond-guidelines-sbg/
[112] K-Water (2022). *K-Water Green Financing Framework*. https://www.kwater.or.kr/web/eng/bond/K-water%20Green%20Financing%20Framework%2028Mar22_vf.pdf
[113] K-Water (2019). *Annual Green Bond Report 2018*. https://www.kwater.or.kr/web/eng/bond/Annual_Green_Bond_Report_2018_K-water.pdf
[114] Ibid.
[115] Climate Bonds Initiative (2022). *Sustainable Debt*.
[116] European Commission (n.d.). SURE Social Bonds. https://ec.europa.eu/info/strategy/eu-budget/eu-borrower-investor-relations/sure-social-bonds_en
[117] Ibid.
[118] Ibid.

green bond proceeds can be traced to climate resilience-related efforts, totalling about US$12 billion. Most of this issuance is for the water sector with proceeds allocated to securing drinking water supply, installing water meters, reducing combined sewage water overflow, and stormwater management. The other major resilience-related use of proceeds is forestry and land-use sectors, with proceeds going towards coastal protection and restoration of rivers and watersheds. The most common issuers of resilience-related green bonds were development banks and sovereign-backed entities, followed by financial corporates, primarily commercial banks in China. The largest climate resilience-linked issuers originate in China, France, the Netherlands, and the USA.[119]

Case Study: EBRD climate resilience bond

The first climate resilience bond was issued in 2019 by the European Bank for Reconstruction and Development (EBRD), raising US$700 million at 1.625% with the issuance. BNP Paribas, Goldman Sachs, and Skandinaviska Enskilda Banken AB acted as joint bookrunners, which saw demand from approximately 40 investors in 15 countries.[120] The first orderbook's distribution statistics saw demand from 15 countries (58% from Europe, 28% from North America and 14% from Asia) from over 40 accounts (32% asset managers, 31% central banks/official institutions, 28% banks, 9% insurance and pension funds).[121] The bond was oversubscribed by US$200 million which demonstrates strong investor appeal. The adaptation-related projects under the resilience bond include climate-resilient infrastructure (such as the Qairokkum hydropower plant in Tajikistan), climate-resilient business and commercial operations, and climate-resilient agriculture and ecological systems (such as the Saiss water conservation project in Morocco).[122] The bond is not only aligned with the four core principles of the GBP mentioned above, but the projects earmarked for the use-of-proceeds are also aligned with the Climate Resilience Principles (CRP) by the Climate Bonds Initiative as the first issuer to use the CRP to structure their climate resilience bond.

A key opportunity for GSS bonds is the potential for aggregation. This is where a number of small-scale projects, which might otherwise struggle to access low-cost financing, can be combined into a single large-scale transaction with a tenor and ticket size that meets market expectations and justifies associated transaction costs.[123] An example is the EBRD climate resilience (see case study above) which aggregates projects in different sectors and countries. Aggregation is particularly advantageous for a small country like Aotearoa New Zealand, where individual projects might not reach sufficient scale to access global debt markets.

Green bonds can also attract a lower cost of capital. A recent review of empirical analyses of green bonds confirmed the existence of a green premium within 56% of primary and 70% of secondary market studies. The green premium (or greenium) varies widely for the primary market; however, an average green premium of −1 to −9 basis points on the secondary market is observed.[124] A range of economic, social and environmental drivers are thought to explain the premium, including strong market demand, relatively low volatility, positive and negative screening among investors, and a growing for mitigating environmental risks.

A key challenge for GSS bonds is defining what counts as 'green', 'social' and 'sustainable'. Different investment frameworks and standards exist; for example, the Climate Bonds Initiative are more demanding than the ICMA guidelines, whereas Chinese guidelines under

[119] Climate Bonds Initiative (2019). *Climate resilience principles: A framework for assessing climate resilience investments.* https://www.climatebonds.net/files/page/files/climateresilience-principles-climate-bonds-initiative-20190917-.pdf
[120] Bennett, V. (2019). World's first dedicated climate resilience bond, for US$ 700m, is issued by EBRD. *EBRD News.* https://www.ebrd.com/news/2019/worlds-first-dedicated-climate-resilience-bond-for-us-700m-is-issued-by-ebrd-.html
[121] Dhanjal, M. (2020). Why climate resilience bonds can make a significant contribution to financing climate change adaptation initiatives. *PreventionWeb.* https://www.preventionweb.net/news/why-climate-resilience-bonds-can-make-significant-contribution-financing-climate-change
[122] Ibid.
[123] UNDP & Climate Bonds Initiative (2022). Linking Global Finance to Small-Scale Clean Energy; Financial Aggregation for Distributed Renewable Energy in Developing Countries, New York.
[124] MacAskill, S. et al. (2021) Is there a green premium in the green bond market? Systematic literature review revealing premium determinants, *Journal of Cleaner Production*, 280(2). https://doi.org/10.1016/j.jclepro.2020.124491

the National Development and Reform Commission are less so. Following a 2018 recommendation by the High-Level Expert Group on Sustainable Finance, the EU is developing a sustainability taxonomy to create greater certainty and consistency on standards. In the meantime, this lack of clarity heightens the risk of greenwashing, where bond proceeds are used for projects and activities that are not green, social or sustainable. It can also be challenging to confirm the integrity of GSS bonds, because reporting practices remain inconsistent and third-party review is only voluntary under the ICMA guidelines. Greenwashing exposés are widely seen as a risk both for individual bonds and the market more generally.[125] Climate litigation is also emerging in this space: in Australia, the holder of an unlabelled sovereign bond is suing the government for misleading or deceiving investors over failures to disclose climate change risk.[126] Ambiguity over use-of-proceeds in GSS-labelled bonds is another potential area for litigation. On the flipside, the green premium and lower cost financing is highly correlated with the more rigorous Climate Bonds Initiative certification label and third-party assessment.[127]

Opportunities for Aotearoa New Zealand

Green bond issuance is developing steadily in Aotearoa New Zealand, a significant shift since 2017 when there was no green bond issuance at all.[128]

Auckland Council was Aotearoa New Zealand's first green bond issuer with its NZ$200 million issuance in June 2018.[129] It issued a second bond in July 2019 for NZ$150 million, certified under the Low Carbon Transport Criteria by the Climate Bonds Standard and Certification Scheme.[130] Auckland Council is now a programmatic issuer under the Climate Bonds Standard, indicating there is likely to be more green transactions to come.

Westpac New Zealand was the first bank in Aotearoa New Zealand to raise funding through the issuance of a green bond in 2019. The 5-year green bond issued by Westpac raised €500 million (NZ$860 million) from European investors, to support the funding of climate change solutions. The transaction attracted significant interest from 83 investors across 20 countries.[131]

In 2021, the New Zealand Government also approved the issuance of sovereign green bonds.[132] In September 2022, New Zealand Debt Management at Treasury issued a green bond framework which identifies green categories of clean transport, energy efficiency and renewable energy, green buildings, living and natural resources and land use, terrestrial and aquatic biodiversity, climate change adaptation, sustainable water and wastewater management, pollution prevention and control; as well as indicative impact indicators for each category.[133] Sovereign GSS bonds are therefore a viable options for raising capital to fund

[125] Doran, M, & Tanner, J. (2019). Critical challenges facing the green bond market. *International Financial Law Review*. October/November 2019. https://www.bakermckenzie.com/-/media/files/insight/publications/2019/09/iflr--green-bonds-(002).pdf?la=en

[126] Wootton, H. (2021). *Australian Financial* Review. https://www.afr.com/politics/federal/court-gives-student-ok-to-sue-government-over-climate-disclosure-20211118-p599zr

[127] MacAskill, S. et al. (2021) Is there a green premium in the green bond market?

[128] Hall, D. & Lindsay, S. (2017). *Climate Finance Landscape for Aotearoa New Zealand: A Preliminary Survey*. Report Prepared for the Ministry for the Environment. Mōhio Research.

[129] Auckland Council (2021). Auckland Council raises $1 billion in Green Bonds. *Our Auckland*. https://ourauckland.aucklandcouncil.govt.nz/news/2021/10/auckland-council-raises-1-billion-in-green-bonds/

[130] Climate Bonds Initiative (2019). Auckland Council. https://www.climatebonds.net/certification/auckland-council

[131] Westpac New Zealand (2019). Westpac New Zealand raises funding through green bond. https://www.westpac.co.nz/about-us/media/westpac-new-zealand-raises-funding-through-green-bond/

[132] New Zealand Treasury (2021). New Zealand to issue Sovereign Green Bonds. https://www.treasury.govt.nz/news-and-events/news/new-zealand-issue-sovereign-green-bonds

[133] New Zealand Debt Management (2022). *New Zealand Sovereign Green Bond Framework*. https://debtmanagement.treasury.govt.nz/sites/default/files/media/media_attachment/nz-sovereign-green-bond-framework.pdf

projects and activities that improve adaptation and societal resilience, especially to aggregate multiple projects to achieve commercial scale.

A key challenge – which is political as much as financial – is how to manage the debt created, especially when many (but not all) adaptation projects lack a clear line to revenue streams.

A bond is, after all, like a loan that needs to be repaid. For commercial issuers, reliable revenue streams from associated assets can enable repayment of the bond. For local and central government, the business case is different, because governments can use rates or tax revenue to repay bonds. This is what makes government bonds so vital to fixed-income markets, because of the reliability and high credit ratings of sovereign issuers. If future governments choose to take on greater debt to address the climate challenge, then a rigorous GSS bond framework might ensure that proceeds of bond issuance are channelled toward climate-aligned projects and activities. However, local and central government is not unconstrained in expanding debt. Local councils operate under debt ceilings, some with very little headroom to take on further debt. Also, central government operates under strong expectations of a low debt-to-GDP ratio to satisfy the principles of responsible fiscal management in the Public Finance Act 1989.[134]

Consequently, if future governments continue to operate under restrictive debt limits, the key to unlocking opportunities for GSS bonds will be securing revenue streams from funded projects. This can be achieved through user-pays approaches to infrastructure and assets that can impose a fee, such a utility charges for water usage. Where a direct payment is not feasible, value capture mechanisms can create revenue indirectly by operationalising the beneficiary-pays principle (see §1.4.2). This is shown in Figure 6 below where revenue from users and value capture from beneficiaries is used by bond issuers to service debt repayments.

Value capture mechanisms are underutilised in Aotearoa New Zealand, but there are examples in use:

- Targeted rates are implemented by local councils, a notable example being Auckland Council's Climate Action Targeted Rate, approved in 2022 and expected to raise NZ$574 million over the next 10 years. Similarly, Auckland Council's Natural Environment Targeted Rate is expected to raise NZ$311 million over 10 years from July 2018, which will support nature-positive activities that enhance landscape resilience.
- Local councils also have the means for raising a levy for repayment through the Infrastructure Funding and Financing Act 2020. This empowers local councils to collect a levy from the beneficiaries of new infrastructure, which is transferred to a Special Purpose Vehicle (SPV) which raises debt to undertake the construction. The SPV can build and finance various types of infrastructure, including three waters, transport, community facilities, and environmental resilience infrastructure such as flood protection, pump stations and environmental restoration.[135]

However, as shown earlier in Table 3 (see §1.4.2), there are a wider suite of value capture mechanisms which might be deployed to service debt on long-lived infrastructure. For example, a resilience bond which funds flood mitigation infrastructure might be complemented by a levy on incremental property tax value increases that eventuate from improvements (tax increment financing). Or a green bond raised to fund urban resilience through the establishment of green infrastructure and nature-based solutions could capture revenue through fees charged on businesses operating in the benefiting district (business improvement districts). Greater use of value capture mechanisms – with careful consideration of

[134] See Public Finance Act 1989, 26G Principles of responsible fiscal management. https://www.legislation.govt.nz/act/public/1989/0044/latest/DLM161668.html

[135] Ministry of Housing and Urban Development (2021). The new funding and financing model. https://www.hud.govt.nz/urban-development/infrastructure-funding-and-financing-act-2020/the-new-funding-and-financing-model/

distributional impacts – could enable critical infrastructure to be brought forward through bond issuance.

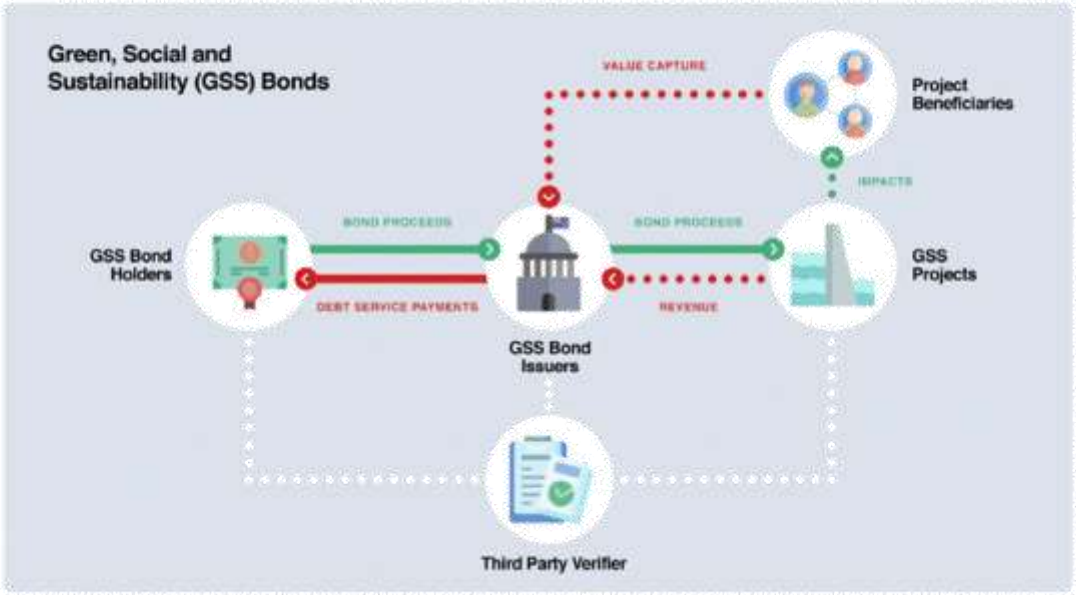


Figure 6: Financial flows for Green, Social and Sustainability (GSS) Bonds.

In the US, municipal revenue bonds are commonly used to finance adaptation infrastructure, where investors are repaid from the income created by that project. Consequently, cities and municipal subdivisions issue bonds to fund municipal projects such as a toll road, housing, hospitals, lighting systems, stadiums, and other community enterprises which serve those in the community who pay for services. These revenue bonds are issued in alignment with the Green Bond Principles and generally mature in 20 to 30 years.[136] To fund adaptation in Aotearoa New Zealand, these instruments could be used for infrastructure that produces a revenue stream, such as water infrastructure which attract utility payments. Alternatively, adaptation infrastructure might secure revenue from co-benefits or associated services. For example, in the Netherlands, seawalls and flooding buffer zones may have a dual function as car parks, thereby securing income from ticketing. Similarly, a constructed wetland or urban forest which contributes to water regulation and flood mitigation might impose a fee for access for recreational benefits (although this approach does raise issues of public access and equity). One example is Zealandia | Te Māra a Tāne in Wellington: this model of predator-proofed sanctuary could be replicated in other towns and cities to finance the protection and rehabilitation of critical ecosystems, such as wetlands, estuaries and urban forest, that enhance localised climate resilience.

Concept proposal: Resilient water infrastructure bond (or blue bond)

Sustainable water management is an eligible theme for the use-of-proceeds within green bond standards. Water-related use of proceeds can relate to aquatic biodiversity, wetland protection, climate change adaptation, and smart cities. In 2018, the Republic of the Seychelles issued the first bond explicitly marketed as 'blue', the Seychelles Blue Bond, which raised US$15 million for the expansion of marine protected areas, improved governance of priority fisheries, and the development of the Seychelles' blue economy. In January 2019, the

[136] McManus, K. (2022). Case study: Green municipal bonds in Massachusetts, USA. *LGiU*. https://lgiu.org/case-study-green-municipal-bonds-in-massachusetts-usa/

Nordic Investment Bank launched a Nordic-Baltic Blue Bond which raised SEK2 billion for projects such as wastewater treatment, prevention of water pollution and water-related climate change adaptation.

In Aotearoa New Zealand, water-related risks are a high priority for adaptation. In some regions, investment into three water infrastructure (drinking water, wastewater, and stormwater) has been insufficient.[137] The New Zealand Government is currently progressing the Three Waters programme to enable better investment by transitioning ownership of water assets from local councils to four new publicly-owned Water Services Entities.[138] One potential advantage of centralisation is that Water Services Entities would be attractive to capital market investors, and also enable higher leverage ratios than councils by creating additional debt capacity following reform (estimated at an additional NZ$4-8 billion over 2021-2031).[139]

Consequently, there is an opportunity to develop green bonds for water infrastructure (or blue bonds), issued by local councils and/or future Water Services Entities. These bonds could be used to aggregate a variety of activities that enable catchment-level improvements to water outcomes, such as upgrades to water treatment plants and pump stations, water supply pipes, stormwater networks and so on. Repayment for such infrastructure would be relatively simple, potentially through rates, water use and wastewater charges, and targeted or general rates. A blue bond might also complement grey infrastructure with green infrastructure – that is, the use of urban trees, wetlands, rain gardens, permeable pavements, bioswales etc. to regulate water, mitigate flooding and therefore reduce pressure on stormwater system. Such a proposal has been explored by Mōhio Research as the Hauraki Gulf Blue Bond (see image below), for which the use-of-proceeds are linked to the protection, rehabilitation and enhancement of the mauri (or life force) of the Hauraki Gulf/Tīkapa Moana/Te Moana-nui-ā-Toi.[140] The use of proceeds would generate a rich suite of environmental, social and financial benefits by taking a coordinated catchment-level approach to the protection of water resources by improved waste water treatment and water pollution prevention, storm water systems and flood protection; and also the application of a ki uti ki tai (from mountains to the sea) approach by the restoration of freshwater and marine ecosystems throughout the catchment. This same approach could be applied to other catchments.

