HAWKE'S BAY CLIMATE RESILIENCE PROGRAMME











HAWKE'S BAY CLIMATE RESILIENCE PROGRMME. A framework for the climate change component of the Hawke's Bay Long-Term Plan.

By Sean Weaver

Executive Director

ekos

www.ekos.org.nz | sean@ekos.org.nz | 027 356 3601

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ABOUT EKOS

A social enterprise specialising in performance-based environmental financing policy, strategy, design, and implementation. We focus on climate finance, carbon management services, indigenous forest carbon, and sustainable land management. We work with local and national governments, multilateral agencies, multilateral development banks, universities, carbon standards, NGOs, and small, medium and large businesses. We also operate a carbon neutrality and carbon offsetting service in the New Zealand voluntary offsets market, specialising in indigenous forest carbon.

Disclaimer: Due to the very broad scope of this topic and the limited time to undertake this analysis, this report has limitations in terms of both breadth and depth in some areas. Apologies are in order for any sector, community or stakeholder group that were insufficiently represented in this analysis.

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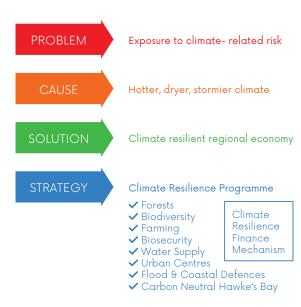
EXECUTIVE SUMMARY



1.

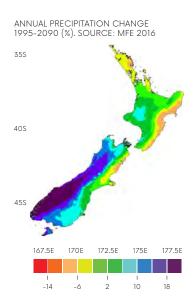
EXECUTIVE SUMMARY

Hawke's Bay faces a range of climate change challenges relevant to its Long-Term Plan time horizon, with actions needing to be completed, or initiated by 2028. On the front line are Hawke's Bay farmers, who stand to suffer greater exposure to drought risk, and whose wellbeing and livelihoods are threatened by a warmer, dryer, and stormier future climate. Coastal communities also stand to suffer from rising sea levels, storm surges and infrastructure limitations. The task is to reduce exposure to climate-related risk by bringing the region together under a common purpose: climate resilience.



Climate projections show a warmer, stormier and dryer climate in coming decades, with more intense extreme weather events expected, including droughts and flooding, sea level rise and storm surges. In their aggregate, these climate change impacts present a significant threat to current and future human wellbeing.

This report applies an "ecological infrastructure" lens to the challenge of climate change in Hawke's Bay, and focuses predominantly on climate change adaptation and resilience. Regional ecological infrastructure includes soils, forested catchments and stream banks, waterways, aquifers, wetlands, biodiversity, and coastlines. This ecological infrastructure delivers beneficial ecosystem services in the form of agricultural, horticultural, and forestry production, water quality, flood mitigation, drought mitigation, recreation, and cultural heritage. Without adequate investments in ecological and



engineering infrastructure sufficient to cope with projected climate change risks, human wellbeing in the Hawke's Bay region will decline.

The emphasis on climate resilience in this report arises from recognition that a community-wide response to a collective threat has greater motivating force than shaming people for their greenhouse gas emissions. Greenhouse gas emissions will reduce significantly under implementation of the framework presented here including in the agricultural sectors. But the underlying strategy focuses on incentivising change, community-building and reducing collective risk to a region economically dependent on the alignment of good soil and good water supply. What do the risks include? - A changing global and local climate, changing global carbon pricing, changing global energy pricing, and changing global markets.



WHAT'S IN THIS REPORT? INTRODUCTION SCIENCE PERFORMANCE MEASUREMENT STOCK TAKE

- Global trends
- National trends
- Local trends
- Higher temperatures
- Drought risk
- Cyclone risk
- Flood risk
- Sea level rise
- Carbon, energy pricing & markets

Climate change solutions delivered by HBRC so far:

- Facilities management
- Air quality
- Transport
- Sustainable farming
- Monitoring & planning tools
- Reforestation
- Biodiversity & biosecurity
- Flood and coastal protection

Proposed solutions:

- Conduct a climate resilience assessment of the region to future-proof the Hawke's Bay economy and
- Strengthen policy and funding options to deliver climate resilience in forests, urban centres, farming, biodiversity, biosecurity, rivers, water supplies, flood and coastal
- Complement the delivery of current efforts through existing and new funding channels including market-based and market-linked financing options - here called the Climate Resilience Mechanism
- Utilise a range of policy tools to implement programmes, such as an Indigenous Forest Carbon Programme, that drives resilience at scale.



SOLUTION FOUNDATIONS: CLIMATE FINANCE

If your dream can't be financed, it remains a dream. Big dreams need big finance, and big finance at the scale sufficient to address Hawke's Bay's climate resilience challenges is beyond the capacity of the public purse. For example, the finance required to reforest all erosion-prone lands in Hawke's Bay between 2018 and 2030 has 8 zeros. Globally the situation is similar. A study by the World Bank estimates that the cost of adapting to a 2°C warmer world by 2050 comes with a price tag of US\$70–100 billion per year. Similarly, a study by the United Nations Foundation concluded that avoiding 2°C global warming will require over US\$2 trillion in low carbon investment. For this reason, this report recommends a public-private financing model designed to deliver the greatest gains at least cost, using market-based and market-linked mechanisms to complement grant and fund instruments.





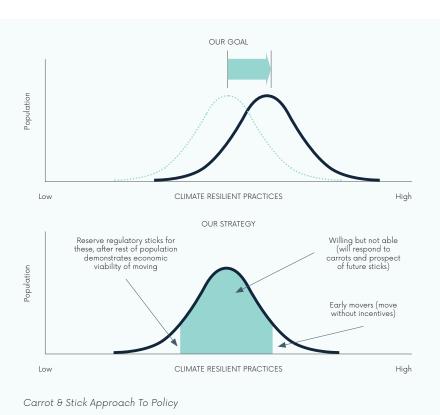
CLIMATE RESILIENCE MECHANISM The "engine room" for innovative solutions presented in this report is the 'Climate Resilience Mechanism' - an integrated financing mechanism designed to deliver a series of climate resilience outcomes at scale¹. The Climate Resilience Mechanism (CRM) encompasses 21st century financing modalities in a world-leading package, that will put HBRC on the national and international stage as a leader in climate resilient policy and planning.