[137] Infrastructure Commission (2021). *Investment gap or efficiency gap? Benchmarking New Zealand's investment in infrastructure.* Te Waihanga Research Insights series December 2021.
[138] Department of Internal Affairs (2022). Three Waters Reform Programme. https://www.dia.govt.nz/Three-Waters-Reform-Programme
[139] Department of Internal Affairs (2022). *Transforming the system for delivering three waters services: Summary of proposals.* https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme-2022/$file/Three-waters-reform-case-for-change-and-summary-of-proposals-15-June-2022.pdf
[140] Hall, D. & Lindsay, S. (2021). *Scaling Climate Finance: Biodiversity Instruments.* Mōhio Research. https://doi.org/10.34721/yc1w-me20

3.2 Sustainability-linked debt

Sustainability-linked debt	
Sustainability-linked debt (e.g. bonds and loans) involves interest rates tied to the achievement of sustainability performance targets.	
Advantages	**Challenges**
• A type of transition finance which creates incentives to increase the environmental performance of poor-performing assets. • A clear link to improved outcomes, because borrowers must meet sustainability performance targets to reduce their cost of funding.	• Ensuring that the selection of KPIs and the calibration of sustainability performance targets is sufficiently ambitious. • The risk of design flaws, such as built-in loopholes or ambiguity over achievement of targets. • A lack of standardisation in reporting and measurement criteria as the market emerges.
Enablers	
• Development of metrics and indicators that track adaptation alignment to incorporate into sustainability performance targets. • Standardised reporting and evaluation criteria will make sustainability-linked products more attractive to borrowers, issuers, and financing sources.	

Adaptation gap

Use-of-proceeds bonds, like green bonds, make up a large share of sustainable debt, about 45% of the US$4 trillion of total aggregate sustainable debt issued up to 2021.[141] But there are concerns that green bonds cannot drive transformational change, that debt financing might be applied to more sensitive leverage points.

Firstly, it is not uncommon for green bonds to involve the refinancing of existing green projects, or the funding of infrastructure that would have otherwise been funded with unlabelled infrastructure bonds or fiscal spending. This raises questions about additionality, about whether green bond issuance is actually driving change that would not have occurred without that intervention.[142] Secondly, because green bonds are defined by their use of proceeds, there is no clear link to actual outcomes or deliverables. Inadequate and inconsistent reporting and verification can mean that it is hard to determine whether green bonds are succeeding in delivering the desired impacts. Finally, green bonds do not necessarily channel finance to where it makes the most impact – that is, to improve the sustainability performance of poor-performing assets or activities. Indeed, such assets might be excluded from eligible investment categories, which entails a lost opportunity for transitioning those assets to more sustainable outcomes.

There is a gap, therefore, for finance that directly targets climate-misaligned assets, including assets which should be ineligible for GSS bond proceeds, with the intention of flipping them to climate-alignment. Encouraging the transition of individual assets is a key leverage point for the wider cross-sectoral transition to net-zero, climate resilient development.

[141] Bloomberg NEF (2022). Sustainable Debt Issuance Breezed Past $1.6 Trillion in 2021. *Bloomberg NEF*. https://about.bnef.com/blog/sustainable-debt-issuance-breezed-past-1-6-trillion-in-2021/

[142] Donovan, E., Abramskiehn, D., Hallmeyer, K. & Brown, J. (2018). *Approaches to assess the additionality of climate investments: Findings from the evaluation of the Climate Public Private Partnership Programme (CP3)*. Climate Policy Initiative. https://www.climatepolicyinitiative.org/wpcontent/uploads/2018/03/Approaches-to-assess-the-additionality-of-climateinvestments-_-Findings-from-the-evaluation-of-the-Climate-Public-Private-Partnership-Programme-CP3-2.pdf

Financial instrument

Sustainability-linked instruments are general debt instruments which offer borrowers a lower cost of capital if they achieve predefined sustainability targets. Sustainability-linked bonds (SLBs) and loans (SLLs) can be used to finance projects that are not 'green', but under the condition that borrowers improve their overall sustainability performance.[143] As such, SLBs and SLLs are types of transition finance, which support companies with poor sustainability performance to implement improvements. This is also the fastest growing theme in sustainability debt issuance. In 2021, SLLs and SLBs saw more than US$530 billion issued globally, compared to only a quarter of this value in 2020.[144]

For sustainability-linked debt, the issuer defines one or more key performance indicators (KPIs) and corresponding sustainability performance targets (SPTs) that are integrated into the financial and/or structural characteristics of the bond or loan. The SPTs serve as triggers for relevant financial clauses. Most commonly, issuers include a penalty clause, meaning that a missed target results in a coupon step-up or a premium payment to investors. Alternatively, the achievement of pre-agreed sustainability targets might trigger interest rate reductions that incentivise good performance.

Crucially, the reduction of interest is not merely altruistic, but strongly grounded in the prudential interests of lenders. The underlying financial logic of sustainability-linked debt is that 'sustainability performance can reduce environment-related risks and thus credit risk, some of which can be passed on to the borrower in lower interest rates.'[145] There, the adaptation theme ought to be well-suited to SLBs and SLLs, because the reduction of material risks from climate change impacts will also improve the capacity of the borrower to repay debt.

Case study: Chile's sovereign sustainability-linked bonds

The issuance of Chile's sovereign sustainability-linked bonds started in 2019 and provided positive financial results while simultaneously demonstrating Chile's commitment to climate action. The Ministry of Finance, responsible for the country's fiscal policy, has taken on a key role in channeling public and private capital flows to support and comply with environmental commitments, as evidenced by a diverse assortment of initiatives. These initiatives include the establishment of the Public-Private Green Finance Roundtable (Mesa público-privada de Finanzas Verdes), the publication of the first National Financial Strategy to deal with climate change, and the adoption of the first Sovereign Green and Sustainable Bond Frameworks in Latin America. Reinforcing this sustainable development strategy, Chile has purposefully embedded sustainability criteria within its sovereign bond issuances to simultaneously encourage inclusive development and economic growth.[146] In March 2022, the Republic of Chile priced the first-ever Sovereign Sustainability-Linked Bond (SSLB). This US$2 billion 20-year SLB was more than four-times oversubscribed. Chile's SLB Framework includes two KPIs: Absolute GHG Emissions (KPI 1) and Share of Non-Conventional Renewable Energy Generation in the National Electric System (KPI 2).[147]

[143] Vulturius, G., Maltais, A. & Forsbacka, K. (2022). Sustainability-linked bonds, their potential to promote issuers' transition to net-zero emissions and future research directions, *Journal of Sustainable Finance & Investment*. https://doi.org/10.1080/20430795.2022.2040943

[144] Bloomberg NEF (2022). Sustainable Debt Issuance Breezed Past $1.6 Trillion in 2021. https://about.bnef.com/blog/sustainable-debt-issuance-breezed-past-1-6-trillion-in-2021/

[145] Thomä, J., Caldecott, B. & Ralite, S. (2019). *Sustainability Improvement Loans: a risk-based approach to changing capital requirements in favour of sustainability outcomes*. Berlin, 2° Investing Initiative; Oxford, Smith School of Enterprise and the Environment, p.4.

[146] The Ministry of Finance of Chile (2022). *Chile's Sustainability-Linked Bond Framework*. https://www.hacienda.cl/english/work-areas/international-finance/public-debt-office/esg-bonds/sustainability-linked-bonds/chile-s-sustainability-linked-bond-framework

[147] Sustainalytics (2022). Government of Chile Sustainability-Linked Bond Framework Second Party Opinion. https://www.sustainalytics.com/corporate-solutions/sustainable-finance-and-lending/published-projects/project/government-of-chile/government-of-chile-sustainability-linked-bond-framework-second-party-opinion-(2022)/government-of-chile-sustainability-linked-bond-framework-second-party-opinion-(2022)

For SLBs, the ICMA's Sustainability-Linked Bond Principles (SLBP) provide guidelines on structuring features, disclosure and reporting.[148] The SLBP are intended for use by market participants and are designed to drive the provision of information needed to increase capital allocation to such financial products. The SLBP are applicable to all types of issuers and any type of financial capital market instruments. In 2021, the scale of global SLB issuance was nearly US$119 billion, significantly lower than the other GSS bond themes (see §3.1). However, SLB was also the fastest growing, increasing by 941% in the year to 2021 and issued in more than twice as many countries.[149]

Opportunities for Aotearoa New Zealand

There is already a proliferation of SLLs in Aotearoa New Zealand, especially in the agriculture sector.

The first SLL in Aotearoa New Zealand in 2019 was issued by ANZ to Synlait. The NZ$50 million loan was linked to Sustainalytics' ESG Risk Ratings, with a discount or premium applied to the base lending margin, contingent upon an annual assessment of performance against target. The targets were primarily focused on climate mitigation, including on-farm reduction of greenhouse gas emissions by 35% per kilogram of milk solids (kgMS) by 2028, avoiding the use of coal, improving water quality and supporting farmers and local communities. [150]

Other applications of SLLs in New Zealand include Pāmu, Spark Finance, Metlifecare, Genesis, The Warehouse Group, Hawke's Bay Airport, Summerset Group Holdings, Contact Energy, Kathmandu Holdings Ltd, Southern Pastures, and Christchurch International Airport.[151] Most SLLs are aligned with the SBTi for Scope 1 and 2 emissions. While these SLLs mostly relate to mitigation, the inclusion of targets to improve adaptation alignment offer another domain for innovation (see **Concept Proposal: Climate Resilience Loans** below).

A recent SLL by BNZ tilts in this direction by incorporating resilience factors, especially around water management. In line with the Sustainable Agriculture Finance (SAFI) guidance, released by The Aotearoa Circle, farmers are able to choose between 3-5 areas to improve upon, including: (1) climate change mitigation (mandatory) by mitigating total on-farm GHG emissions; (2) pollution prevention and control by improving no-farm waterway quality; (3) sustainable use and protection of water by increasing efficiency of water use on-farm; (4) protection of healthy eco-systems by improving on-farm native terrestrial and aquatic biodiversity and/ or improvements in soil health; (5) waste prevention and recycling waste by reduction in the level of on-farm waste generated/improvement in recycling of waste; and (6) a social target to improve in areas such as animal welfare, labour practices (including health and safety and labour rights), and governance.[152]

Emergence of adaptation-oriented SLLs is likely to occur organically as lenders increase their knowledge of climate-related risks. The forthcoming mandatory requirements for climate risk disclosures for large companies is likely to accelerate this process by making large companies and financial institutions more aware of the climate-related risks in their assets and portfolios. SLLs, or even SLBs for large companies with investment-grade credit ratings, could be used to manage risks and to engage proactively with (prospective) lenders.

---

[148] ICMA (2020). *Sustainability-Linked Bond Principles.* https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/sustainability-linked-bond-principles-slbp/
[149] Climate Bonds Initiative (2022). *Sustainable Debt*
[150] ANZ (2019). A sustainable first: Synlait inks NZ's first ESG-linked loan. *ANZ News.* https://news.anz.com/new-zealand/posts/2019/10/nz-s-first-sustainability-loan
[151] Toitū Tahua | Centre for Sustainable Finance (2022). Examples of Sustainable Debt Transactions in Aotearoa New Zealand. https://www.sustainablefinance.nz/updates/sustainability-linked-loans-amp-green-bond-issuances-on-the-rise-in-aotearoa
[152] BNZ (2022). BNZ launches interest rate incentives for environmentally ambitious farmers. https://blog.bnz.co.nz/2022/05/bnz-launches-interest-rate-incentives-for-environmentally-ambitious-farmers

Arguably, SLLs and SLBs have greater transformative potential than GSS bonds, by being linked to verified outcomes rather than mere use-of-proceeds. Issuing SLBs under Treasury's investment framework for sovereign green bonds could be a way to ensure that the New Zealand Government is driving change through future issuances. However, greater scrutiny is needed to overcome greenwashing and confusion.[153] These risks can be managed by using definitional tools such as taxonomies to improve understanding of eligible economic activities and material performance indicators; using science-based targets as best practice; and setting meaningful incentives for issuers or borrowers to improve their sustainability performance.

Concept proposal: Climate resilience loans

Through the growing influence of disclosure frameworks such as Taskforce for Climate-related Financial Disclosures (TCFD) and Taskforce for Nature-related Financial Disclosures (TNFD), lenders and investors will in future years increase their awareness and knowledge of climate- and nature-related risks. Climate risk will increasingly be treated as financial risk. This opens the door to climate risk-adjusted loans that reflect climate risk through the setting of interest rates.

Consider the forestry sector. A recent survey found that, in Aotearoa New Zealand, less than 10% of smallholder forest owners adopted adaptation strategies.[154] While there is high uncertainty for climate-related risks for plantation forestry, there are reasonable concerns over issues such as windthrow, particularly in densely planted stands, [155] and wildfire as the frequency of fire weather increases along the east coast of Aotearoa New Zealand.[156] These pose material risks to forestry companies and farm businesses with small forests, which have relevance for associated investors and creditors. For example, the 2020 New Zealand Superannuation Fund Climate Change report identified timber investments as one of five investments with the greatest physical climate-related risk to its real assets.[157]

In a 2020 concept paper on forest finance, Mōhio Research proposed sustainability-linked loans which offer declining interest rates as forest managers implement climate adaptation best practices to avoid climate-related risks such as wildfire and windthrow.[158] For example, forest managers might transition from even-aged monocultures to mixed stands, plant alternate genotypes or new species, incorporate green firebreaks and fire ponds, increase the use of continuous cover forestry systems, reduce rotation lengths for clearfell forestry, undertake sanitation thinning, and other strategies.[159] Subsequent reductions to interest rates would reflect the declining risk of loss and damages to the forestry asset, and therefore the reduced risk of default.

This same approach could be applied across the primary sector (and other sectors too). For example, climate-induced changes in temperature and seasonality will have significant implications for agriculture and horticulture, affecting where certain crops such as kiwifruit can be grown. Drought is projected to increase in frequency and severity, which puts pressure on freshwater uses and makes New Zealand's primary sector particularly vulnerable to declining crop yields and pasture growth. Extreme weather events which trigger erosions and flooding will also increase damages to farm infrastructure such as fences and roads. These physical risks could all contribute to financial stress among farmers and growers, increasing the risk of default on underlying loans and mortgages.

However, these risks can be anticipated and managed. Risk reduction strategies, such as the integration of on-farm nature-based solutions, water demand management, and drought-tolerant crops and pastures could be the basis of sustainability performance targets. A sustainability-linked loan structure could be developing, using revolving credit facilities with an interest rate that adjusts depending on whether targets are met – e.g. successfully retiring and restoring a pre-agreed percentage of vulnerable land to natural or semi-natural ecosystems, reducing water use to a pre-specific or diversifying the pasture mix.

[153] Walsh, T. (2022). SLBs 'more effective' in driving energy transition than green bonds. *IFR*. https://www.ifre.com/story/3451678/slbs-more-effective-in-driving-energy-transition-than-green-bonds-t65lfnfvqq

[154] Villamor, G.B., Dunningham, A., Stahlmann-Brown, P. and Clinton, P.W. (2022). Improving the Representation of Climate Change Adaptation Behaviour in New Zealand's Forest Growing Sector. Land, 11, 364.

[155] Modelling the influence of predicted future climate change on the risk of wind damage within New Zealand's planted forests JR Moore, MS Watt *Global change biology* 21 (8), 3021-3035.

[156] Melia, N., Dean, S., Pearce, H. G., Harrington, L., Frame, D. J., & Strand, T. (2022). Aotearoa New Zealand's 21st-century wildfire climate. *Earth's Future*, 10, e2022EF002853. https://doi.org/10.1029/2022EF002853

[157] The other four were retirement/aged care, New Zealand rural land (dairy), toll roads, and banking. See NZ Super Fund (2022). *Climate Change Report 2022*. https://www.nzsuperfund.nz/how-we-invest/sustainable-finance/climate-change/

[158] Hall, D. & Lindsay, S. (2020). *Scaling Climate Finance: Forest Finance Instruments*. Mōhio Research. https://www.mohio.co/forestfinance

[159] Yousefpour R. et al., (2012). A review of decision-making approaches to handle uncertainty and risk in adaptive forest management under climate change. *Annals of Forest Science* 69, pp.1–15.

3.3 Resilience credits

Resilience credits	
Resilience credits are a carbon-plus-resilience credit where a carbon credit in voluntary or compliance markets is earmarked with additional, verified adaptation impact.	
Advantages	**Challenges**
• Resilience credits piggy-back on existing market structures, so no new market development is required. • Potentially creates market premium for carbon credits with additional resilience and biodiversity value.	• Requires agreed-upon metrics for adaptation value and baseline settings. • Resilience credits create additional verification costs for suppliers. • Creates a 'right to emit' that may deter emissions reductions.
Enablers	
• The integration of tagging and improved traceability into compliance and voluntary carbon markets. • Improved valuation of adaptation-related ecosystem services to help the market price the added value of resilience. • Development of MRV protocol for adaptation improvement which complement existing MRV protocol for emissions reduction units.	