The CRM is an ambitious yet realistic

financing framework, designed to enable a high level of ambition to translate into high resilience impact at scale.

The emphasis of the CRM is on positive solutions that can be delivered at least cost. This delivery is channelled through a series of public-private-partnerships, designed to significantly amplify the impact of any ratepayer spending. These financing models integrate with strategic deployment of regulation (stick) designed to stimulate voluntary uptake and early action in response to incentives (carrots).







The policy and financing model of the Climate Resilience Mechanism (CRM) includes an integrated set of financing modalities and programmes as follows:

- Climate Enterprise Start Up Fund
- Climate Enterprise Loans
- Climate Enterprise Investment Readiness Programme
- ClimateSmart Programme
- Climate Collateral
- Climate Impact Investment
- Climate Resilience Exchange
- Indigenous Forest Carbon Programme
- Carbon Neutrality Programme
- Climate Cents
- Climathon Hawke's Bay
- Carbon-Biodiversity Market

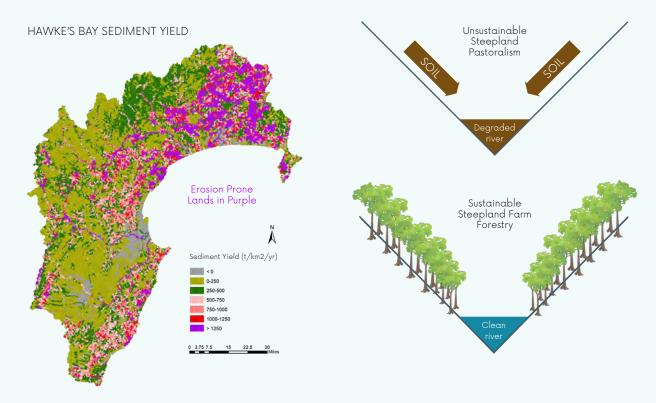
The purpose of the Climate Resilience Mechanism is to facilitate the delivery (at scale) of Climate Resilient:

- Farming
- Forests
- **Biodiversity**
- **Biosecurity**
- Rivers
- Urban communities
- Water supply
- Flood and coastal defences

A few examples from this list of modalities are presented below.

EXAMPLE 1: INDIGENOUS FOREST CARBON PROGRAMME

Hawke's Bay has approximately 200,000 hectares of erosion-prone land that is seriously vulnerable to climate change, is currently degrading the region's rivers, and urgently needs afforestation. An indigenous forest carbon programme can be developed to establish diverse forest cover at scale.



Carbon farming presents a significant opportunity to drive afforestation at scale. Because of the steepness, remoteness, and sensitivity of these erosion-prone lands, the majority of such afforestation needs to comprise permanent forest with no intent (or permission) to harvest.

Economic production on these lands can change from beef/lamb production to carbon/honey, with the latter likely matching the former on a net return basis.



INDIGENOUS FOREST CARBON PROGRAMME The Indigenous Forest Carbon Programme (IFCP) is a proposed regional social enterprise programme designed to:

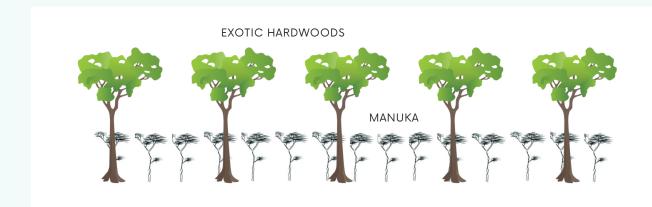
- 1. Coordinate and support large scale adoption of carbon farming projects on private, erosion-prone land, and generate economies of scale.
- 2. Aggregate carbon credits from participating farmers and negotiate single point, large volume sales to large scale carbon buyers.
- Command investment at a scale sufficient to deliver an erosion-control and water quality solution at scale.
- 4. Maximise environmental outcomes rather than commercial profit.



While planting indigenous species may seem ideal from a biodiversity point of view, indigenous forest growth rates are very slow. Accordingly, a large-scale afforestation programme at the scale needed, would unlikely be economically viable with indigenous-only plantings.

The most economically viable method of carbon farming on these lands is indigenous afforestation under a nursery crop of suitable (e.g. non-wilding), widely spaced exotic hardwoods, capable of rapidly creating a favourable

micro-environment for natural indigenous regeneration. This delivers approximately triple the annual carbon revenue of indigenous-only forest, with preliminary investment analysis showing it to be economically viable at the scale needed. Such an approach would also enable indigenous-only plantings for a proportion of the total particularly where high biodiversity values are targeted at specific sites.



An ambitious planting regime that recruits 10,000 hectares of land annually into the programme (rising to 20,000 ha p.a. in 2024) would deliver 200,000 ha of afforestation by 2030. This would require a net (of revenues) investment of around \$385m (\$700m gross) disbursed between 2018 and 2030. It would pay for itself by 2034, deliver an internal rate of return of 14% for a programme modelled to 2040, and has a net present value of \$130m of which a portion can be delivered to farmers, funders, and conservation management. In contrast, planting the equivalent area in indigenous-only tree species requires a net investment of \$600m, yielding an internal rate of return of 0% and a NPV of -\$200m (i.e. is not economic).

If HBRC is serious about solving the erosion problem in Hawke's Bay hill country, it will need to:

- a) Carrot: Invest in an ambitious carbon farming programme (and win co-financing investment from external partners).
- Stick: Send a signal that in future (e.g. in 10 years' time) it will regulate to preclude pastoralism as a permitted activity on the most erosion-prone lands in the region.