Adaptation gap

One function of carbon markets is to monetise the sequestration of carbon, and thereby to internalise the positive externality of carbon removals. In Aotearoa New Zealand, the primary instrument is the Emissions Trading Scheme (ETS), a compliance carbon market, but transactions occur through voluntary carbon markets too. However, there is no equivalent market for adaptation that produces a direct incentive for activities that improve resilience to climate-related shocks. Consequently, there is an asymmetrical approach to climate strategy, where mitigation is prioritised over adaptation. Unfortunately, this results not only in insufficient action on adaptation, but also heightens the risk that action on mitigation will produce maladaptive outcomes.

Consider unharvested exotic forestry (i.e. carbon farming) which, as the price of NZUs in the ETS increases, is becoming the highest and best land use across many land classifications. Moreover, profitability is maximised by dense, monospecific planting of mass-produced species with minimal ongoing management. However, such forests are suboptimal from an adaptation perspective. Forests that lack diversity in species and age class are generally more vulnerable to widespread impacts from climate-related impacts such as drought stress, wildfire, novel pests or diseases, or windthrow from extreme weather.[160] Furthermore, once forest growth slows and cashflow diminishes, then liquid income for ongoing forest management will reduce. These forests are liabilities, for which the costs may be ultimately borne by local communities. Outcomes of this kind have been referred to as *bio-perversities*, where climate policy drives perverse outcomes from the standpoint of other environmental objectives.[161]

One option is to create a complementary economic instrument that creates a direct financial incentive for adaptation-aligned outcomes. This is explored in §3.4 on adaptation markets below.

Another option is to redesign existing carbon markets to give greater weight to adaptation value. There are inherent challenges in designing a policy instrument that attempts to address multiple policy objectives; however, for a complex policy problem like climate change, it is

[160] Anderegg, W. et al. (2020). Climate-driven risks to the climate mitigation potential of forests. *Science*, 368(6497). https://doi.org/10.1126/science.aaz7005

[161] Lindenmayer, D. B. et al. (2012). Avoiding bio-perversity from carbon sequestration solutions. *Conservation Letters*, 5(1), pp.28–36. https://doi.org/10.1111/j.1755-263X.2011.00213.x.

highly likely that any particular policy instrument will affect more than one objective. This is indeed the case for the ETS which, by incentivising afforestation, has both negative and positive implications for climate adaptation. On the negative side, as discussed already, carbon markets can produce maladaptive outcomes such as high-risk forests. However, on the positive side, the right tree in the right place for the right purpose can enrich landscape resilience through biodiversity enhancement, ecological connectivity, and the amelioration of erosion, soil loss and sedimentation. By acknowledging these negative and positive spillovers, then redesigning the instrument accordingly, there is an opportunity to better align an existing policy instrument, such as carbon markets, toward improved adaptation outcomes.

Financial instrument

Resilience credits involve supplementing a carbon credit in voluntary or compliance markets with a 'clip-on' that signifies additional resilience value. This enables the market to distinguish between carbon credits that are produced by adaptation-aligned activities from activities that are maladaptive or neutral. By combining carbon and adaptation value in a single unit, a price premium may emerge in market trading. Alternatively, in a compliance market like the ETS, a premium might be secured by fixed price contracts or the implementation of purchase obligations where market participants are required to purchase a set volume of resilience credits as part of their surrender obligations.

This financing opportunity is currently limited to projects and activities that are (1) eligible for receiving units in voluntary and/or compliance carbon markets; and (2) co-produce dual benefits of mitigation and adaptation. Globally, carbon markets have been established to include a wide range of ecosystems, such as forests, wetlands and mangroves – with efforts underway to develop methodologies and protocols to enable the inclusion of soil and peatlands, and blue carbon like seagrasses and kelp forests. Where these nature-based solutions *also* enhance the resilience of landscapes and seascapes, there is a potential opportunity to develop resilience credits in search of a premium.

Resilience credits would work in the same way that nature-based carbon credits do. Nature-based carbon credits are tagged or earmarked as representing biodiversity value beyond the simple value of carbon, and therefore may attract a market premium. An example of a nature-based carbon market is Climate Impact X (CIX) in Singapore,[162] which has a marketplace of nature-based projects for firms to invest in to meet corporate sustainability objectives, and an exchange where high-quality carbon credits are freely traded in larger quantities, catering mainly to multinationals and institutional investors. CIX uses satellite monitoring, machine learning and blockchain to ensure the enhance transparency, integrity and quality of its carbon credits and their nature-positive benefits.

Case study: Blue Carbon Resilience Credit

Nature Conservancy has proposed a Blue Carbon Resilience Credit, a hybrid blue carbon and resilience credit, which companies can purchase to offset their carbon footprint and thereby fund coastal restoration and conservation projects.[163] It was recognised that mangroves alone provide more than US$82 billion in annual storm protection throughout the world. Meanwhile insurers have paid out over US$300 billion for coastal damages from storms in the last decade. Although carbon markets are well-established, coastal wetlands have had limited access. BCRC integrates mitigation metrics in the form of avoided CO2 equivalent emissions; and adaptation metrics in the form of flood protection benefits that a wetland provides nearby coastal communities. A third-party verified framework ensures purchaser confidence and offers purchasers the added benefit of quantifying their contributions to SDG Goal 13: Climate Action. Target pilot sites include Belize and Papua New Guinea.

[162] SGX (n.d.). Climate Impact X. https://www.sgx.com/climate-impact-x-cix
[163] The Lab (2019). Blue Carbon Resilience Credit. https://www.climatefinancelab.org/project/blue-carbon-resilience-credit/

For resilience credits, the premium would be driven by a verified contribution to adaptation rather than biodiversity. However, there is likely to be a significant overlap with nature-based carbon credits, given that nature-based sequestration remains the major source of carbon removals, and also because biodiversity is strongly correlated with ecosystem resilience. However, the scope of resilience credits is likely to be narrower than nature-based markets, because it may prioritise, for instance, forest on erosion-prone slopes rather than forest on flat land, or wetland restoration in flood-prone catchments rather than wetland.

Opportunities for Aotearoa New Zealand

The opportunity for resilience credits in Aotearoa New Zealand can be conceived by imagining a Venn diagram, where the opportunity is defined by the intersection of two sets: (1) carbon removals that are eligible for carbon markets and (2) carbon removals that demonstrably improve adaptation and resilience. In practice, however, this overlapping region is likely to be relatively small, potentially excluding too much ecosystem-based adaptation to warrant the instrument.

In Aotearoa New Zealand, the most important eligibility criterion is the forestry definition, which is used for target accounting and also currently determines eligibility for the ETS. This requires a forest to be planted after 31st December 1989 and to be larger than one hectare, wider than 30 metres, over 30 per cent canopy cover, with trees higher than five metres. Voluntary markets also generally defer to the forestry definition to ensure alignment with national target accounting.

Of ETS-eligible forest, resilience credits might be issued to, say, registered forest on Land Use Capability 5 or above – that is, steep and erosion-prone land. Resilience credits might also be issued to forest within, say, 100 metres of a waterway to recognise the benefits of the prevention of sedimentation, and water and nutrient regulation. Resilience credits might also be issued to forests with high resilience functions, such as forests with an uneven age class, diverse species mix, and high proportion of species with lower flammability. If the resilience credit secured a price premium – either by market demand or regulatory settings such as purchase obligations or fixed price offers – this would further incentivise the planting of forests that produce the greatest adaptation co-benefits. Higher cashflow might also further reduce the need for harvesting.

However, this only captures a small proportion of the nature-based solutions that co-produce carbon sequestration and adaptation value. Specifically, the forestry definition excludes small forests, riparian buffers, wetlands, peatlands, mangroves and other forms of ecosystem-based adaptation. This could be changed by revising the forestry definition, but renegotiating rule changes through the UNFCCC is a significant undertaking, especially under the Paris-era framework of raising ambition. Voluntary markets have greater flexibility; however voluntary markets for units from these ecosystem types are nascent or non-existent. Furthermore, the creation of markets takes time and resources, especially to develop MRV protocol to underpin the issuance of credits. While carbon markets are sure to evolve, it is also likely that, in future, the political and social pressure will increase to constrain – rather than expand – the volume of carbon credits for offsetting. As the world depletes the carbon budgets for 1.5°C and 2°C, the importance of reducing emissions by decarbonisation and demand reductions is ever more critical, as well as reserving carbon removal opportunities for negative emissions rather than net-zero.[164]

[164] Carton, W., Knorr, W., Lewis, S. et al. (2022). *Net Zero, Carbon Removal and the Limitations of Carbon Offsetting*. CSSN Position Paper 2022:1. https://cssn.org/wp-content/uploads/2022/06/Net-Zero-and-Carbon-Offsetting-Position-Paper.pdf

Consequently, resilience credits are likely an instrument with limited applicability in Aotearoa New Zealand. Such credits may create extra cashflow for large forests which can already access revenue through carbon markets (and indeed can already access some payments for adaptation value via local and central government grants for erosion control, such as the Erosion Control Funding Programme). But resilience credits cannot generate revenue for the ecosystem types that arguably need financing options more urgently, because they are ineligible for carbon markets.

3.4 Adaptation equity

Adaptation equity	
Adaptation equity involves taking ownership stakes in companies that produce adaptation and resilience benefits as part of their business strategy, alongside financial returns.	
Advantages	**Challenges**
• Impact-oriented equity creates a more flexible form of financing for companies. • Companies can gain valuable technical support and guidance from shareholders to assist in company growth.	• Impact investment ecosystem in Aotearoa New Zealand is still relatively immature. • A culture of risk aversion to equity financing. • A reluctance to dilute ownership through partial liquidation of assets, especially for whenua Māori.
Enablers	
• Structured finance that includes a first-loss layer for investors or grantors with higher risk appetites, which enables risk averse investors to participate within their fiduciary mandate.	

Adaptation gap

Some companies produce adaptation and resilience benefits as a part of their ordinary business companies. One way to enhance adaptation alignment is to ensure that these companies scale up in order to maximise these benefits.

Adaptation companies come in two types. The first type 'offer technologies, products and services (adaptation solutions) that build resilience, reduce vulnerability and help clients adapt to climate change or identify, evaluate, manage and/or monitor physical climate risks and impacts'.[165] Examples are companies which offer climate-resilient agricultural extension services, drought tolerant crop species, drip irrigation technology, IT-supported weather forecasts, or storm resistant building materials.

The second type are companies that 'adapt to climate change in their production or operational process beyond "business as usual" and in a way which also contributes to climate resilience of clients or society.'[166] Examples are an agricultural producer which uses climate-resilient production methods to ensure food security for local communities, or a water utility company which invests in grey and green infrastructure that improves water regulation in a hydrological catchment.

Improving access to equity for adaptation companies, and improving the terms and conditions on which it is given, can support these companies to grow and maximise their impact. However, Aotearoa New Zealand is relatively risk averse in respect to holding company share, especially among retail investors. More generally, investment into start-ups and early-stage companies is inadequate. Recent analysis found that, among small advanced economies, New Zealand had both the lowest amount of investment in climate tech and the fewest climate tech innovators receiving funding. New Zealand climate tech innovators raised 95% less funding than climate tech innovators in the average small advanced economy.[167]

[165] Würtenberger, L. (2022). *Impact investing for climate change adaptation: An introduction*. Bonn and Eschborn: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. https://www.adaptationcommunity.net/wp-content/uploads/2022/11/GIZ_PAF-Impact-Investing-for-Climate-Change-Adaptation.pdf
[166] Ibid.
[167] Cleantech Group (2021). *New Zealand Climate Tech for the World*. San Francisco & London: Cleantech Group. https://www.callaghaninnovation.govt.nz/sites/all/files/NZ_Climate_Tech_For_The_World_report.pdf

Financial instrument

Equity is an individual or entity's degree of ownership in any asset after all associated debts or liabilities are accounted for. A common type of equity is shares which each represent an ownership interest in that company.

Equity tends to have a higher cost of capital for companies than debt financing, because shareholders expect a higher rate of return to compensate for taking on the risk of the investment. Accessing equity can also be time-consuming and incur additional costs through fees for lawyers and other financial professionals. Nevertheless, issuing equity is a critical means of raising growth capital: it is more flexible than debt because it avoids the regular repayments which increase fixed costs for the company. Equity also creates opportunities for mentorship and strategy development, because investors may provide technical expertise and support to support the company's growth.

To improve access to equity for companies that produce social and environmental impact, impact-oriented investors and funds are increasingly seeking shares in companies that can demonstrate a positive contribution to challenges like climate adaptation. This is one investment strategy for impact investing, which seeks to produce positive social and environmental impacts in addition to financial return. Where the latter is difficult to achieve, blended finance structures (see §3.6) can be used to restructure risks and returns in order to meet the requirements of investors. Under the right circumstances, impact investors may take on the responsibilities of partial ownership of adaptation companies to gain exposure to social and environmental impacts, as well as financial returns.

Internationally, adaptation equity funds are beginning to emerge, which focus on both types of adaptation company: firstly, companies which offer goods and services that address adaptation challenges (see **Case study: Lightsmith Climate Resilience Fund** below) and, secondly, companies which benefit communities and stakeholders by adapting to climate change and therefore continuing to provide essential goods and services (see **Case study: Acumen Resilient Agriculture Fund** below).

Case study: Lightsmith Climate Resilience Fund (LCRF)

The Lightsmith Climate Resilience Fund (LCRF), managed by the Lightsmith Group, is the first private equity fund focusing on climate resilience and adaptation by investing in growth-stage technology companies that address climate impacts. The fund focuses on six initial technology areas: water efficiency and smart water management, resilient food systems, agricultural analytics, geospatial intelligence, supply chain analytics, and catastrophe risk modelling and risk transfer. With its final closing in January 2022, the LCRF had US$186 million of commitments from, among others, the Green Climate Fund, European Investment Bank, Asian Infrastructure Investment Bank, KfW on behalf of the German Ministry for Economic Cooperation and Development (BMZ), the PNC Insurance Group, The Rockefeller Foundation, Kinneret Group, and Caprock Impact Partners.

The LCRF is complement by the Adaptation SME Accelerator Project (ASAP), a grant-funded initiative which seeks to build an ecosystem for small- to medium-sized companies in emerging markets that have technologies, products, and services that enhance climate resilience in sectors such as agriculture, analytics and risk modelling, water, insurance and risk transfer, energy, transportation, and infrastructure. It partners with existing incubator and accelerator programmes to scale up promising adaptation companies.

Case study: Acumen Resilient Agriculture Fund (ARAF)

The Acumen Resilient Agriculture Fund (ARAF) is a US$58 million impact fund and the world's first equity fund designed to build the climate resilience of smallholder farmers. ARAF supports smallholder farmers in Africa by investing in early and early-growth stage agribusinesses, then providing assistance through critical information, affordable financing, modern inputs, and access to formal markets. This enables farmers to anticipate, withstand and bounce-back from climate-related impacts, resulting in increased yields and incomes. Consequently, ARAF succeeds as an example of 'doing well by doing good', where the increased resilience of farmers translates into higher and more secure financial returns from equity funding.

ARAF is capitalised with blended finance (see §3.6) which is anchored by the UNFCCC's Green Climate Fund, but crowds in further contributions from FMO, the Soros Economic Development Fund, PROPARCO, the

Children's Investment Fund Foundation, Global Social Impact, IKEA Foundation, and others. The structure of ARAF involves a first-loss layer, funded by the IKEA Foundation and the Green Climate Fund, which enables investors with a lower risk tolerance to participate by facilitating a higher close. This differs from traditional investment funds where each investor enters with the same terms and expectations.

Opportunities for Aotearoa New Zealand

Equity funding for environmental impact is an under-utilised source of finance in Aotearoa New Zealand. Given the steady increase of house prices over past decades, as well as memories of the 1987 stock market crash, financial wealth has tended to pool in housing assets rather than company shares, which deprives companies of an important source of growth capital.

However, initiatives such as Impact Investing Network are raising awareness of the opportunities to use equity finance to pursue social and environmental impact in addition to financial returns. Also, companies such as Sharesies, which offer fractionalised shares, are enabling a wider set of prospective investors to engage in holding shares.

Examples of impact investing in climate resilience are already emerging in Aotearoa New Zealand. AgRegen is a newly established impact investment fund which aims to apply large-scale regenerative farming techniques to environmentally degraded and financially distressed dairy farmlands. The strategy is to acquire farmland by buying low at a 'stranded price', then improve the farm business model by reducing input costs through regenerative practices and securing a price premium for agricultural produce.[168]

There are challenges, however, on the supply side of adaptation equity. Although agriculture is an obvious candidate for adaptation equity, farmers generally do not like to share ownership of farms through partial liquidation of the farm asset. This is especially relevant for Māori farmers and landowners who, given the history of land loss throughout colonisation, may not wish to dilute ownership of land.

However, there are ways around this. Firstly, farmers can only sell a minority stake and therefore retain majority ownership of farm businesses, which preserves the decision-making power of the farmer while improving access to equity capital and investment advice. Secondly, LOVE TO in Australia is piloting an equity scheme where shares belong to a mutual company which verifies environmental impact, rather than the farm business themselves, so farmers retain ownership of farms while monetising the environmental impact (see **Case study: LOVE TO's LivingShares™** below). However, to adopt that model, the New Zealand Government will need to pass reforms like Australia did in 2019 which enable mutual companies to issue capital instruments for ordinary shares. The Reserve Bank of New Zealand is currently considering options for enabling such issuance in future.[169]

Case study: LOVE TO's LivingShares™

LOVE TO is an ecosystem of companies in Australia which protect and regenerate nature as part of their business activities, especially regenerative agricultural businesses which improve the resilience of pastoral land. LOVE TO is a Mutual Company which issues LivingShares™, a tradeable, liquid, public company share which is backed by verified environmental impact and pays a dividend yield. Businesses that join LOVE TO must undertake a monitoring and evaluation process to verify the positive environmental impacts of their businesses, but subsequently receive options over LivingShares™ in recognition of this value.

Technically, the LivingShares™ are a Mutual Capital Instrument, a form of share that an investor can own in mutual entities. For every four options issued to participating businesses, one option is issued to the Mutual Company in recognition of its verification work. Options can then be sold via brokers, or potentially a stock

[168] See the AgRegen website: https://agregen.co.nz/

[169] Reserve Bank of New Zealand (2022). Mutual capital instruments: Developing options for mutual banks to issue capital instruments which qualify as CET1 capital. Wellington: RBNZ. https://www.rbnz.govt.nz/-/media/cef21fcf60f54585a9ef0e5d5594500f.ashx

exchange in future. Market demand is expected especially from institutional investors whose governments or corporate clients have mandated them to invest in projects that demonstrate and verifiably prove outcomes like climate change mitigation or adaptation or positive social impacts. By selling options, businesses receive liquid cashflow for their environmental impact.

At the time of writing, LOVE TO is piloting with 25 regenerative farmers working across 295,000 hectares of Australia. This has yielded an initial asset of 9.5 million LivingShares™, initially valued at A$1 per share, but with an ambition to increase volume and price as the programme scales up.[170]

[170] LOVE TO Be Bright Green website. https://www.loveto.group/bbg-im

3.5 Adaptation markets

Adaptation markets	
Adaptation markets (voluntary or compliance) enable the exchange of climate-related risk reductions, where the owners of resilience-enhancing projects can sell that value on to purchasers, thus matching supply and demand for resilience.	
Advantages	**Challenges**
• Directly values the benefits of adaptation so optimises for adaptation alignment. • Potential applications in both voluntary and compliance markets. • Enables cost-efficient adaptation without central planning.	• Requires agreed-upon metrics for adaptation value and baseline settings. • Political economy constraints in price-based instruments, especially if price pushed onto consumers. • Compliance markets would require significant regulatory development.
Enablers	
• Development of MRV protocol for monitoring, reporting and verification of adaptation improvements. • Improved knowledge through climate and nature-related risk disclosures of the vulnerabilities across value chains, and hence an enlightened self-interest to finance risk reductions. • Compliance markets can ensure demand for adaptation alignment.	

Adaptation gap

Resilience is a property that belongs not only to individuals, companies, or communities, but also to the systems within which they operate. These wider systems might include infrastructure networks, supply chains, landscapes, and local or global economies. If these wider systems are resilient, they bestow some resilience upon the humans who inhabit them.

This poses a challenge for improving resilience and adaptive capacity. If the resilience of private individuals and/or companies is dependent on these wider systems, how can works be undertaken at the system level to improve resilience? Public infrastructure is historically delivered by public works, but this is well-suited to single-asset interventions at a particular location. It is less well-suited to, say, landscape-level restoration which involves a multitude of actions and practices across diverse locations. This is because Aotearoa New Zealand is defined by a regime of individual property rights, as well as collectively owned Māori land, which puts legislative and sociocultural limits on the extent to which government can determine land use choices. If government uses its coercive powers to mandate certain land uses (beyond what is already possible by resource management legislation), the government runs the risk of violating private property rights or Māori land rights. This constrains government's capacity to deliver system-level adaptation.

Turning from the supply- to the demand-side, however, there is a growing appreciation of the importance of system-level resilience among those who stand to benefit. The uptake of climate-related risk reporting and disclosure under the TCFD frameworks is designed to sharpen the minds of boards and directors to the risks of climate change. The TNFD is currently preparing a complementary framework on nature-related risks that emerge from biodiversity loss and degradation. By improving knowledge of the materiality of such risks, businesses are increasingly motivated to improve the resilience of their value chain through risk reductions. Some risks can be reduced directly by investing in a company's assets and employees; however, much will depend on enhancing the resilience of a company's supply chains, its stakeholders, and the ecosystems it interacts with. In other words, it requires future-proofing the systems in which a company's value chain operates – and therefore overcoming the constraints identified in the previous paragraph.

Financial instrument

Adaptation markets involve the exchange of climate-related risk reductions, where the demand for system-level resilience by beneficiaries is matched with supply from the owners of adaptation projects. By creating novel supply chains that connect demand with supply, landscape-level activities can be delivered by diverse actors without relying upon government intervention on privately owned property. These markets could be voluntary, which involve voluntary exchange of adaptation outcomes, or a compliance market, where participants have legally mandated obligations to purchase adaptation outcomes.

The concept of adaptation markets is not novel.[171,172] However, there are few examples in practice, especially when compared to the relative maturity and coverage of carbon markets. The examples that do exist are voluntary. One example is Landscape Enterprise Networks (LENs), a series of pilots in the UK and Europe which link together the demand- and supply-side for landscape-level adaptation through collaborative value chains (see **Case Study: Landscape Enterprise Networks** on the following page). Another example is The Nature Conservancy's Water Funds which enable the downstream beneficiaries of water quality improvements to invest collectively in a fund, which is then deployed upstream to fund activities, such as nature-based solutions, that enhance water outcomes (see **Case Study: The Nature Conservancy's Water Funds** below).

Compliance adaptation markets are a hypothetical instrument which exist in academic literature but not yet the real world.[173] These are similar to compliance carbon markets, such as the ETS, insofar as they impose mandatory obligations upon participants. However, instead of ratcheting down the quantity of a harm (e.g. emissions in a cap-and-trade scheme), the objective of adaptation markets is to ratchet up the quantity of a public and private good: namely, system-level resilience. As such, the compliance market compels individuals and firms to act in their own enlightened self-interest by reducing their climate risks, thereby overcoming any behavioural barriers that might otherwise have prevented risk management. This also fixes demand, reducing the uncertainty and higher transaction costs that suppliers face in voluntary markets.

One proposal is a system of tradable certificates to achieve adaptation quotas.[174] In this system, participating companies, sectors or even countries will have obligations to produce or purchase a specific amount of adaptation certificates over a given time period. Owners of adaptation projects will receive certificates depending on the achievement of adaptation units, then trade these with participants who have obligations under the scheme. Such a system would be economically efficient insofar as participants in the market would prioritise the projects that avoided the most damage for the lowest cost.

[171] Callaway, J. (2004). Adaptation benefits and costs: are they important in the global policy picture and how can we estimate them?,*Global Environmental Change* 14, pp.273-282.
[172] Michaelowa, A, (2012). *Carbon Markets or Climate Finance: Low Carbon and Adaptation Investment Choices for the Developing World*. London: Routledge.
[173] Butzengeiger, S., Michaelowa, A., Köhler, M. & Stadelmann, M. (2011). *Policy instruments for climate change adaptation - lessons from mitigation and preconditions for introduction of market mechanisms for adaptation*. OECD. https://www.oecd.org/env/cc/48351213.pdf
[174] Tarask, G. (2014). The concept and potential of adaptation markets. *American Progress*. https://www.americanprogress.org/article/the-concept-and-potential-of-adaptation-markets/

Case study: Landscape Enterprise Networks (LENs)

Landscape Enterprise Networks (LENs) are a mechanism which link investment and management practices to the long-term needs of business and society.[175] These interests could include mitigation of flood risk, regulation of water catchments, management of carbon or biodiversity, resilient food production, and workforce wellbeing. LENs mobilise these interests by building a series of place-based chains of transactions – 'collaborative value chains' – which enable groups of businesses to co-procure landscape outcomes from land-based organisations that can make things happen on the ground. Aggregators are used on both the demand and supply-side to coordinate actors, increase efficiencies and achieve a commercialisable scale. This lays the foundations for regional trading systems that support and enable farmers and landowners to contribute to resilient landscape outcomes. LENS were first piloted by 3Keel in Cumbria in 2017, which have extended throughout the UK as well as Poland, Hungary and Italy. Nestlé is a partner in the LENs network.

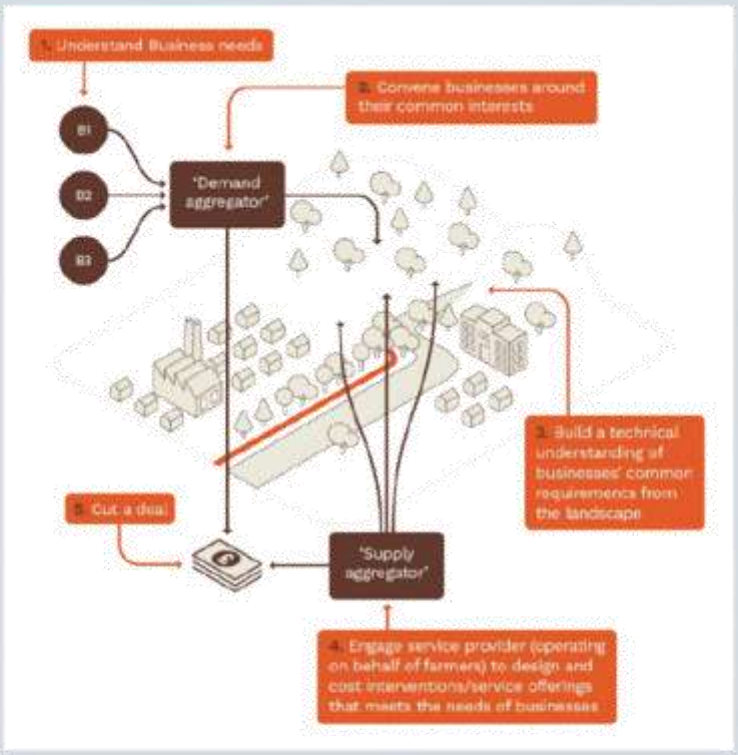


Figure 7: Structure for Landscape Enterprise Networks (from https://landscapeenterprisenetworks.com).

A key technical precondition for a compliance market is defining an adaptation unit with robust impact metrics. Ideally, this would be backed by an evaluation framework that quantifies the avoided harms, such as economic damages to natural or engineered assets (expressed in dollars) or health impacts (expressed in disability-adjusted life-years, or DALYs). Once the unit is defined, policy makers must then overcome the political challenge of developing baselines; develop a monitoring, reporting and verification (MRV) framework to govern *ex post* verification and issuance of units; and negotiate quotas which set an appropriate level of ambition and cost for participants. A further technical precondition is predictability – that is, it must be possible to anticipate *ex ante* how many adaptation units can be achieved by a specific project, so that project managers and investors know how to allocate funding. In short, compliance markets for adaptation, no different to the ETS, would be a significant regulatory undertaking.

[175] Landscape Enterprise Networks. https://landscapeenterprisenetworks.com/

Case study: The Nature Conservancy's Water Funds

The Nature Conservancy (TNC) developed Water Funds to improve water quality in watersheds or hydrological catchments through nature-based solutions and sustainable watershed management. Downstream water users, such as businesses, utilities and local governments, invest money collectively in the Water Fund, which is then used to pay for activities upstream needed to conserve and restore the natural systems that generate value throughout the watershed. By maintaining a supply of clean water, Water Funds enhance the resilience and prosperity of downstream water users – such as water utility companies, hydropower companies, and other industries. The use of nature-based solutions upstream also enables downstream water users to avoid expensive investment in grey infrastructure. TNC established its first Water Fund in Quito, Ecuador, in 2000. By November 2020, there are 43 Water Funds created in 13 countries globally, including Aotearoa New Zealand.[176]

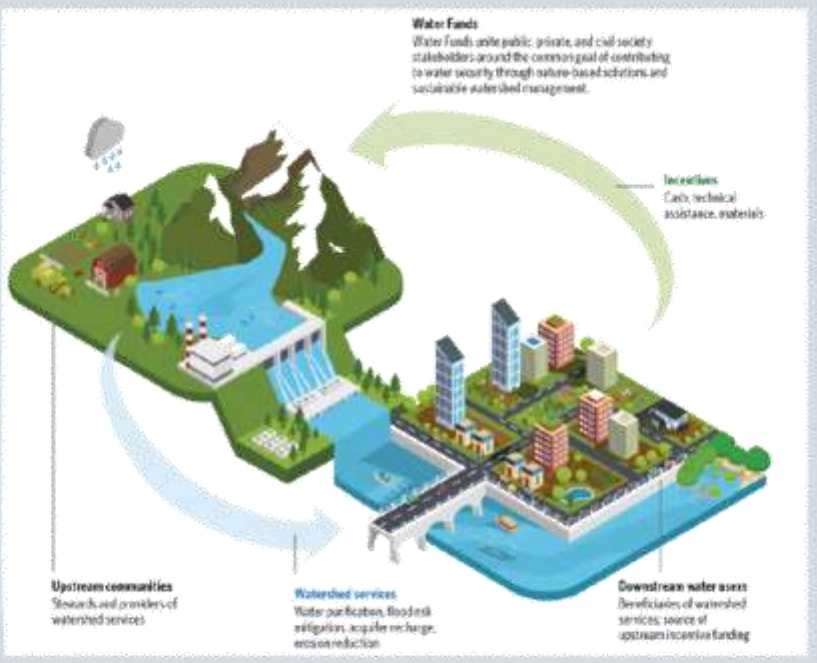


Figure 8: Structure for TNC Water Funds (from TNC Water Funds Toolbox).

Opportunities for Aotearoa New Zealand

Voluntary markets for adaptation in Aotearoa New Zealand are viable and should be encouraged. In many regards, this instrument is preferable to resilience credits (see §3.3) because adaptation markets are not constrained by the scope of target accounting or ETS eligibility, so therefore directly include ecosystem types that are (presently) ineligible for carbon revenue, such as small-scale forests, riparian buffers, wetlands, coastal habitats, and so on. The direct payment for adaptation value also reduces the risk of negative interactions between the policy instruments and its objective.

Critically, by enabling the exchange of adaptation benefits, these markets might also enable adaptation to be self-organised at a highly localised level where landowners, companies and communities are responding to very specific adaptation challenges. This might complement large-scale adaptation projects by addressing vulnerabilities that central planners cannot easily

[176] TNC (n.d.). What is a Water Fund? *TNC Water Funds Toolbox*. https://waterfundstoolbox.org/getting-started/what-is-a-water-fund

identify. Peer-to-peer exchange might also help to strengthen connections within communities, such that social resilience is strengthened through the process of addressing material risks (see **Concept proposal: Peer-to-peer adaptation exchange** below).

Concept proposal: Peer-to-peer adaptation exchange

The August 2022 floods in Nelson were a reminder that maladaptation is highly localised. Of course, there is a global dimension to climate-related risks, such as the greater frequency and intensity of extreme weather events as global temperatures increase. But the risk of actual losses and damages is strongly determined by local factors, such as land-use decisions elsewhere in a catchment, or even in a neighbouring property.

For instance, a housing subdivision might be located beside an erosion-prone slope, which the neighbouring landowner uses for pastoral farming. This may be consistent with the district plan so no resource consent is needed. However, in an extreme rain event, there could be risk of flooding, land subsidence and sedimentation into the neighbouring subdivision, which might result in costly damages. Consequently, the homeowners might want to see the slope retired and planted in appropriate vegetation, ideally tree species with good soil binding capacity.[177] However, there is a split-incentive problem, because the neighbouring farmer has no incentive to retire the land (e.g. if the site is not ETS eligible or not large enough to justify registration) and some incentive to continue grazing.

This impasse could be overcome if homeowners aggregated their demand for adaptation improvements, then monetised it in the form of a payment for adaptation benefits. New technologies, such as smart contracts, create new possibilities for coordinating peer-to-peer payments that bypass the need for financial intermediaries like commercial banks. Smart contracts are a digital transaction protocol which can automatically execute or manage the terms of a contract or an agreement. So, for instance, homeowners could commit a small annual fee to the smart contract, which releases the sum payment only if certain conditions are met. The neighbouring farmer can access that payment if pre-agreed actions are undertaken and verified, specifically the retiring and revegetation of the erosion-prone slope. In this way, peer-to-peer approaches are possible where technology becomes a facilitator for people to self-organise to address highly localised challenges in their area.

Although this example is focused on erosion control, the same approach could be applied to a variety of applications, such as a coordinated approach for coastal resilience by funding the restoration of dune habitats or coastal wetlands, or crowdfunding to clear rivers of debris to reduce flood risk.

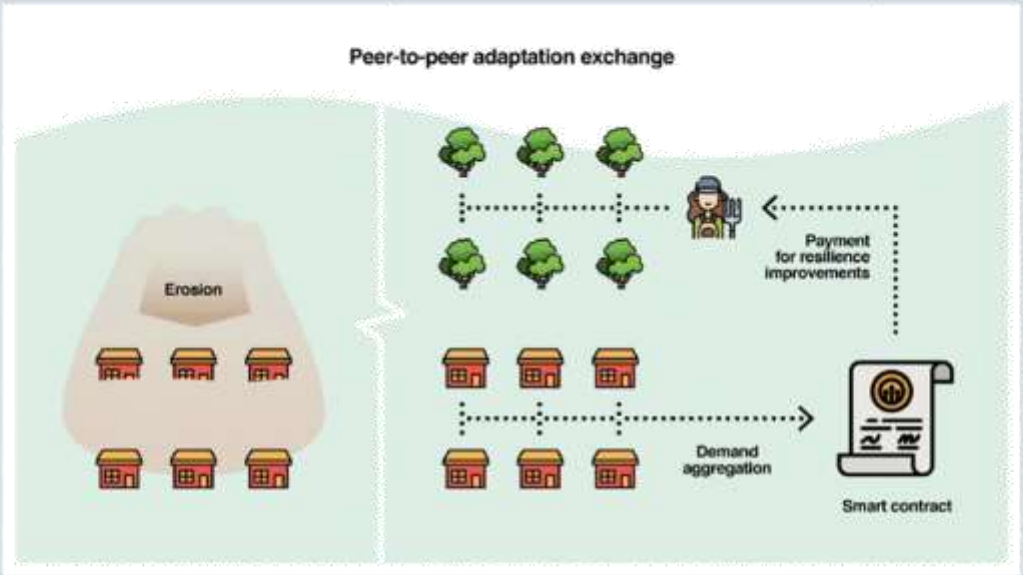


Figure 9: Structure for peer-to-peer adaptation exchange.