Without the "stick", the rate of voluntary uptake in an ambitious regional carbon farming incentive programme will be low, and this will very likely result in the failure of the programme to deliver the scale of change needed in order to solve the erosion problem.

EXAMPLE 2: URBAN RESILIENCE

The HBRC Heatsmart programme is a great example of innovative financing for resilience. The funding model that takes advantage of bulk-purchased debt finance by HBRC, and disbursed at a low cost of capital to homeowners, and cost-recovered through rates is ideally suited to other climate resilience measures in existing homes.



climatesmart resilient homes

The Heatsmart programme could be upgraded to include other resilience technologies including rain water harvesting, solar hot water, photovoltaic electricity.



To have sufficient capacity in the national grid for mainstreaming electric cars in coming years, the country will need to reduce existing grid-connected electricity demand where possible. One of the most efficient ways to reduce electricity demand is to avoid using electricity to heat water. As such, scaling up solar hot water uptake for households and new builds has high strategic value in a climate resilient, low carbon economy.



Climate projections of a warmer and dryer Hawke's Bay will put further pressure on water resources. Making household rainwater collection the "new normal" will increase the water-independence of urban households, and enable greater water efficiency across the (growing) population.



EXAMPLE 3: CARBON NEUTRALITY



CARBON **NEUTRAL** HAWKE'S BAY

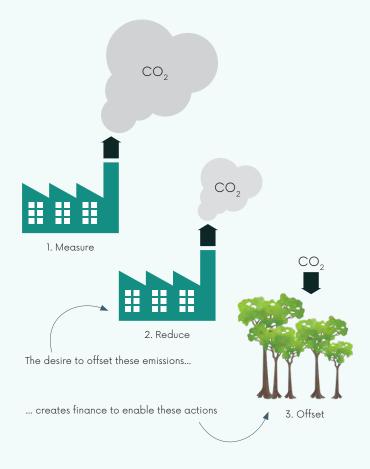
The drive towards a low carbon economy could also be delivered through a carbon neutrality programme for Hawke's Bay. The regional scale carbon balance is the net result of all emissions and removals (sequestration). Some preliminary analysis of regional carbon balance on was undertaken by Landcare Research in 2007 under the Carbon Neutral Hawke's Bay project. This involved a top-down assessment of emissions and removals resulting in an estimated net balance of 2.5 million tCO₂e annually. This accounted for 1.75 million tCO₂e removals (sequestration) into the regions plantation and indigenous forests¹.

Rekindling the Carbon Neutral Hawke's Bay concept is recommended in this report, with an emphasis on a combined top-down and bottomup approach to the task of neutrality. The top-down element involves regional-scale carbon accounting updates using more recent data. The bottom-up element involves a business-by-business carbon neutrality programme (also available to individuals and community organisations). HBRC could form the corner stone of a Hawke's Bay carbon neutrality programme by going carbon neutral with its Dalton St business operations.

Preliminary carbon footprint calculations for Dalton St business operations reveal a 2016 CO₂ emissions footprint of approximately 460 tCO₂e. This results from significant emission reductions from energy efficiency investments in recent years.

Offsetting these emissions by purchasing indigenous forest carbon offsets would enable HBRC 2016 business operations to become carbon neutral at a cost of approximately \$10,000, whilst supporting local indigenous reforestation carbon projects (e.g. sourcing carbon credits from the Indigenous Forest Carbon Programme).

Should HBRC decide to show even stronger leadership, it could offset 120% of its CO₂ footprint and be a carbon negative council (perhaps a world first) at a cost of approximately \$12,000.

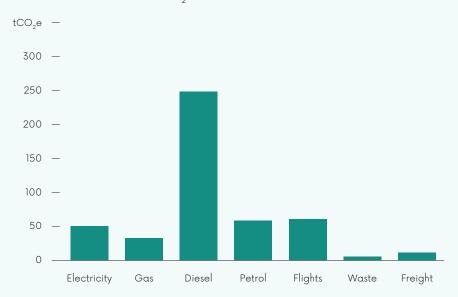


This 2007 analysis did not account for agricultural soil carbon, but there may be scope for exploring the latter in a renewed regional carbon accounting exercise

By engaging in regional leadership at the micro-economic scale, HBRC has the opportunity to help show other public service entities, the private sector and individuals how accessible carbon neutrality really is. A key to stimulating demand in local carbon neutrality efforts, includes

deploying a demand-side engagement model with low transaction costs², and to develop local indigenous forest carbon projects that potential carbon buyers want to support.

2016 $\rm{CO_2}$ EMISSIONS - DALTON STREET



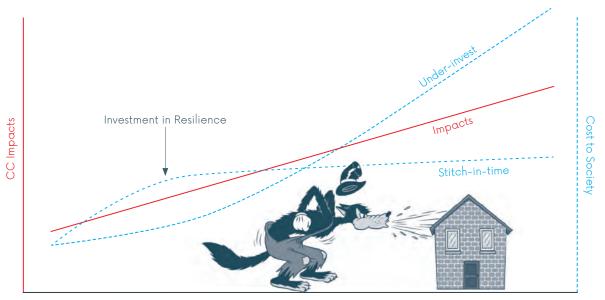


²Ekos (a charity) has developed and refined a low-cost austomer engagement model for carbon neutrality, that caused it to win the 2016 Sustainable Business Network national award for Restorative Innovation.



WHICH LITTLE PIG?

Ultimately, the task of delivering climate resilience to Hawke's Bay is a conservative and prudent public and private investment in the region's future. By investing wisely, the return on investment will be realised in the short-term as well as long-term. In the short-term, the regional economy will be stimulated into new areas of growth, whilst preparing early-century foundations for mid-century prosperity and wellbeing.