[177] Satchell, D. (2018). *Trees for steep slopes*. Sustainable Forest Solutions. https://www.nzffa.org.nz/farm-forestry-model/why-farm-forestry/trees-for-erosion-controlsoil-conservation/report-trees-for-steep-slopes/

The critical factor here is market demand. Increased knowledge of climate and nature-related risks – whether by climate risk reporting or improved knowledge sharing – should bolster the enlightened self-interest of individuals and firms to invest in system-level resilience. However, the experience of voluntary carbon markets demonstrates that there is no guarantee of stable, sizeable demand. There are also significant transaction costs involved in securing contracts from buyers.

Consequently, while voluntary schemes may generate marginal and localised benefits, it is possible that compliance markets are needed to drive major sectoral change (see **Concept proposal: Food system adaptation market** below). This is a significant regulatory undertaking, as discussed above, which involves agreeing to MRV protocol, baselines, and quota setting. However, it is worth noting that the emergence of voluntary adaptation markets could drive innovation (such as the setting of metrics and indicators) that underpins a compliance market, as well as build the social licence for such an approach.

A compliance market also raises issues of policy design which require careful consideration, such as the distributional implications. For example, the lowest cost adaptation options may not be where adaptation improvements are most urgently needed, so suppliers might focus on nature-based solutions in easily accessible locations rather than steep, remote hillsides where erosion is most severe. Similarly, the least cost adaptation might not be in regions that would most benefit from the economic spillovers of adaptation activities. Such issues would need to anticipated and planned for, potentially by targeting quotas for certain land types or regions.

However, from the perspective of net-zero strategy, the implementation of adaptation payments is highly attractive, because it creates a long-term exit strategy for carbon offsetting. In the short-term, adaptation markets might rebalance the asymmetric approach to climate policy which prioritises mitigation over adaptation. Because the value of climate adaptation is not fungible with climate mitigation, it should be possible for an adaptation-aligned forest to participate simultaneously in carbon and adaptation markets. Indeed, these overlapping revenue streams may help to reduce the economic differential between slower growing forests and fast growing forests,[178] the latter of which may lack ecosystem resilience over the long run.[179] But it is also increasingly important that the removals from forestry are used less for reducing net emissions through offsetting, and more as negative emissions that are not associated with the creation of a carbon credit. Consequently, it is critical to find ways to pay for the protection, restoration, management and creation of forests by any means other than carbon offsetting. If a forest is established by payments for adaptation benefit, the carbon sequestered will count as a genuine removal which is not neutralised by the creation of a right to emit, thereby contributing to the goal of net-negative.[180]

Concept proposal: Food system adaptation market

Agricultural Nature-based Solutions (Agri-NbS) involve the protection, restoration, management, and creation of natural and semi-natural ecosystems in pastoral landscapes. This encompasses a diverse range of practices and actions including forest and wetland restoration, agroforestry and silvopastoral systems, pole planting for erosion control, green fire breaks, riparian buffer zones, vegetated swales, restored or constructed wetlands, use of denitrifying bioreactors, soil quality enhancement and fallows. The interweaving of such activities throughout a hydrological catchment will enhance a variety of functions which include (1) sustainable practices that enhance agricultural production; (2) natural infrastructure which provide structural engineering functions; (3) environmental amelioration for beneficial biochemical, biological or microbial function; and (4) protection of

[178] The Aotearoa Circle (2020). *Native Forests: Resetting the Balance.* https://www.theaotearoacircle.nz/news/native-forests-report-resetting-the-balance

[179] Brienen, R. J. W. et al. (2020), Forest carbon sink neutralized by pervasive growth-lifespan trade-offs. *Nature Communications*, 11(4241).

[180] Babiker, M., Berndes, G., Blok, K. et al (2022). Cross-sectoral perspectives. *Climate Change 2022: Mitigation of Climate Change.* Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/

biodiverse species and habitats. These functions all underpin adaptive capacity within a catchment, which in turn improve the resilience of food supply chains which domestic and international markets depend upon.

The challenge is that the beneficiaries of a resilient food system are not currently investing in this adaptive capacity. This is not due to a lack of available capital. The Commerce Commission's recent analysis of the New Zealand supermarket duopoly found that profits for supermarkets are high: the recent return on average capital employed was about 13%, well above normal rates of 5.5% for grocery retailing.[181] Meanwhile, there are costs of agricultural production, such as sedimentation and nutrient runoff, which are not being fully accounted for in the food sector value chain, instead increasing environmental risks for downstream communities. To reframe this in economic terms, the total social value of agriculture could be significantly increased by minimising negative externalities and maximising positive externalities, including the public good of catchment-level resilience. If those who benefit most from the status quo were to reinvest surplus profits into the amelioration of pastoral landscapes, then the total value of agriculture would increase.

A compliance market for adaptation could be implemented across the food value chain – from producers to processors, distributors and consumers – to improve the resilience of the landscapes that food is produced in. A quota would be set to achieve specific adaptation outcomes, with obligations imposed at a point along the value chain to establish demand for the supply of adaptation outcomes. So, for example, imagine that a sectoral target is set for the food sector. Businesses along the value chain, such as wholesale distributors and/or supermarkets, are set targets to contribute to the resilience of food suppliers. Modelling is used to quantify probable damages from erosion, sedimentation and flooding as a consequence of extreme weather events. By year X, the sector needs to achieve Y-million dollars of avoided damages. Adaptation units are awarded for the establishment of appropriate forest on erosion-prone sites, wetland restoration, and revegetation of riparian margins which contribute to achieving that goal. Ideally, landscape resilience would become another type of agricultural produce which farmers and growers sell alongside food and fibre.

Quotas might be applied to particular hydrological catchments, especially where the economic spillovers will create the greatest benefit. Operating at the catchment scale will reduce the uncertainty for verification of outcomes at the farm level, which is prone to influence by confounding variables from activities elsewhere in the catchment. By taking a catchment-level approach – ki uta ki tai, from the mountains to the sea – these uncertainties can be reduced. In terms of evaluation, water quality can serve as an indicator for the health of the catchment, in terms of sediment and nutrient levels.

Any such scheme will require careful consideration of distributional impacts. One challenge is the potential impact on food prices, because producers or distributors are likely to pass the additional costs of meeting the adaptation quota onto consumers. Given the price inelasticity of food – it is a basic necessity – these costs cannot easily be avoided by consumers. Furthermore, because food constitutes a higher proportion of household expenditure for low-income groups, this price signal is likely to have a regressive effect. These distributional issues will need to be mitigated through policy design to ensure the instrument's fairness and feasibility.

[181] Commerce Commision New Zealand. (2022). *Market study into the retail grocery sector: Final report – Executive summary.* https://comcom.govt.nz/__data/assets/pdf_file/0023/278402/Market-study-into-the-retail-grocery-sector-Executive-summary-8-March-2022.pdf

3.6 Blended finance

Blended finance	
Blended finance uses public or philanthropic money to improve the risk-return profile or commercial viability for a private investor, allowing it to invest in places and projects where it would not otherwise go.	
Advantages	**Challenges**
• Public funding can overcome the economic barriers, especially the lack of financial returns, to adaptation. • Enables cost-sharing between the public and private sector.	• Public investment may be inconsistent across consecutive governments given differing priorities. • There are political economy constraints to public funding.
Enablers	
• A clear investment strategy so that public money is used only for catalytic purposes that satisfy the principle of additionality, not merely for derisking private capital.	

Adaptation gap

In principle, the New Zealand Government could directly address the adaptation gap by a purely public-pays approach; for example, by investing in public infrastructure, undertaking buyout schemes for vulnerable properties, and funding betterment after disasters to relocate homes instead of repairing them without reducing exposure to future risks. As John Maynard Keynes declared in 1942: 'Anything we can actually do we can afford'.[182] In this Keynesian spirit, the New Zealand Government could address the adaptation gap by increased public spending, constrained not by debt targets but rather by the productive capacity of the economy and the feedback effect of inflation.

Public expenditure should play a role in adaptation alignment, especially for disadvantaged communities. However, setting aside the political constraints to increased levels of spending, there is also a risk of perverse outcomes from a broad-based public-pays approach. As discussed in §1.4.3, there is the problem of rent-seeking where affluent communities seek priority for funding, the problem of creating moral hazards that incentivise risky behaviour, and the problem of socialising the costs of adaptation that companies ought to contribute to as private beneficiaries. Consequently, there is a vital role for private finance to share in the costs and risks of investment.

Financial instrument

Blended finance refers to using 'public or philanthropic money to improve the risk-return profile or commercial viability for a private investor, allowing it to invest in places and projects where it wouldn't otherwise go, by mitigating a raft of real or perceived barriers, including political risk, currency volatility, lack of liquidity, weak local financial markets, knowledge gaps about investment opportunities, and challenging the investment climates, including poor regulatory and legal frameworks.'[183] Consequently, blended finance has the potential to: (1) increase capital leverage by using public and philanthropic funds to facilitate larger volumes of private capital; (2) to deliver risk-adjusted returns by structuring finance in a way that re-allocates risk and better aligns with market expectations; and (3) to enhance impact by combining the skills and knowledge of public and private stakeholders.

[182] Keynes, J. (1978). Employment Policy. In E. Johnson & D. Moggridge (eds.) *The Collected Writings of John Maynard Keynes*. Royal Economic Society.
[183] Blended Finance Taskforce (2018). *Better Finance, Better World*. Consultation Paper of the Blended Finance Taskforce, prepared by the Business & Sustainable Development Commission and SYSTEMIQ. https://www.blendedfinance.earth/better-finance-betterworld

'Crowding in' refers to investment strategies that attract diverse sources of finance – from governments, philanthropic donors, or private capital. Given the extent of total investment required to bridge the adaptation gap, it is important that investment structures enable participants to co-invest where possible, in order to increase the total available pool of capital that can be deployed to adaptation-aligned outcomes. An effective strategy will begin by ensuring that private investors are not 'crowded out' of investment opportunities – that is, we should avoid situations where public investments substitute, rather than complement or stimulate, private investment activity.

Case study: AGRI3 Fund

The AGRI3 Fund was established in 2017 to mobilise US$1 billion of financing to enable a transition to more sustainable practices in agricultural value chains and avert deforestation. It was established by the UN Environment Programme and Rabobank, since expanded to include the Dutch development bank (FMO) and IDH The Sustainable Trade Initiative. The AGRI3 Fund works by providing credit enhancement tools and technical assistance to stimulate investment. The Fund will provide guarantees to commercial banks and other financial institutions, and subordinated loans to customers of these institutions to mobilise financing by de-risking and catalysing transactions that actively prevent deforestation; stimulate reforestation; contribute to efficient sustainable agricultural production; and improve rural livelihoods. A Technical Assistance facility was also established to accelerate the development of investable opportunities and maximise their impacts. The facility is managed by IDH The Sustainable Trade Initiative and works closely with the Fund Manager and Investment Advisers.

On the other hand, it is important that blended finance does not use public funding to merely 'derisk' private investment – that is, public sector balance sheets should not be used to protect private capital from investment risks without sharing in the returns.[184] Otherwise, this enables the socialisation of the risks and the privatisation of the profits. The purpose of blended finance should be catalytic – that is, to enable an investment that would not otherwise have occurred and therefore contributes to market-shaping, directing the flows of capital and innovation toward addressing novel challenges. Consequently, the risks and returns should be shared so that both public and private sector participants are exposed to appropriate incentives.

Presently, adaptation outcomes are a small portion of the global climate blended finance market. In aggregate, about US$108 billion of blended finance transactions are climate-focused, but only about US$6.9 billion on adaptation specifically, with about US$2.5 billion of this investment coming from the private sector. Meanwhile, about US$26.6 billion of blended finance transactions have dual mitigation-adaptation benefits. Much of this investment activity relates to agriculture and land use, but also aquaculture and water infrastructure. Potential explanations for the shortfall of adaptation blended finance is, firstly, the lack of viable business cases for adaptation and, secondly, the mitigation-oriented mandates of blended finance providers.[185]

Opportunities for Aotearoa New Zealand

A recent KPMG New Zealand report identifies the opportunity for 'blended finance models to better leverage private capital for high impact projects.'[186] Greater public-private collaboration can help to overcome the barriers to sustainable finance in Aotearoa New Zealand, in particular by increasing investment scale through aggregation, reducing the

[184] Gabor, D. (2021). The Wall Street Consensus. *Development and Change* 52(3), pp.429–459. https://doi.org/10.1111/dech.12645

[185] Convergence (2022). *State of Blended Finance 2022*. https://www.convergence.finance/resource/state-of-blended-finance-2022/view

[186] KPMG (2022). *Mobilising capital for impact*. KPMG New Zealand and Toitū Tahua | the Centre for Sustainable Finance. https://www.sustainablefinance.nz/s/KPMG-Mobilising-Capital-for-Impact-mbrs.pdf

perceived risks of innovation and novel asset classes, and redirecting capital markets toward investment into long-term value creation.

The New Zealand Government already uses co-funding programmes to bring forward private-sector investment to advance policy objectives for climate mitigation. One such example is the New Zealand Green Investment Finance (NZGIF), a green investment bank which the New Zealand Government capitalises to provide debt or equity to crowd-in private capital, or to deliver products and programmes that facilitate additional private sector finance. NZGIF's target sectors are agriculture, process heat, distributed energy resources, waste, plastics, energy efficiency and transport. It operates under expectations of positive portfolio-level returns and therefore is exposed to the financial upsides of co-investment in these sectors, not only to the risks. More importantly, however, blended finance to bring forward private investment into climate mitigation.

The opportunity is to apply a similar approach to climate adaptation, in order to broaden the capital pool for adaptation investments, while also preserving private-sector incentives for risk reduction which would otherwise be muted under a pure public-pays approach. Plausibly, NZGIF itself could play a role if adaptation was included among its target sectors. Bankable projects might be identified in areas like agricultural resilience, agroforestry, critical infrastructure, fisheries and aquaculture, and tourism. However, given the challenge of achieving commercialisable returns from many adaptation projects (see §1.2.2), much of what needs to be done may fall outside of NZGIF's return requirements. Therefore, it is likely that adaptation-specific funds would be needed, where the purpose is not to make a positive financial return for public and private co-investors, rather to share the upfront costs of adaptation infrastructure in order to avoid the greater costs of climate-related losses and damages to public and private assets over the long run.

Concept proposal: Blended revolving fund for managed retreat

One of the greatest challenges of climate adaptation for Aotearoa New Zealand is coastal adaptation and managed retreat.[187,188] In other countries, such as the US, buyout schemes are an established mechanism for managed retreat. This involves the government acquisition of flood-prone properties, generally funded by federal agencies, especially the U.S. Federal Emergency Management Agency (FEMA) and administered by state or local governments. However, these schemes are criticised for their unjust impacts on marginalised communities, often communities of colour, who are disproportionately located in exposed places. Consequently, there are calls for co-production approaches which involve local communities in an equitable way.[189]

In some contexts, where coastal inundation is likely to occur incrementally (i.e. coastal plains), there is significant value for seaward properties to relocate pre-emptively, in order to make space for the integration of hard and soft infrastructure to mitigate coastal inundation. Buyouts of seaward properties at an early stage, therefore, creates the opportunity to slow the onset of coastal inundation for property owners that are located further away from the coast. As highlighted above, a community-led approach to buyouts may address some of the concerns around equity and procedural justice, therefore improving the social licence of managed retreat. Also, from a beneficiary-pays perspective, it is reasonable for the beneficiaries of pre-emptive retreat to contribute to the costs of infrastructure that extends the time value of their assets.

In terms of financial structure, a revolving fund could be established which is replenished as withdrawals are made. Government might play a role as intermediary and underwriter, but the revolving fund would be mostly capitalised by property and asset owners who stand to benefit from the substitution of seaside properties for hard and soft infrastructure to protect against coastal inundation. Property owners who are directly adjacent to the coastline could apply to the revolving fund, under pre-agreed conditions, to be bought out. With the forfeiture of associated property rights, the land could then be cleared for the creation of a coastal buffer zone,

[187] Ware, D. & Banhalmi-Zakar, Z. (2020). Strategies for governments to help close the coastal adaptation funding gap, *Ocean & Coastal Management*, 198. https://doi.org/10.1016/j.ocecoaman.2020.105223
[188] Harvey, N. (2019). Protecting private properties from the sea: Australian policies and practice. *Marine Policy* 107. https://doi.org/10.1016/j.marpol.2019.103566
[189] Tubridy, F., Lennon, M. & Scott, M. (2022). Managed retreat and coastal climate change adaptation: The environmental justice implications and value of a coproduction approach. *Land Use Policy* 114. https://doi.org/10.1016/j.landusepol.2021.105960

supplemented by hard and/or soft infrastructure, which extends the time-use of landward properties. As the sea level rises and the coastal buffer zone is inundated, the process could be repeated multiple times, where landward property owners buy out seaward owners in order to extend the coastal buffer and to enable (partial) liquidation of assets being forfeited. Decision making could be informed by Dynamic Adaptive Policy Pathways (DAPP) which enable options analysis over time under changing circumstances.[190] The revolving fund would be continually replenished by a combination of public funds, as well as contributions from landward property owners who benefit from the delayed encroachment of rising sea levels.