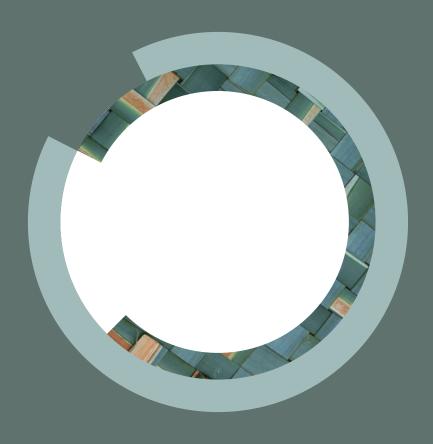
Time

How to deliver this as a Council? HBRC cannot be expected to do it all. But it can play a pivotal leadership role in a series of public-private partnerships to deliver an ambitious programme of action. HBRC can also continue with, upgrade, coordinate, and make more visible its existing activities (including investment and regulation) to stimulate a "whole of community" and "community building" response to the challenge of regional climate resilience.



2.

INTRODUCTION





2 Introduction

Global climate change poses a significant threat to human wellbeing in Hawke's Bay for the coming decades and beyond. This global trend has local implications both for adapting to a changing climate and reducing the greenhouse gas emissions that contribute to climate change.



The scope of this proposed Long-Term Plan framework has a primary focus on Council assets and services, with a secondary focus on the wider Hawke's Bay community.

The aim is to show leadership in climate change innovation at the local government level. This focuses on a drive towards a low carbon, prosperous regional economy, that is also agile and adaptive to a changing climate. To achieve this, HBRC will need to pay full attention to the latest developments in climate science and innovation, and use these as a guide for action.



The most independent scientific advice available on climate change can be gathered from the following sources:

- Intergovernmental Panel on Climate Change (IPCC) a collection of the world's leading climate scientists tasked with reviewing all of the available published science on this topic and to provide summaries for policy-makers. The IPCC includes New Zealand scientists working in government agencies, universities and the private sector.1
- New Zealand Government agencies such as NIWA, Ministry for the Environment, the Ministry for Primary Industries, as well as the studies undertaken by others but funded by these agencies.
- Hawke's Bay Regional Council scientific staff.

It is worth taking heed of innovation in climate change response measures from a wide range of sources, to benefit from lessons learned locally and from around the world. This will enable HBRC to consolidate what it is already doing, and trial, then scale up innovations that enable Hawke's Bay to prosper in a changing climate and in the context of a low carbon regional economy.

This climate change Long-Term Plan framework is structured as follows:

- Defining the challenge
- Stock take on HBRC actions
- Climate change solutions

An additional consideration is how to measure progress against specific targets.

- INVESTING IN NATURE **ekos** 13

¹ To view the latest IPCC Assessment Report go to: https://www.ipcc.ch/report/ar5/

DEFINING THE CHALLENGE





3 Defining the Challenge

The climate change challenge for Hawke's Bay Regional Council falls into two broad categories:

- Climate change adaptation (learning to live with a changing climate).
- 2. Climate change mitigation (transitioning to a low carbon economy).

Understanding global and local climate change trends and associated threats help to set the context for appropriate response measures.

Adaptation

From a climate change adaptation perspective, it is important to reduce exposure to climate-related risk for a) Council assets and services and b) the wider regional community.

Mitigation

This can be delivered by strengthening resilience to climate change through prudent investments and strategic planning.

A key element of climate change mitigation (greenhouse gas emission reductions), is to reduce exposure to current and future climate policy risks associated with emission reduction responsibilities. The HBRC can approach this challenge by being proactive and innovative to eliminate inefficiencies that would expose Council assets and services and regional economy to future carbon pricing, energy pricing, or land/coastal management risks. This approach would acknowledge that an energy efficient, low carbon economy is more agile, prosperous and durable, compared with an energy inefficient economy overly reliant on fossil fuels and carbon-intensive activities.



In both climate change adaptation and mitigation, the HBRC could prioritise "no-regrets" actions that deliver win-win outcomes where possible, for Council assets and services, the region as a whole, and especially where economic efficiencies can be gained.

This Long-Term Plan framework is built on the following structure:

Problem	Regional climate change challenges requiring planning response measures.
Performance	A set of criteria for measuring HBRC performance against planning goals.
Stocktake	HBRC performance and gap analysis.
Solution	Specific planning goals to set the agenda for action.

4.

PROBLEM: REGIONAL CLIMATE CHANGE CHALLENGES





4 Climate Change Threats

To assess climate change impacts on Council functions it is necessary to examine global, national and (where possible) local climate change data and associated trends. This can enable a risk assessment to be undertaken for Council functions potentially affected by climate change.

4.1 GLOBAL TRENDS

Global trends identified by the IPCC Fifth Assessment Report (IPCC 2013b) are:

- Global warming is unequivocal. Many of the observed changes in the global climate system since the 1950s are unprecedented over decades to millennia. Both the oceans and atmosphere have warmed, snow and ice volumes have diminished, sea level has risen.
- Atmospheric greenhouse gas concentrations have increased to levels unprecedented
 in at least the last 800,000 years. Atmospheric carbon dioxide concentrations have
 increased by 40% since 1750. The primary cause of this increase is emissions from
 fossil fuel burning, with land-use change emissions comprising the secondary cause.
 Global oceans have absorbed approximately 30% of the emitted anthropogenic
 carbon dioxide. This has caused ocean acidification.
- It is extremely likely (95–100% confidence) that human influence has been the dominant cause of the observed warming since the mid-20th century.
- The global surface temperature is projected to rise by greater than 1.5°C relative to temperatures between 1850 and 1900 (66–100% confidence), and could exceed 2°C.
 Warming will continue to exhibit inter-annual-to-decadal variability, and will not be regionally uniform.