A blended fund of this type would also enable government to ensure evidence-based approach to managed retreat, in particular the value of ecosystem-based adaptation for coastal margins. Although hard infrastructure such as seawalls are often popular, it is well understood that nature-based solutions can offer the most cost-effective, long-term protection against sea level rise and coastal hazards by managing and regulating flooding, erosion, sedimentation, and tidal creeks and channels. This includes the restoration of coastal forest and dune habitat, mangrove restoration, the protection and creation of coastal wetlands and estuarine ecosystems, and so on. An ecosystem-based approach not only provides many co-benefits for biodiversity and recreation, it can also be more resilient, adaptable and cost-effective than hard infrastructure, especially for areas exposed to high-frequency, low-intensity hazards. For example, mangrove root systems reinforce and even build up coastline which may, under certain conditions, be able to keep pace with sea level rise.[191] Also, because nature-based solutions are comprised of living organisms, this 'natural infrastructure' can repair and regenerate after damage, as well as move, migrate, and retreat to adapt to changing conditions. Finally, in contrast to hard infrastructure such as seawalls which deteriorate over a finite lifespan, natural ecosystems can grow stronger over time, potentially providing more robust coastal protection as they mature.[192] Consequently, this may slow the impacts of sea level rise, thereby extending the time value of adjacent properties, as well as creating significant amenity and recreation value for nearby properties.

A distinct focus of blended finance should be partnership with Māori to support the ambitions of whānau, hapū and iwi to invest into climate adaptation. Cost-sharing is a potential strategy where central and local government uses its balance sheet to co-invest in adaptation such as marae upgrades, nature-based solutions, or managed retreat. This is especially relevant for post-settlement iwi which can draw on their balance sheets to co-invest. However, pre-settlement iwi and hapū, or whenua Māori collectives, may lack liquid cash reserves to co-invest. In these circumstances, a major barrier to adaptation investment is financial exclusion where Māori entities face discriminatory barriers to accessing finance. This was identified by the Auditor-General in a landmark 2011 report as one of the key barriers to developing Māori land, in particular the inability to access commercial mortgages on communally owned, inalienable Māori freehold land.[193] Changes have since been made, such as the creation of Kāinga Whenua loans and infrastructure grants to enable housing infrastructure, but challenges remain, including for land development for primary sector purposes. Ultimately, conventional bank lending practices are not well aligned to Māori needs and circumstances, including the nature of Māori land title and ownership, so there remains an unwillingness to lend to Māori entities.

However, blended finance offers tools for overcoming these barriers, where central and local government use their balance sheets to derisk finance for Māori. Credit guarantees are a type of insurance which help to protect the interests of a lender from the risk of non-payment by a borrower. There is significant variation among credit guarantees, with some providing a 100% guarantee of a loan or portfolio, whereas others only guarantee a lesser proportion. By

[190] Haasnoot, M., Warren, A., & Kwakkel, J.H. (2019). Dynamic Adaptive Policy Pathways (DAPP). In Marchau, V., Walker, W., Bloemen, P., Popper, S. (eds). *Decision Making under Deep Uncertainty*. Springer, Cham. https://doi.org/10.1007/978-3-030-05252-2_4

[191] McIvor, A. L., Spencer, T., & Moller, I. & Spalding, M. (2013). *The Response of Mangrove Soil Surface Elevation to Sea Level Rise. Natural Coastal Protection Series: Report 1*. Cambridge Coastal Research Unit Working Paper. The Nature Conservancy, Wetlands International. https://www.conservationgateway.org/ConservationPractices/Marine/crr/library/Documents/mangrove-surface-elevation-and-sea-level-rise.pdf

[192] Sutton-Grier, A. E., Wowk, K. & Bamford, H. (2015). Future of Our Coasts: The Potential for Natural and Hybrid Infrastructure to Enhance the Resilience of Our Coastal Communities, Economies and Ecosystems. *Environmental Science & Policy* 51, pp.137–48

[193] Office of the Auditor-General (2011). *Government planning and support for housing on Māori land – Ngā whakatakotoranga kaupapa me te tautoko a te Kāwanatanga ki te hanga whare i runga i te whenua Māori*. Wellington: New Zealand Government. https://oag.parliament.nz/2011/housing-on-maori-land

coordinating with commercial banks to provide credit guarantees for resilience-enhancing activities on Māori land, central and local governments could use their balance sheets and high credit ratings to improve financial access to Māori and therefore to achieve environmental objectives at relatively low public cost (for further discussion, see **Concept proposal: Tiakitanga fund for intensified stewardship** in §3.7).

3.7 Systemic investing fund

Systemic investing fund	
A systemic investing fund is a pooled vehicle which combines public, private and philanthropic finance, as well as non-financial interventions, to implement system-level change through a portfolio approach.	
Advantages	**Challenges**
• Takes a system-level approach which strongly aligns with system-level attributes of resilience and adaptive capacity. • Takes a transitions management approach, so proactively manages barriers to change at the micro-, meso- and macro-level. • Enables sharing of costs and risks. • Significant knowledge spillovers by designing solutions to system barriers.	• Requires a change of mindset for investors and policy makers. • High upfront transaction costs in deal orchestration. • Complexity of managing a portfolio of financial and non-financial interventions, plus their interactions.
Enablers	
• A mission-led approach from policy makers which accepts greater upfront costs and procedural risks in order to maximise long-term value creation and avoided damages from climate change. • New impact frameworks which capture the full spectrum of environmental, social and financial benefits across the system, including avoided costs. • Modelling tools which enable decision makers to optimise across the whole system, not merely its constituent parts.	

Adaptation gap

Adaptation is a complex problem, indeed a 'wicked problem par excellence.'[194] In part, this is because adaptation projects tend not to adhere to cleanly defined boundaries. As discussed throughout this report, adaptation projects tend to involve non-excludable benefits and therefore dispersed beneficiaries, which is characteristic of public goods. Resilience also tends to be a property that belongs to whole systems, such as hydrological catchments, urban environments, local communities or various scales of economy. Indeed, because human and natural systems are deeply interwoven and mutually interactive, the property of resilience tends to sit across multiple systems. For example, the resilience of a rural landscape depends to some degree on the resilience of the economy (and vice-versa), because changes to one system (e.g. a collapse in the carbon price) can have implications for the other (e.g. land-use conversions from forest to pastoral agriculture).

Consequently, discrete actions cannot always make the difference to adaptive capacity that is needed, unless they are part of a pattern of actions that shift the characteristics of the system. In the words of Climate KIC Australia, climate adaptation is 'the consequence of interconnected, ongoing, multi-layered interventions and has non-linear, interconnected systems properties.'[195]

This complexity defies the habits and routines of traditional finance (see discussion in §1.2.2). Traditional finance is oriented toward single, typically large scale, assets. A comprehensive climate adaptation strategy may involve the development of some such assets, such as a dam for an irrigation scheme or a desalination plant, for which private finance can be mobilised on standard commercial terms through user-pays arrangements. However, traditional finance is not well-aligned for infrastructure that involves more dispersed benefits, such as stopbanks and seawalls, or infrastructure that is dispersed in nature such as distributed energy systems or catchment-level restoration.

[194] Termeer, C., Dewulf, A., Breeman, G. (2013). Governance of Wicked Climate Adaptation Problems. In Knieling, J., Leal Filho, W. (eds.) *Climate Change Governance. Climate Change Management*. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-29831-8_3

[195] Mortimer, G., Whelan, B. & Lee, C. (2020). *Adaptation Finance*, p.19.

Also, even when the risk-return expectations of traditional finance are well-aligned to a certain type of asset, this does not mean that that asset is optimal in terms of efficiency, effectiveness, resilience, distributional effects, or other critical factors. In other words, access to traditional finance is not, in itself, a determinant of good outcomes. On the contrary, hard, centralised infrastructure can be expensive, maladaptive, or energy and resource intensive. Traditional finance may neglect these drawbacks, while also overlooking the relative advantages of a dispersed, systemic approach which uses well-coordinated, small-scale interventions to reduce the need for large scale infrastructure. With its reliance on marginal approaches to options analysis such as cost-benefit analysis, traditional finance is also likely to neglect the opportunity for transformative change where the existing system is substituted by a more adaptive system. Climate KIC Australia summarises the mismatch between the characteristics of climate adaptation and traditional finance in Table 4 below.[196] The objective of resilience may ultimately require an investment approach that mirrors the systemic qualities of resilience itself.

Table 4: The mismatch between the qualities of adaptation and a single asset investment logic (adapted from Mortimer et al. 2020).

	Qualities of adaptation	Single asset investment logic
Scope	Resilience is emergent property of complex system.	Single asset valuation uses reductionist atomistic approaches to simplify.
Timeframe	Adaptation is long-term, involving non-linear risks and opportunities.	Single asset investment focuses disproportionately on short-term costs and benefits.
Managing change	Adaptation is a process of ongoing learning, not an end state.	Learning occurs through fast-cycle feedback, often informed solely by price signals.
Role of finance	To maximise strategic synergies and long-term value creation.	To minimise cost and manage risk.

Financial instrument

A systemic investing fund is a pooled vehicle which combines public, private and philanthropic finance, as well as non-financial interventions (e.g. policy innovation), to implement system-level change.[197] Financial support may involve a combination of debt, equity and/or grants depending on the characteristics of the intervention, as well as the cross-subsidy effects of the finance. It is derived from pioneering insights from the systemic investing movement, which is associated with organisations such as Climate KIC, Transformation Capital (TransCap) Initiative, Dark Matter Labs, UNDP Innovation, and Catalyst2030.

There are two critical features of a systemic investing approach. The first is the adoption of a *portfolio approach*, as distinct from a single-asset approach, to drive system-level change. The purpose is to optimise investing for the positive synergies and network effects that a strategic portfolio of projects can produce.

The TransCap Initiative is currently developing methodologies and pilots for a systemic investing approach in Viet Nam to accelerate the transition to a circular economy.[198] But the portfolio approach is also manifest in earlier thinking on *ecosystem investing* which encourages impact investors to aim for transformational impact, systems analysis, and an attentiveness to

[196] Ibid.
[197] Gurciullo, S. (2021). *System Finance for Development Portfolios: A Multi-Asset Approach to Accelerate SDG Localisation*. UNDP Innovation. Available from: https://medium.com/@undp.innovation/from-funding-projects-to-funding-portfolios-b14c744f8adf
[198] Lai Van Manh, Nam Nguyen, G. Collins, Nguyen Trong Hanh, and Tran Thanh Hung (2021). *The role of systemic investing in Viet Nam's transition to a circular economy*. UNDP & Embassy of Finland, Hanoi. https://www.undp.org/vietnam/publications/role-systemic-investing-viet-nams-transition-circular-economy

the interrelationships between interventions.[199] In a similar vein, researchers at University College London developed an *integrated portfolio composition method* which not only produces greater non-financial impact (i.e. social and environmental impact) than a single-asset approach, it also makes a wider set of projects investable by strategically improving alignment with financial risk/return criteria.[200] In sum, the selection of assets depends not only on the individual merits of each, nor the diversification of risk across multiple projects, but also the collective interplay between projects through reinforcing feedbacks and networks effects which increase the total value of the portfolio. The whole becomes more than the sum of its parts.

The second feature of systemic investing is the *nesting approach*, which involves 'the deliberate synergistic alignment of an investment portfolio with a broader system intervention approach that encompasses non-financial levers of change'.[201] This treats investment and financing as just one element within a wider set of interventions that span the whole enabling environment, including policy and regulation, skills and education, citizen engagement, norms, behaviours, narratives, technologies and markets. The strategy is not only to invest in new projects, practices and technologies, but also to address system-level barriers, obstacles, and institutional lock-ins that inhibit the emergence and acceleration of sustainability transitions.[202]

One framework for systemic change strategy is multi-level perspective theory, which conceives of transitions across three levels of niche, regime and landscape.[203,204] The *niche* or micro-level is where new innovations or practices emerge, striving to gain a foothold in markets, localities, or applications. These might include new technologies that enhance resilience, or Indigenous adaptation strategies that lack mainstream uptake, or the installation of adaptation infrastructure that was not required under earlier climatic conditions. The *regime* or meso-level consists of the incumbent institutions, rules, technologies and infrastructures that support existing markets, industry, regulatory systems, policy, science, and culture. In terms of adaptation, this socio-technical regime reflects the status quo and therefore is adapted for the relatively stable climate of previous centuries, not the hotter and more volatile climate which is being produced by global heating. Finally, the *landscape* or macro-level refers to the wider societal context, such as slow-moving mega-trends (e.g., demographics, ideology, geopolitics) and exogenous shocks (e.g., pandemics, economic crises, major accidents, political upheavals, wars). A key change at this level is climate change itself, which creates new demands and social pressures as communities react to its physical and economic impacts.

Transitions, such as the transition to climate-resilient development, will occur as a consequence of mutually reinforcing changes across all these levels, which enable the niche practices of climate resilience to scale up and become mainstream. Consequently, to encourage and accelerate the transition, it is not sufficient to only fund and finance adaptation initiatives at the niche level, it is necessary to take a nested approach which creates 'windows of opportunity' at the regime level through institutional reform and market-shaping policies,

[199] Edmondson, J., et al. (2015). Ecosystem Investing: Achieving Impact at Scale. *Stanford Social Innovation Review*. https://ssir.org/articles/entry/ecosystem_investing_achieving_impact_at_scale
[200] Medda, F., et al. (2013). *Assignment 29 – Strategic UDF Investing and Project Structuring*. Mazars LLP.
[201] Hofstetter, D. (2020). *Transformation capital – Systemic investing for sustainability*. EIT Climate KIC, p.24 https://www.transformation.capital/assets/uploads/Transformation-Capital-Systemic-Investing-for-Sustainability-1-1_2021-06-25-114435.pdf
[202] Geels, F., Turnheim, B., Asquith, M., Kern, F., and Kivimaa, P. (2019). *Sustainability Transitions: Policy and Practice*. EEA Report 9/2019. European Environment Agency (EEA). https://www.eea.europa.eu/publications/sustainability-transitions-policy-and-practice
[203] European Environment Agency (2019). *Sustainability Transitions: Policy and Practice*. EEA Report No 9/2019. https://www.eea.europa.eu/publications/sustainability-transitions-policy-and-practice
[204] Geels, F. W., Sovacool, B. K., Schwanen, T. & Sorrell, S. (2017). The Socio-Technical Dynamics of Low-Carbon Transitions. *Joule*, *1*(3), 463–479. https://doi.org/10.1016/J.JOULE.2017.09.018

77

and also to be responsive to changes at the landscape level which create demand for climate-resilient activities (see Figure 10 below).

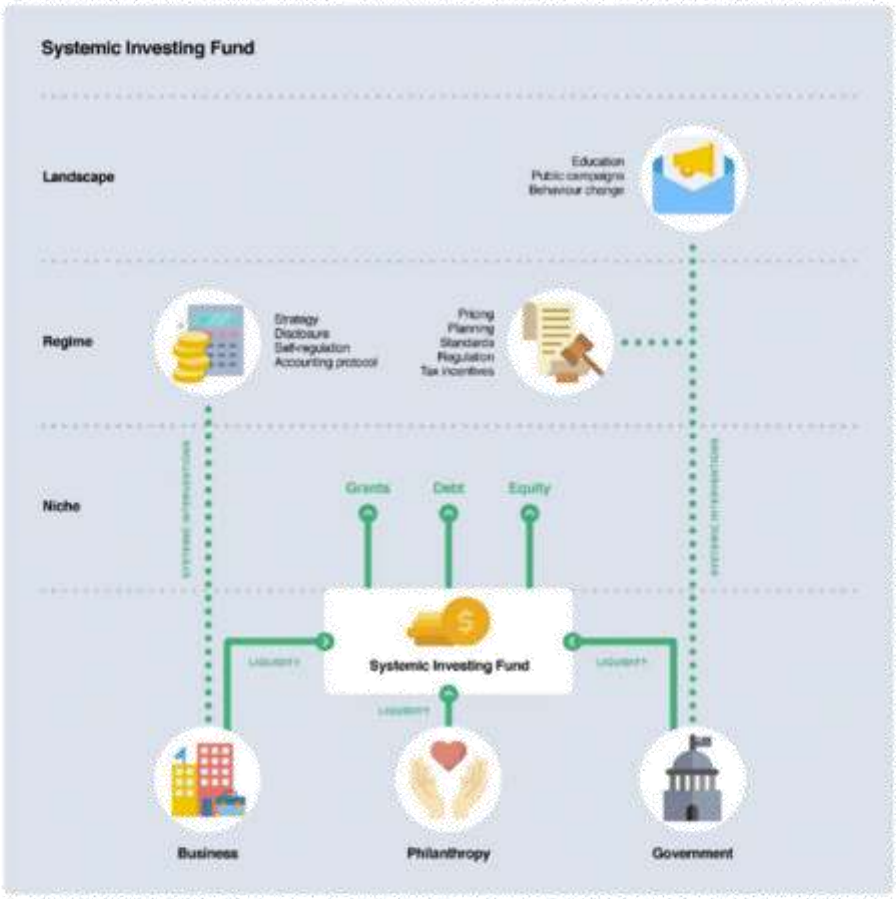


Figure 10: Structure of systemic investing fund across transition levels.

Consequently, systemic investing requires coordination among multiple actors, potentially playing multiple roles. Government might not only contribute to systemic investing as a co-funder, but also in its roles as regulator and policymaker to induce change at the regime and landscape levels through regulatory, economic, and information-based policy instruments. Similarly, private financial actors who occupy the current financial regime might not only 'finance the transformation', but also 'transform the financial system' by changing risk and return requirements, discount rates, and accounting frameworks to support long-term value creation.[205] By making complementary change across system levels, these actors can address barriers and increase the efficiency and effectiveness of funding and financing, ensuring the investment stimulates the change it intended to.