4.2 NEW ZEALAND CLIMATE CHANGE TRENDS

New Zealand climate change trends as identified by the Ministry for the Environment are summarized in the report entitled Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment (Ministry for the Environment 2016). This report is restricted to terrestrial projections (predominantly temperature and precipitation) with other reports still in preparation at the time of writing (hydrological impacts, sea level rise and coastal impacts, and return periods of extreme precipitation).

4.2.1 Temperature And Precipitation

Temperature trends both globally and for New Zealand show an upward trend for mean annual temperatures. New Zealand shows wider variability than the global average (as would many locations around the world), with local variability resulting from our maritime climate with combined influences from tropical and Antarctic climate patterns.

Figure 4.2.1a: Comparison of New Zealand and global annual surface air temperature anomalies (in °C) over land, relative to a 1981-2010 baseline. Source: MFE 2016.

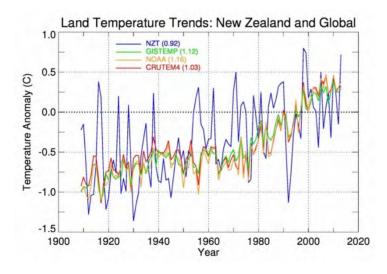
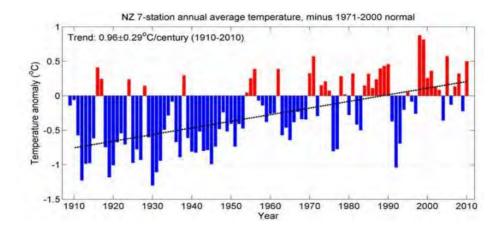




Figure 4.2.1b: Mean annual temperature for New Zealand, calculated form NIWA's 'seven-station' series. The blue and red bars show the difference from the 1971-2000 average. The black dotted line is the linear trend over 1910 to 2010. Source: NIWA 2015.



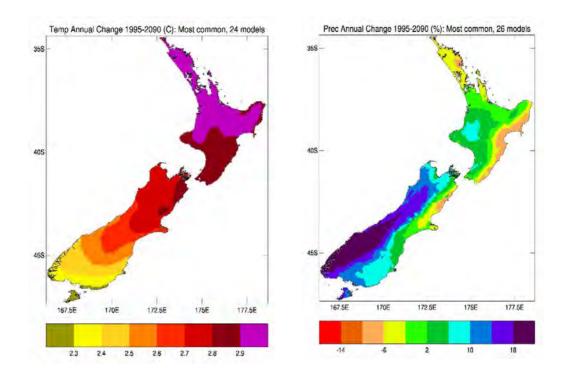
Projections for annual temperature and precipitation change between 1995 and 2090 are shown in Figure 4.2.1b below.

The general warming signal has north-south and east-west gradients, with the strongest warming over the north-eastern North Island. This will be accompanied by an increase in high temperature extremes (number of days 25°C or above).

Tropical cyclones and extra-tropical cyclones are likely to not increase in frequency, but are likely to increase in intensity through the 21st century. This will bring more intense winds and rainfall during these events as a result of more energy in weather systems and more water vapour in the atmosphere.



Figure 4.2.1c: The most common patterns of annual temperature (left) and precipitation (right) change between 1995 (1986–2005) and 2090 (2081–2100). Source: MFE 2016.



4.2.2 Sea Level Rise And Coastal Hazards

Global mean sea level rose at a mean rate 3.2 mm per year between 1993 and 2010. This has mainly been caused by thermal expansion of the oceans (as a consequence of ocean warming), and melting glaciers. Global mean sea levels are projected to rise from between 44cm and 74 cm by 2100². Extreme sea levels arise from a combination of factors including astronomical tides (e.g. spring tides), storm surges, wind-driven waves and swell, and interannual variability of sea levels.

The erosive force of the ocean along the coastline is predominantly horizontal, and is most severe when delivered through extreme weather events such as extra-tropical cyclones. Accordingly, relatively small rises in mean annual sea level can translate into substantial additional coastal erosion in low-lying areas in association with high tides, storm surges and swells caused by storm-driven winds.

² IPCC 2014a. WGIIAR5-Chap5, p 369.



4.2.3 Hawke's Bay Climate Change Trends

National and regional data and projections show that (in summary) Hawke's Bay can expect higher mean temperatures, higher temperature extremes, lower mean precipitation, and increased drought risk. This will include a projected increase in the average number of hot days (maximum temperature ≥25°C) from 27.5 currently to closer to 40 in the period of 2031-2050, and closer to 60 in the period 2081-2100. This is projected to be accompanied by a significant decrease in the number of frosts over the same period.

Coastal areas of Hawke's Bay can expect increased inshore sedimentation risk from rivers, increased coastal erosion risk from sea level rise, increased fisheries risk associated with sedimentation (inshore fisheries) and ocean acidification (inshore and ocean fisheries). Fisheries may also be affected by changes in distribution of fish stocks and an increase in marine pest species due to ocean temperature changes.

4.3 CLIMATE CHANGE RISKS

The categories of risk in climate change adaptation and resilience as defined by the IPCC are broken down into five integrative "reasons for concern" (RFCs):

- 1. Unique and threatened systems
- 2. Extreme weather events
- 3. Distribution of impacts
- 4. Global aggregate impacts
- 5. Large-scale singular events.

Key specific risk types running across these RFCs (as identified by the IPCC) are defined in Table 4.3 (below) with specific reference to their relevance to HBRC assets and services and the wider Hawke's Bay community.



Table 4.3 Climate Change Risk Types

IPCC key risk types	Relevance:	Relevance:
	HBRC Assets & Services	Wider Community
(i) Risk of death, injury, ill hea or disrupted livelihoods in I lying coastal areas due to storm surges, coastal floodi and sea level rise. [RFC 1-5]	ow- Council transportation services on coastal	 Low-lying coastal housing settlements (including Haumoana, Clive, Te Awanga, Ocean Beach, Ahuriri, Westshore, north Napier coastal housing along State Highway 2, Mahia Beach, Mahanga) Low-lying industrial areas (including Awatoto, Ahurir Pandora) Low-lying coastal farmland Beach erosion Airport access
(ii) Risk of severe ill health and disrupted livelihoods for urban populations due to inland flooding. [RFC 2, 3]	 Council buildings and depots in Napier 	 Businesses in low-lying areas of Napier, Hastings, Havelock North, Wairoa Homes in low-lying areas of Napier, Hastings, Havelock North, Wairoa
(iii) Systematic risks due to extreme weather events leading to breakdown of infrastructure networks and critical services such as electricity, water supply, and health and emergency services. [RFC 2-4]	 Council transportation services and operations on road networks Council electricity and water supply 	 Business and household transportation services on road networks Business and household electricity and water suppl Access to Hawke's Bay Hospital (e.g. during flood)
(iv) Risk of mortality and morbidity during periods of extreme heat, particularly for vulnerable urban populations. [RFC 2, 3]	 Council field staff working during heatwaves 	 Young and elderly urban population during heat waves
(v) Risk of food insecurity and the breakdown of food systems linked to warming, drought, flooding, and precipitation variability and extremes. [RFC 2-4]	No significant risks identified	 Potential loss of agricultural and horticultural productivity



Table 4.3 Climate Change Risk Types

IPCC key risk types	Relevance:	Relevance:	
	HBRC Assets & Services	Wider Community	
(vi) Risk of loss of rural livelihoods and income due to insufficient access to drinking water and irrigation water and reduced agricultural productivity, particularly farmers and pastoralists. [RFC 2, 3]	 Forest fire risk to HRBC plantation forest assets 	 Drought, flooding, and reduced soil water retention: Horticultural and agricultural farming systems and associated economic impact throughout the region. Forest fire risk to plantation forestry industry 	
(vii) Risk of loss of marine and coastal ecosystems, biodiversity, and the ecosystem services they provide for coastal livelihoods, especially for fishing communities. [RFC 1,2, 4]	Council responsibilities for coastal & inshore marine biodiversity conservation	 Fishing industry and kai moana availability challenged by ocean acidification, river-fed inshore marine sedimentation, & changing fish species distribution. Loss of coastal and inshore marine biodiversity 	
(viii) Risk of loss of terrestrial and inland water ecosystems, biodiversity and the ecosystem services they provide for livelihoods. [RFC 1,3,4]	 Council responsibilities for terrestrial and freshwater biodiversity conservation, and water quality 	 Loss of ecosystem services provided by indigenous forests, streams, lakes, wetlands and estuaries. This includes increased exposure to flood risk and loss of water purification services, and biodiversity loss. Loss of indigenous forest habitat to forest fires. 	



4.4 CLIMATE CHANGE MITIGATION RISKS & **OPPORTUNITIES**

New Zealand has made an international commitment under the Paris Agreement to the United Nations Convention on Climate Change (UNFCCC). This commitment is defined as New Zealand's Nationally Determined Contribution (NDC) under the Paris Agreement.

Under the NDC New Zealand commits to reducing national greenhouse gas emissions to 30% below 2005 levels by 2030. This national commitment has regional implications given that all regions will need to play a role in meeting this national commitment.

As part of New Zealand's domestic strategy to meet this commitment, the government has implemented the New Zealand Emissions Trading Scheme (NZETS). This exposes HBRC and the Hawke's Bay regional economy to climate policy risk in the form of carbon pricing. This has relevance to those sectors whose core GHG emissions are directly exposed to carbon pricing: transportation, energy, industrial processes (with the possibility of agriculture becoming affected at some future date).

Carbon pricing risk may also increase during the 10-year term of this LTP and beyond. This is due to a) increasing emissions in key sectors such as energy and agriculture, b) shifts in international carbon pricing for carbon units sourced offshore, and c) a reduction in national emissions removal capacity in the forest sector, particularly between 2017-2023.

In other words, the forest sector has historically played an important role in offsetting growth in emissions in energy and agriculture sectors, but this role will diminish significantly for 2018-2030 as plantation forests planted in the 1980s and 1990s are harvested and the associated carbon emissions impact on the national carbon account.

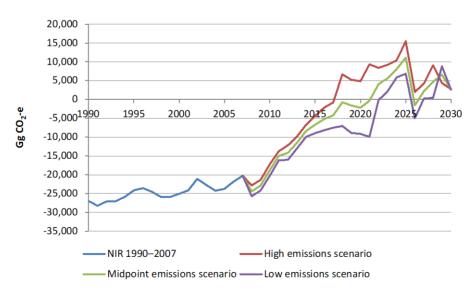


Figure 4.4a Actual and projected total gross (excluding forestry) and net (including forestry) emissions, 1990-2030. Source: Ministry for the Environment 2013.

When the green dotted line goes above the blue dotted

line, our plantation forests are no longer soaking up lots of fossil fuel emissions, but are emitting lots of CO2 themselves (from harvesting) 100,000 90,000 80,000 70,000 60,000 50,000 40,000 30,000 20,000 10,000 0 1990 1995 2000 2005 2010 2015 2020 2025 2030 Actual gross emissions ---- Projected gross emissions Projected net emissions Actual net emissions

Figure 4.4b Net emissions as presented in the 2013 Greenhouse Gas Inventory (1990-2007) and projected (2008-2030). Source: Ministry for the Environment 2013.





The regional upside of national carbon pricing risk is the opportunity for HBRC and hill country landowners to benefit from carbon financing for afforestation for erosion control. Any rising carbon prices will benefit the business case for investment in carbon farming at scale across the region.

Another area of climate change mitigation opportunity is the potential role of HBRC to provide corporate leadership in low carbon performance.



This could be expressed through HBRC becoming carbon neutral or carbon negative for its own operations. Such leadership can then be applied to facilitate similar performance by other large public organisations in the region, as well as the private sector.