[205] Sustainable Finance Forum (2020). *Roadmap for Action: Final Report*.

In sum, the basic recipe for a systemic investing fund is as follows:[206]

- Identify a real-world system that currently lacks resilience: a city, a catchment, a food supply chain, a climate-exposed community.
- Articulate a 'mission' or vision for transformation, map the system, identify barriers and sensitive intervention points, then backcast to articulate transition pathways and transformation strategies.
- Compose multi-asset-class portfolios of investments and loans that generate combinatorial effects (i.e. positive synergies) amongst each other.
- Nest these investment portfolios within a set of interventions to the enabling environment that engages non-financial, non-investable levers of change (e.g. policy innovation, culture change) and therefore derisks the value proposition.
- Issue a green bond to institutional and retail investors to raise capital to undertake the interventions, potentially using blended and structured finance to meet risk-return requirements of various parties (see §3.6).
- Apply an adaptive learning and sensemaking approach which generates insights and generate strategic intelligence for follow-on investments.

The key challenge is finding investors who are willing to expose themselves to the risks and opportunities of systemic investing. A recent analysis of systemic investing by The Yunus Centre[207] highlights the challenges of sustaining common purpose among multiple investors in dynamic contexts, and matching supply and demand for financing systems transformation. However, it identifies opportunities among progressive, impact-first investors 'to make endowments and/or take long-term positions on flexible, and potentially unspecified, terms', especially in response to the growing urgency of challenges like climate change.[208] The report also highlights the role of government which can 'pool common resources for common good' through tax and transfer mechanisms, but tends to lack the capabilities or tools for systemic approaches.

Opportunities for Aotearoa New Zealand

In Aotearoa New Zealand, there are signs of systemic approaches to innovation, including The Southern Initiative (TSI),[209] The Connective,[210] The Ākina Foundation, Ara Ake, and Climate Connect Aotearoa. Building on this momentum, a systemic investing fund could operationalise these approaches, especially to roll out distributed or holistic approaches that aim to enhance community resilience. Two plausible applications are a community energy fund to improve the resilience through distributed energy systems (see **Concept Proposal: Community energy fund** below), or a fund to support the myriad activities that constitute Māori resilience (see **Concept Proposal: Tiakitanga fund for intensified stewardship** below).

Systemic investing, by facing up to the complexity of challenges like climate adaptation, is itself inevitably complex. This entails high transaction costs as new relationships are established, new knowledge is produced, and new investment tools are created. However, the knowledge spillovers from these investments will be significant, which should enable adaptation funding and financing to move faster and more efficiently.

[206] Hofstetter, D. (2020). *Transformation capital*.
[207] Hannant, A., Burkett, I., Fowler, E., O'Brien, T, McNeill, J., and Price, A. (2022). *Design Foundations for Systems Capital*. The Yunus Centre, Griffith University.
[208] Ibid. p.24.
[209] Burkett, I. and Boorman, C. (2020). *Review of TSI 2020: Strengths and Opportunities*. The Yunus Centre, Griffith University. https://www.griffith.edu.au/__data/assets/pdf_file/0030/1372737/Review-of-TSI-2020.pdf
[210] Price, R., Kelly, J. and Short, I. (2020). *Tikanga-led Impact Investment*. The Connective. https://theconnective.nz/

Concept proposal: Community energy fund

Aotearoa New Zealand has a relatively centralised national grid which relies on only a limited number of large-scale generation assets and long-range transmission lines. This leaves electricity supply vulnerable to single-point shocks, such as damage to transmission and distribution infrastructure from wildfire or extreme storm events, which is especially acute risks for remote communities in rural and . Furthermore, because of the major role of hydropower in electricity generation, the national grid is exposed to critical risks from climate variability, especially the impact of consecutive drought years on water supply.

Distributed or decentralised energy systems, which involve community-level networks of small-scale generation and storage assets, are known to have significant resilience benefits, including to climate-related risks like wildfire and extreme storm events.[211,212] Damage or disruption to specific assets can be compensated for by other assets in the network. This decentralised approach also gives greater self-sufficiency, modularity, and flexibility to communities. There are also potential co-benefits in terms of more competitive pricing and reduced energy hardship.[213] These virtues are especially important to Māori communities, because community energy can support mana motuhake or self-determination.[214]

Finance could play a critical role in unlocking this potential, with clear opportunities for commercialisable returns through the provision of energy services. However, this requires investors to overcome the single-asset mindset and to invest in the types of asset in generation, storage and grid capacity that constitute community-scale distributed energy networks. It also requires a coordinated approach which includes strategic regulatory and market interventions to overcome the lock-in of the existing centralised system, such as overcoming barriers to bidirectional distribution capacity in local grids.

A systemic investing fund could combine financial instruments to accelerate the shift to decentralised electricity, such as pay-as-you-save schemes for household generation assets like rooftop solar, and equity financing for electricity distribution businesses to enable infrastructure development. The fund could also leverage existing government subsidies such as the Warmer Kiwi Homes Programme and the community energy fund (which will replace the Māori and Public Housing Renewable Energy Fund). By focusing on papakāinga, social housing developments, and remote communities which are not well served by the current electricity system, the systemic investing fund could also maximise the social benefits of the investment.

A systemic investing fund could also help to overcome the problem of scale. Aotearoa New Zealand is a relatively small country, which means that financial instruments which rely on large transaction volume are unviable. This problem is exacerbated by the single-asset approach, because if individual projects are too small to attract the interest of institutional investors, then beneficial investments might go uncapitalised. However, if individual projects can be aggregated into larger investment portfolios, then there is an opportunity for 'in bulk' transactions that meet the scale requirements of investors. Aggregation becomes a vital tool for small markets to improve access to climate finance.

A critical enabling factor for systemic investing will be the identification of intermediaries that can serve as go-betweens to achieve objectives,[215] especially by working between relevant stakeholders to coordinate and orchestrate a deal. These intermediaries will need strong capabilities and resourcing, because there will be high upfront transaction costs in system mapping and coordinating a portfolio of synergistic investments across grants, debt and equity, as well as complementary changes to policy and regulation where required. In particular, intermediaries will need to enable coordination and collaboration across public and private-sector organisations, working with policy entrepreneurs and intrapreneurs who can drive change from the inside, creating windows of opportunity for new models.[216]

One opportunity is the Climate Innovation Platforms proposed in the Emissions Reduction Plan which will 'coordinate action and provide the enabling environment for key challenges

[211] Jasiūnas, J., Lund, P. D., and Mikkola, J. (2021). Energy system resilience – A review. *Renewable and Sustainable Energy Reviews* 150. https://doi.org/10.1016/j.rser.2021.111476

[212] R. Moreno *et al.*, (2022). Microgrids Against Wildfires: Distributed Energy Resources Enhance System Resilience. *IEEE Power and Energy Magazine* 20(1), pp..78-89. https://doi.org/10.1109/MPE.2021.3122772

[213] Hoicka, C.E. and MacArthur, J. L. (2018). From tip to toes: mapping community energy models in Canada and New Zealand. *Energy Policy* 121, pp.162–174. https://doi.org/10.1016/j.enpol.2018.06.002

[214] Bargh, M. (2010). Indigenous peoples' energy projects. *Australasian Canadian Studies Journal*, 28(2), pp.1-30.

[215] Abbott, K. W., Levi-Faur, D. & Snidal, D. (2017). Theorizing regulatory intermediaries: The RIT model. *The ANNALS of the American academy of political and social science* 670(1), pp.14-35. https://doi.org/10.1177/0002716216688882

[216] Kivimaa, P., Boon, W., Hyysalo, S. & Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. *Research Policy*, 48(4). https://doi.org/10.1016/j.respol.2018.10.006

and opportunities in our shift to a low-emissions future' across a wide spectrum of stakeholders including government agencies, companies, research organisations, Māori, and communities.[217] The proposed platforms are well-suited to a systemic investing approach as 'outcome or missioned-focused... designed around a specific goal' and 'designed to help Aotearoa absorb climate innovation at pace – with a mandate stretching across different agencies and sectors to identify and remove barriers to testing and widespread use of innovations'. Other options might include existing intermediaries such as The Aotearoa Circle, Ara Ake or Community Energy Network, which already play an intermediating function by improving coordination between the public and private sector. Alternatively, bespoke arrangements could be created; however, securing government partnership will be critical to success.

Concept proposal: Tiakitanga fund for intensified stewardship

Indigenous lands make up around 22% of the Earth's territory, yet contain about 80% of the world's remaining biodiversity – a testament to the capacity of Indigenous Peoples to be effective stewards of the environment.[218] These positive interactions with natural ecosystems are critical to climate resilience in the present and future.

Indigenous stewardship, which draws on traditional practices and knowledges, is a vital source of adaptive capacity. It also critical when Indigenous communities are marginalised from mainstream economies by the processes of colonisation, so cannot access financial markets to protect assets through risk transfer or partial liquidation. As Bose notes, 'an asset owner with no capacity to pay insurance premiums or realize value in monetary terms is faced with the need to intensify stewardship of the asset to increase general resilience... In general, communities with limited capacity to purchase formal insurance are more likely to have evolved informal risk-sharing institutions such as kinship networks, systems of barter and reciprocal obligations, and community self-help.'[219]

This characterises the situation for many whānau and hapū throughout Aotearoa who are asset rich in terms of land holdings, but capital poor in terms of liquid cash. Pre-settlement iwi are especially financially constrained, without cash reserves from settlement and often excluded from access to commercial finance from banks. Nevertheless, Māori freehold land constitutes 5.7% percent (approximately 1.6 million hectares) of the total area of Aotearoa New Zealand.[220] This is a significant proportion of land which, through climate-resilient development, could contribute to catchment resilience. Moreover, Māori also have ancestral links to land which is not Māori-owned, rather in public or private ownership, which poses challenges for how to enact stewardship duties. Despite these challenges, Māori engage informally and voluntarily in adaptation activities, guided by duties of tiakitanga and manaakitanga, which enhance the resilience of land and community. This includes environmental restoration in vulnerable catchments, declaration of rahui or prohibitions to prevent degradation of resources, and offering marae as a refuge to local communities when disasters occur. Māori prosperity is enhanced through the residual benefits that flow from this greater adaptive capacity.

Consequently, support that helps Māori to intensify the stewardship of their assets may be a source of cost-effective adaptation with significant social co-benefits and spillovers for local communities. A systemic investing approach is well-suited to preparing a portfolio of actions to enable greater stewardship, such as the adaptation strategies identified in the *He Uringa Āhuarangi, He Huringa Ao* report.[221] This could include crowdfunding to scale up informal risk-sharing networks, microinsurance to increase access to risk transfer, tailored insurance for Māori cultural infrastructure and events, equity and loans for Māori entrepreneurship in resilience-enhancing enterprises, pay-for-performance arrangements which enable revenue collection from the beneficiaries of increased resilience, technological support for environmental monitoring, finance to enable relocation and energy independence of marae, and so on. This could also be nested within regime-level interventions to address financial barriers to Māori, such as the provision of credit guarantees to banks to support lending to whenua Māori or public procurement commitments which derisk Māori businesses and improve credit ratings.

[217] Ministry for the Environment (2022). *Te hau mārohi ki anamata Towards a productive, sustainable and inclusive economy: Aotearoa New Zealand's first emissions reduction plan.* https://environment.govt.nz/publications/aotearoa-new-zealands-first-emissions-reduction-plan/

[218] Sobrevila, C. (2008). *The role of indigenous peoples in biodiversity conservation: the natural but often forgotten partners.* Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/995271468177530126/The-role-of-indigenous-peoples-in-biodiversity-conservation-the-natural-but-often-forgotten-partners

[219] Bose, S. (2021). Adaptation Finance: A Review of Financial Instruments to Facilitate Climate Resilience. In R. Brears (ed.), *The Palgrave Handbook of Climate Resilient Societies*, https://doi.org/10.1007/978-3-030-32811-5_15-1 p.18.

[220] Reserve Bank of NZ (2021). *Te Ōhanga Māori 2018*, p.11.

[221] Awatere, S. et al. (2021). *He huringa ā huarangi, he huringa ao.*

4. The enabling environment: A role for government?

The role of government in encouraging and enabling investment in adaptation is vital. A recent OECD framing paper on climate resilient finance concludes that: 'The public sector plays a critical role in enabling adaptation and enhancing resilience... specifically in creating the right enabling environment for private finance to be aligned with adaptation and resilience goals, which is one component of the broader role in supporting societal adaptation'.[222]

Of course, a favourable enabling environment for adaptation finance involves changes that government is not solely responsible for. Financial companies also need to contribute to an enabling environment for sustainable finance. The Aotearoa Circle's Sustainable Finance Forum released a roadmap for the financial system in 2020, which Toitū Tahua, the Centre for Sustainable Finance, is advancing. If implemented, the roadmap would improve the enabling environment for sustainable finance, including greater resilience.

That said, government has an essential responsibility for creating a coherent policy mix that shapes and steers financial markets toward sustainability objectives, including climate adaptation. Indeed, a strategic market-shaping approach might enable or accelerate the development of some of the instruments discussed in this report, even where these are not economic or practical under current settings. Through new incentives, regulatory innovations, information-based regulation, and other initiatives, the New Zealand Government can facilitate the diversification and upscaling of adaptation financing.

A conducive policy mix for adaptation financing will encompass many more elements, which are discussed below. This section draws variously on the OECD's recent framing report,[223] Karoline Rogge's analysis of policy mixes,[224] as well as insights from the research undertaken to produce this report.

4.1 Policy strategy

The first element is policy strategy, which involves strategic orientation over the long-term. Key components are:

Appropriate targets and metrics, supported by principal plans and strategies.

The core of the New Zealand Government's adaptation strategy is its recently published National Adaptation Plan (NAP) which sets out goals, objectives and actions for climate adaptation. This is supplemented by local government plans, especially the regional plans prepared by regional councils which cover adaptation-related issues, including natural hazards.

A valuable complement for adaptation financing is the development of an investment strategy (or pipeline) which allocates different projects to different funding sources. As discussed throughout this report, adaptation projects will be amenable (or not) to different funding and financing options. For example, some adaptation work can be achieved through scheduled upgrades to infrastructure, only requiring that climate resilience is factored into future upgrades. Consequently, it could be inefficient to design elaborate financial structures if upgrades were sufficient. Also, some types of adaptation may be out of scope for private finance because risks and losses are too great that value cannot be monetised, and/or distributional implications are socially unacceptable. In these cases, public grants may be the

[222] Mullan, M. & Ranger, N. (2022). *Climate-resilient finance and investment: Framing paper*. Environment working paper no. 196. OECD. https://www.oecd-ilibrary.org/environment/climate-resilient-finance-and-investment_223ad3b9-en;jsessionid=xdOd91TRnA7NUdv90BdpvwDV9PR_8P9ghfl-lh7n.ip-10-240-5-122

[223] Ibid.

[224] Rogge, K. (2018). Designing Complex Policy Mixes: Elements, Processes and Characteristics. In M. Howlett & I. Mukherjee (eds.) *Routledge Handbook of Policy Design*. London: Routledge.

only option. However, by clarifying the funding and financing options for necessary adaptation measures, government expenditure can be allocated to where it can make the greatest difference. Meanwhile, private capital can be sought where risk-return requirements permit it, which sets future expectations and allows the private and public sector to plan and coordinate for future investments, and also to overcome financing barriers.

4.2. Policy processes

The second element of an effective policy mix is policy processes – that is, the problem-solving processes by which governments pursue objectives. Key components are:

Enabling the provision of data as a public good.

For many of the financial instruments discussed above, knowledge and research is a key enabler. For example, the insurance premium reduction programme is relatively research intensive, requiring robust knowledge of hazard-specific risks and risk mitigation activities. Similarly, sustainability-linked debt is likely to grow and evolve as the materiality of climate-related risks emerge through empirical analysis and more robust scenario modelling. The New Zealand Government can facilitate this by increasing access to data that its agencies hold. NAP proposes improving access to the latest climate projections data, creating an adaptation information portal, completing a data investment plan, integrating climate risk into economic and fiscal monitoring and forecasting, as well as reforms to the research, science and innovation system and the environmental reporting and monitoring system.[225] At the global level, the new Global Resilience Index Initiative (GRII) which aims to provide both asset-level and sub-national data, fully transparent and open, based on the catastrophe risk modelling approaches of the insurance industry, coupled with best-in-class environmental science and engineering.[226]

These are valuable initiatives; however, to accelerate adaptation financing, a more targeted instrument-specific approach might be needed. The New Zealand Government needs to commit to the issuance of a particular instrument, then release or generate knowledge that supports its issuance. Once such a commitment is made, relevant knowledge can be fast-tracked to open-access in an accessible format. Additionally, knowledge gaps can be filled by targeted public research funding, which is challenge-led instead of researcher-led in order to steer research and innovation toward the solution of urgent public problems.

Convening and supporting the development of best practices.