Linking an aspiration for carbon neutrality to afforestation and biodiversity protection and enhancement could see a demand (carbon neutrality) and supply (indigenous afforestation) market circle develop, with gains from trade on both the demand and supply side.



This leadership in low carbon business activity could extend to enhancing ambitions in the road transport sector through improved cycling, car pooling and public transport services operating in the Napier-Hastings urban areas.

5.

PERFORMANCE: MEASURING PROGRESS





5 Performance Measurement



This Long-Term Plan framework builds on existing and previous HBRC planning documents including the 2012 and 2015 LTP, and the current Strategic Plan, and publications/reports on climate change planning previous efforts including the MFE guide for local government on climate change.

In aggregate, these planning guides present a benchmark upon which actions can be undertaken and measured against. There are also opportunities to establish performance measurement protocols for future planning delivery.

5.1 MFE GUIDE FOR LOCAL GOVERNMENT



5.1.1 Assessing Climate Change Impact on Council Functions

The MFE 2008 guide for local government on climate change³ provides guidance on assessing climate change impacts on council functions. It recommends that key factors are taken into account when assessing climate change impacts on council functions are: duration, drivers, location, extent and the nature of the issues being addressed.

³ Ministry for the Environment 2008, p20.



MFE recommendations on key factors for measuring climate change impacts on council functions:

Duration	Duration refers to the time period over which a decision will have effect. This tends to relate to decisions that will have effects lasting 30 years or more.
Driver	The driver of a climate change risk needs to be taken into consideration and addressed sufficiently in a planning response measure.
Location	Some locations are more vulnerable to climate change than others.
Extent of issue	Decisions over larger areas will have greater long-term implications than decisions over isolated situations.
Nature of issue	Complex climate impacts and influences need to be address in more integrated ways compared with relatively simple impacts.

5.1.2 Integrating Climate Change into Council Decision-Making

On the theme of integrating climate change into Council decision-making the MFE 2008 guide on climate change for local government⁴ states an emphasis on the following three themes:

- 1. Understanding scope and variation of climate change impacts.
- 2. Deciding on priorities for action.
- 3. Applying risk assessment to enable a risk-based response.

⁴ Ministry for the Environment 2008, p27.



Four key stages are identified for assessing climate change influence on Council functions:

- a) Identify which Council functions are vulnerable to climate change.
- b) Undertake a risk analysis for each vulnerable Council function.
- c) Assess whether existing Council planning provisions adequately address the climate change risk to each council function (gap analysis).
- d) Identify changes in Council planning provisions required to fill gaps identified in c) above.

5.1.3 Checklist for Recommended Content for Long-Term Council Community Plans⁵

This checklist was designed to assist local authorities to take climate change principles into account when considering climate change effects in plan development and review. The recommended checklist for Long-term Council Community Plans is:

- 1. Are the long-term implications of climate change identified anywhere in relation to community outcomes? Is any statement clear and able to be measured of monitored?
- 2. How is the timeframe of climate change effects handled? Is there adequate explanation of the need to act within the framework of the current plan, although effects may become apparent only during the preparation of future plans?
- 3. Are adaptive responses to potential climate change s identified in relation to specific assets or activities (water supply, wastewater, stormwater, roading, pest management, parks and reserves management, etc.)? Are these responses specific and targeted to the asset?
- 4. If a change in level of service, or additional capacity, is planed owning to climate change, is this explicit and explained?
- 5. Are other programmes or plans relating to climate change identified (e.g. biosecurity, biodiversity) and details and budgets specified?

⁵ Ministry for the Environment 2008, p19.



- 6. Is a monitoring regime relating to the aspect involving a climate change response identified and are mechanisms, costs and duration foreshadowed?
- 7. Are the levels of uncertainty involved in the forecasts of climate change explained, and an estimate of the uncertainty provided?

5.2 HAWKE'S BAY PREVIOUS LTPS AND STRATEGIC PLAN

5.2.1 HBRC 2012 LTP

A key feature of the 2012 Long-Term Plan was a section entitled "The Right Debate", which highlighted significant issues facing Hawke's Bay, and how HBRC proposed to address these issues over the subsequent 10-year period.

Key strategic goals were broken into the following themes: Resilient Ecosystems, Resilient Economy, and Resilient communities. These key themes are evaluated for their relevance to climate change planning in Table 5.2.1 below.

Table 5.2.1 HBRC 2012 LTP

Resilient Ecosystems Strategic outcomes	Activities	Climate Change Relevance
Land – Viable and resilient farming systems are being achieved through sustainable land use.	Hill Country Afforestation proposal	High adaptation and mitigation
Water quality – There is proactive integrated management of land and water.	Improving the focus on the Regional Landcare Scheme	Medium adaptation
Water allocation – Water supply and ecosystems needs are optimised for sustainable growth.	Biodiversity Strategy	High



Resilient Economy			
Strategic Outcomes	Activities	Climate Change Relevance	
Water security – Water supply and demand for sustainable growth are optimised.	Ruatanewha community water storage dam to improve natural flow of river and improve water security in the area.	High adaptation	
	Feasibility study into adding to the flow of the Ngaruroro river through water storage.	Medium adaptation	
	Improve level of protection from flood control infrastructure – stopbanks, pumps – on the Heretaunga Plains.	High adaptation relevance for potential increase in flood intensity and frequency under a warmer climate	
Natural Hazards and Infrastructure – People and businesses feel safe and are willing to invest in Hawke's Bay.	Work to assist the Regional Economic Development Strategy.	Potentially high depending on infrastructure in question	
Day.	Investment in the Port of Napier.	Medium adaptation to sea level rise and likely increase in storm surge impacts (increasing in relevance through time).	
Resilient Communities			
Strategic Outcomes	Activities	Climate Change Relevance	
People and communities – Comprehensive, relevant and quality services continue to be delivered by HBRC to enable a connected and healthy community.	Continue Heat Smart programme to assist with warmer healthier homes and cleaner air.	Medium climate change mitigation relevance (drive toward a low carbon economy)	
	Provide public transport bus services as an alternative way for people to get around Napier and Hastings. Continue developing resilience and preparedness for natural disasters and recovery in our communities.	Medium climate change mitigation relevance (drive toward a low carbon economy)	
		High climate change adaptation relevance for coping with extreme weather events	
	Consider the advantages, disadvantages and practicality of the region being GMO free	n/a	