This involves working with the finance system to develop harmonised metrics and frameworks for adaptation alignment and to develop best practice and guidance. Again, NAP prescribes a number of such actions including adaptation guidance for central and local government, socio-economic scenario modelling, risk assessments, adaptation plans, integrating mātauranga Māori into adaptive planning and indicators, and monitoring and evaluation of adaptation initiatives.[227] All of this will support adaptation finance by improving the quality of policy processes. However, the most direct enabler for adaptation finance is likely to be the development of definitional tools, or a 'green taxonomy', which establishes a common definition for climate positive investments. This is relevant for the impact frameworks

[225] Ministry for the Environment (2022). *National Adaptation Plan.*
[226] Wood, J. K., Farmer, N. & Signer, B. (2022). *Towards a climate-risk data architecture: Common and open risk metrics to align finance with climate-resilient development goals.* Discussion paper prepared by United Nations Office for Disaster Risk Reduction (UNDRR) and the Centre for Greening Finance and Investment (CGFI) for the Global Resilience Index Initiative (GRII) and Risk Information Exchange (RiX). https://www.cgfi.ac.uk/wp-content/uploads/2022/11/Towards-a-Climate-Risk-Data-Architecture-report.pdf
[227] Ibid.

of all the instruments discussed in Sections 2 and 3. Moreover, this work might also lay the foundations for an adaptation unit, or a measure of resilience improvement, that can underpin tradeable quota instruments such as resilience credits or adaptation markets. Again, challenge-led research funding which aligns to a well-signalled policy commitment will be the most effective means of accelerating the development of definitional tools, because such research is likely to occur in the absence of a clearly signalled need from markets or policy makers.

Intermediation to enable the development of an investment-ready adaptation pipeline.

Intermediaries refer to entities which work between various actors in order to achieve policy objectives. Intermediaries are increasingly understood to play a critical role in sustainability transitions, especially by facilitating innovation and overcoming transition barriers.[228] The Aotearoa Circle and Ara Ake are examples of sustainability intermediaries already in operation in Aotearoa New Zealand which accelerate climate-aligned activity through convening and matchmaking of partners, networking, and facilitation. The Climate Innovation Platforms proposed in the Emissions Reduction Plan is another potential example, depending on how these are implemented. Government could play a role in intermediation, especially to catalyse progress on financing instruments that have high entry barriers. A theme which emerged strongly in this report's research is the high transaction costs of prospective instruments, associated with both product development and implementation. This is especially relevant for the insurance premium reduction plan, pay-for-performance contracts (e.g. environmental impact bonds), adaptation markets, and systemic investing funds. However, all sustainable finance instruments are subject to higher-than-usual transaction costs because of the need to verify sustainability impact, a compliance cost that conventional, unlabelled finance does not bear.

4.3. Policy instrument mix

The third element is the instrument mix, the various policy instruments which government implements to achieve objectives. These can be divided into economic instruments, regulatory instruments, and information-based instruments.

Economic instruments, including taxation and subsidies.

This report covers a variety of adaptation financing instruments, some of which can be market driven, others requiring policy. In both respects, the economic feasibility of such instruments can be improved by higher-order policy settings that shape the directionality of markets.

On the one hand, tax policy can be used to penalise economic activities that undermine the resilience of local ecosystems. For example, environmental taxes, such as an environmental footprint tax,[229] could target externalities from intensive farming and forestry, or the impacts of impermeable surfaces from urban development. On the other hand, grants, subsidies, or payments for ecosystem services (ideally funded through hypothecated revenue from an environmental tax) can be used to monetise actions that enhance resilience, especially to internalise positive spillovers for the public.[230] For example, a payment for biodiversity improvements or adaptation value can encourage investments in nature-based solutions, such as native forests or wetland restoration. Thus, climate-smart fiscal policy can influence the

[228] Kivimaa, P., Boon, W., Hyysalo, S. & Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. Research Policy, 48(4). https://doi.org/10.1016/j.respol.2018.10.006
[229] The Tax Working Group (2019). *Future of Tax: Final Report*. https://taxworkinggroup.govt.nz/resources/future-tax-final-report.html
[230] Hall, D. & Lindsay, S. (2021). *Scaling Climate Finance: Biodiversity Instruments*. Môhio Research.

economic viability of the instruments discussed in this report, increasing revenue streams or market advantages that improve the risk and return profile.

Innovation policy can be supported by economic instruments such as loans, tax relief and other support. This can be mission-led to stimulate innovation in adaptation-related sectors such as drought-resistant crops, water-saving technologies, or fire management.

Finally, public procurement can play a critical role by stabilising demand and supporting economies of scale for adaptation technologies. This is especially important for new innovations, but also to shape markets to support existing technologies. For example, public procurement commitments can prioritise green infrastructure as a substitute or complement to grey infrastructure, thereby supporting providers to scale up and improve establishment and management practices.

Regulatory instruments, including rules and standards.

Regulation is critical to adaptation strategy. NAP proposes a variety of regulatory changes which do not warrant repeating here.

In terms of regulations that could enable adaptation finance, the setting of standards is potentially a significant enabler for the instruments discussed in this report. Action 3.17 of NAP proposes the integration of adaptation and mitigation into new and revised standards for building and infrastructure, which can be set through rules and consent conditions to improve resilience in risk-exposed areas. For instance, standards could include minimum floor heights and other flood-proofing requirements. The establishment of such standards can reduce the transaction costs of adaptation finance by reducing the need to develop a customised impact framework for each instrument; for example, an insurance premium reduction programme might be designed to align with new or revised standards, instead of a bespoke intervention strategy.

Further, there is a suite of information-based regulation which 'encourage firms to generate and share information about their social or environmental performance', which includes voluntary or mandatory labelling, reporting and disclosure, certification, ratings, and rankings.[231] The New Zealand Government's pioneering legislation to mandate climate risk reporting for large companies is a good example. This helps boards of directors to incorporate climate risk management into the exercise of their fiduciary duties, which is critical for preserving capital and ensuring the long-term solvency of financial institutions under climate change.

Improved risk assessment also has positive spillover effects beyond the financial sector. Firstly, it enhances the resilience of the wider community, because if insurers and banks are well-prepared for climate-related shocks, then financial services are likely to be sustained through the response and recovery phase when liquidity is most critical for households and firms to manage the impacts on assets and supply chains.

Secondly, and more relevant to this report, climate-risk disclosures improve the transparency and accessibility of market knowledge. This can stimulate innovation, especially reducing the transaction costs of financial instrument development. Government can further facilitate this potential by ensuring that information is usable and intelligible, so that project leaders can efficiently identify areas of market need, project risks, potential for aggregation and scaling, and so on.

[231] Bowen, F. & Panagiotopoulos, P. (2018). *Information-based regulation. New roles for regulators in shaping regulatory compliance.* BEIS Research Paper Number 9. Department for Business, Energy and Industrial Strategy, UK Government. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/712012/information-based-regulation.pdf

A further initiative could be a certification scheme for projects and activities that enhance adaptation and/or resilience. This might serve to underpin the development of outcome-based instruments such as the insurance premium reduction programme, pay-for-performance contracts, and adaptation markets, because it reduces upfront transaction costs and uncertainties about future regulatory alignment.

At the more general level, financial regulation and supervision can also help to tilt financial flows toward adaptation financing and away from maladaptive assets. This might involve assessing macro-level and systemic physical climate risks and resilience, ensuring that climate-related risks are adequately incorporated into risk management practices, encouraging appropriate risk pricing, and prevention of greenwashing.

Information-based instruments, including campaigns and education.

Information-based instruments refer to 'attempts at influencing people through transfer of knowledge, communication of reasoned argument, and moral suasion in order to achieve a policy result'.[232] Indeed, changing minds and mindsets is critical for an anticipatory and pre-emptive approach to adaptation, in order to overcome the behavioural behaviours to action. The Government is currently investigating a Climate Information Centre which could contribute to an improved general understanding of the need to prepare, prevent and plan for climate-related impacts.[233]

Government might also play a specific role to support particular financial instruments by educational campaigns to raise awareness, to improve understanding of the value of insurance, and to affirm the credibility of providers. This would be most valuable for consumer-facing instruments, such as the insurance premium reduction programme or microinsurance. This could be part of broader efforts to improve financial literacy in Aotearoa New Zealand. Given the lower rates of participation in financial services by Māori and Pacific peoples, it will be important that any such efforts use culturally appropriate communications.

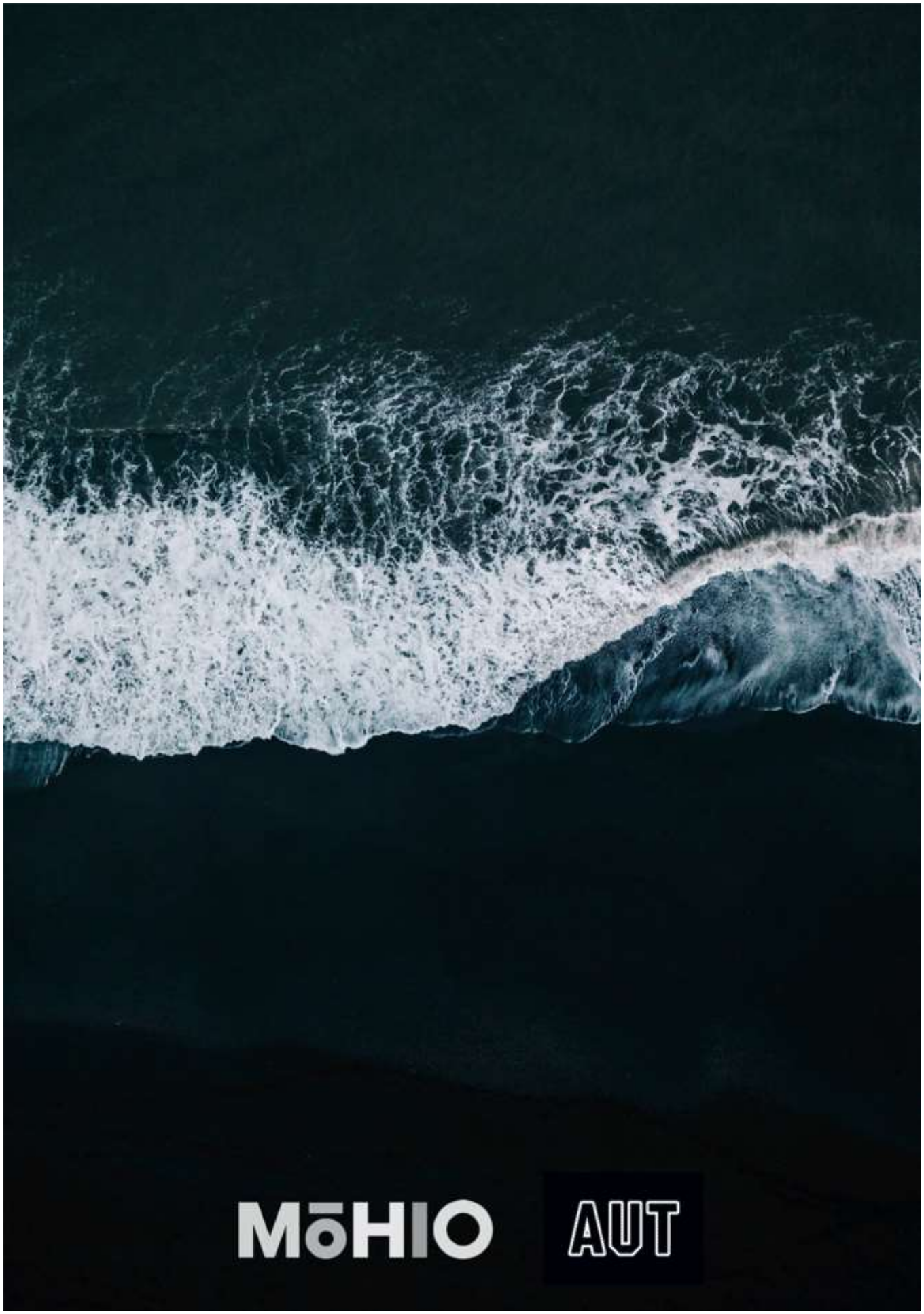
[232] Vedung, E., Frans, C.J., & Doelen, V. D. (1998). The sermon: Information programs in the public policy process: choice, effects, and evaluation. In M-L. Bemelmans-Videc, R.C. Rist, E. Vedung, (eds.) *Carrots, sticks & sermons: Policy instruments and their evaluation*. New Brunswick, N.J.: Transaction Publishers.

[233] Ministry for the Environment (2022). *Te hau mārohi ki anamata Towards a productive, sustainable and inclusive economy: Aotearoa New Zealand's first emissions reduction plan*. Action 3.5.1 https://environment.govt.nz/publications/aotearoa-new-zealands-first-emissions-reduction-plan/

Glossary

Key concepts	Definition
Ability-to-pay principle	An allocative principle which holds that the costs of adaptation should vary with ability, so more abled (i.e. the more wealthy) agents have greater duties to bear the cost of climate adaptation than less abled agents.
Adaptation	In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.
Adaptation alignment	Actions, including funding and financing, that aligns with Article 2.1 of the Paris Agreement by improving consistency with a pathway towards climate-resilient development.
Adaptation companies	Companies which provide goods and services that address adaptation challenge, or companies which benefit communities and stakeholders by adapting to climate change and therefore continuing to provide essential goods and services.
Adaptation equity	A degree of ownership in a company that generates adaptation and resilience benefits as part of its business activities.
Adaptation finance	Adaptation finance describes new and additional funding for all climate adaptation efforts, including the development of adaptive capacity and expenditure on adaptation costs by public and private actors.
Adaptive capacity	Adaptive capacity is the ability of a system to evolve in order to accommodate climate changes or to expand the range of variability with which it can cope
Beneficiary-pays principle	An allocative principle which holds that the cost of producing goods (such as adaptation and resilience) should be borne by those who benefit from those goods.
Blended finance	The use of public or philanthropic money to improve the risk-return profile or commercial viability for a private investor, allowing it to invest in places and projects where it wouldn't otherwise go.
Carbon dioxide removals	The withdrawal of carbon dioxide from the atmosphere as a result of deliberate human activities.
Climate risk	The result of the interaction of physically defined hazards with the properties of the exposed systems (i.e., their sensitivity or social vulnerability). Risk can also be considered as the combination of an event, its likelihood, and its consequences.
Climate risk management	The implementation of strategies to avoid unacceptable consequences. In the context of climate change, adaptation and mitigation are the two broad categories of action that might be taken to avoid unacceptable consequences.
Credit guarantee	A type of insurance which helps to protect the interests of a lender from the risk of non-payment by a borrower, whether at the level of a loan or portfolio.
Debt	An amount of money borrowed by one party from another, for which there is a requirement to repay the balance of the loan by a certain date.
Environmental impact bond	A bond raised on the basis of a pay-for-performance contract which raises capital for the upfront costs of a pre-agreed intervention. If pre-agreed impact targets are met, as per the pay-for-performance contract, investors receive the principal plus coupon; however, investors may face a penalty in the event of underperformance.
Equity	An individual or entity's degree of ownership in any asset after all associated debts or liabilities are accounted for.
Grants	Cash transfers or the provision of in-kind support for which recipients incur no legal obligation for repayment.
Green, Social, and Sustainability (GSS) bonds	Certificates of debt issued by a government or corporation that promise repayment of the borrowed amount, plus interest, by a specified future date; and also commit to the use of bond proceeds for projects with positive environmental and social outcomes.
Insurance-linked securities	Insurance-linked securities, such as catastrophe bonds, are financial instruments which enable insurers to transfer risk from insurance loss events to private capital markets in return for interest payments.

Insurance retreat	Insurance retreat occurs when a private insurer declines an application for insurance coverage, or stops offering renewal for existing coverage, because of a property's exposure and vulnerability to an escalating hazard. Partial occurs when an insurer introduces terms that transfer a significant proportion of a property's risk back onto the policy holder.
Managed retreat	Managed retreat is the carefully planned and managed movement away from areas, such as coastal or riverside sites, that are at high risk of natural hazard and climate change impacts. The relocation can be of buildings, activities, and sites of cultural significance such as urupa.
Microinsurance	Microinsurance is characterised by low premiums and low coverage limits (or caps), which creates accessible risk transfer opportunities for low-income people and microenterprises.
Moral hazard	A situation which incentivises risky behaving by limiting or removing the cost of the risk.
Parametric insurance	Insurance that covers the probability of a predefined event happening instead of indemnifying actual loss incurred.
Pay-as-you-save scheme	A pay as you save scheme in theory is about using private funding, predominantly through finance to fund the upfront cost of adaptation (e.g. energy efficiency measures being installed). A government backed institution would allow lending to consumers at preferential interest rates that would reduce the barrier to entry for such measures.
Pay-for-performance contracts	Pay-for-performance contracts involve a payment for pre-agreed outcomes, rather than contracting for outputs or activities, thereby reallocating project risk away from the outcome funder. Also known as pay-for-results, results-based or outcomes-based funding.
Payment for ecosystem services	A payment which is provided to support ecological processes or functions that have monetary or non-monetary value to individuals or society at large.
Polluter-pays principle	An allocative principle which holds that those who contribute to pollution (such as global heating and/or maladaptation) should bear the costs of managing it.
Public-pays principle	An allocative principle which holds that the costs of adaptation should fall generally on taxpayers or ratepayers.
Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.
Risk-adjusted insurance	A statistical process that takes into account the underlying risks of policy holders when designing the outcomes and costs of the insurance policy, including the setting of the insurance premium.
Sustainability-linked debt instruments	Debt instruments, such as loans or bonds, which offer borrowers a lower cost of capital if they achieve predefined sustainability targets.
Systemic investing fund	A pooled vehicle which combines public, private and philanthropic finance, as well as non-financial interventions (e.g. policy innovation), to implement system-level change.
Targeted rates	Targeted rates are a form of value capture mechanism which enable local councils to recover costs from a 'targeted' group of individuals who may be particularly benefited or impacted by an infrastructure project.
Value capture	A set of public financing mechanisms that recover some or all of the value that public infrastructure generates for private landowners.
Value chain	A connected series of organisations, resources, and knowledge streams involved in the creation and delivery of value to end customers.
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.


MŌHIO
AUT