Resilient Communities Strategic Outcomes	Activities	Climate Change Relevance
	A new proposal to look into the potential of webcasting as a way to improve the opportunity for the public to participate in council meetings and understand the democratic process.	Potentially relevant to community participation in decisions relating to climate change resilience.
	A new proposal to explore possible investment in solar hot water installations, similar to the Heat Smart programme.	Medium relevance to climate change mitigation (drive towards a low carbon economy)

5.2.2 HBRC 2015 LTP



The strategic goals of the 2015 LTP are: Resilient Organisation; Resilient Economy; Resilient Ecosystems; Resilient Community.

Resilience in the face of a likely increase in the risk of storminess, drought intensity, flooding, and sea level rise is a key challenge for long term planning and investment for a regional economy. Such future resilience will require planning and investment by a) HBRC for its own assets, services and operations, and b) the wider community for their risk exposure. While HBRC cannot plan or invest for the wider community, it can provide valuable guidance from the perspective of an agency responsible for facilitating the long-term wellbeing of the regional community.



5.2.3 HBRC Strategic Plan



The four focus areas for strategic priorities for HBRC are:

- 1. Water quality, safety and certainty.
- 2. Smart, sustainable land use.
- 3. Healthy and functioning biodiversity.
- 4. Sustainable services and infrastructure.

Each of these four focus areas have a strong relationship with climate change. From a climate change adaptation point of view water, land use, biodiversity, and infrastructure all need to cope with a changing climate that is projected to get stormier, hotter and dryer in coming decades.

Sustainable land use and sustainable services have a strong link to a low carbon economy. And there are some key synergies between climate change adaptation/resilience and climate change mitigation in the area of sustainable land use - particularly from the perspective of reforestation on council assets and in the region more broadly.



5.3 PERFORMANCE MEASUREMENT

The State Services Commission has defined a framework for performance measurement used by government agencies, and programmes. The framework (Figure 5.3a) focuses on a causal chain starting with the provision/allocation of resources, and ends with the delivery of targeted outcomes.

What are our Less deaths on the road goals for New **Outcomes** Zealanders? Reduced Reduced What difference Increased use **Impacts** drink-driving are we making? What activities **Outputs** Engineering Enforcement Education undertaking? How are we Workforce using our Resources Funding Assets resources?

Figure 5.3a Linking Outputs, Impacts and Outcomes

Source: Performance Measurement: Advice and Examples on How to Develop Effective Frameworks, State Services Commission. Available at: www.ssc.govt.nz/performance-measurement

According to the State Services Commission performance measurement framework, the evaluation of performance is based on the causal link between outputs and desired outcomes. Outputs are things that a delivery agency can directly control, whereas outcomes tend to be beyond the direct control of the delivery agency but can be caused by its outputs. Demonstrating the causal link between outputs and outcomes requires measuring the impact of the activities (outputs), and measuring any indicators of progress towards the delivery of outcomes.

Planning plays a central role in performance-based funding, and involves the careful definition of outcomes, indicators, impacts and outputs in a way that is compatible with the capacity of the delivery agency, its mode of operation, and its ability to measure outputs and indicators of progress associated with outcomes. The example below illustrates the link between planning and delivery in a performance measurement system.

Imagine a catchment group funded by HBRC was planning a project to plant a stream bank with indigenous riparian vegetation. In Plan 'A' the catchment group defined its outcome goal as "an improvement in water quality" then the following situation would unfold: The catchment group would need to identify appropriate indicators of water quality (e.g. threshold nitrogen, phosphate, and faecal coliform concentrations).



The catchment group would then need to undertake riparian management activities to cause a change in water chemistry at that site. This would require the catchment group to cause a reduction in the volumes of nitrogen, phosphate, and faecal coliform concentrations to a desired level. In turn, this would require undertaking activities (delivering outputs) such as reducing fertilizer input volumes and changing livestock management practices on adjacent farmland for several kilometres upstream. These activities may be beyond the capacity of the catchment group. The catchment group would then fail to deliver on its stated outcome because the impact of its riparian planting project (output) had no causal relationship with the success indicators required for the stated outcome of water quality improvement. Then, from a performance measurement perspective, the funder (HBRC) would not get what it paid for.

If on the other hand the same catchment redefined its outcome goal as "an improvement in riparian habitat and stream bank stability," then its delivery of riparian plantings (output) would have a measurable impact on the desired outcome, the funder would get what it paid for and would be more likely to provide funding in the future (see Figure 5.3b).

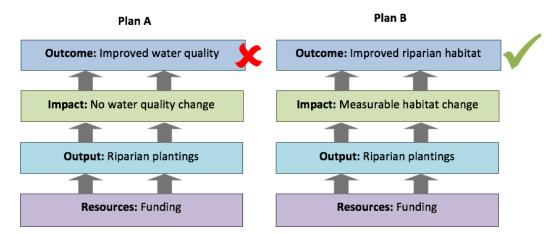


Figure 5.3b. Alignment of outputs, impacts and outputs in planning



Key performance indicators (KPIs) of progress towards (or delivery of) these outcomes can then be measured using best practice measurement methods in collaboration with central and local government entities (see example below).

KPIs for short-term outcomes can then be used as the basis for the determination of outputs, activities and associated project budgets in funding proposals. Detailed project budgets and other resources can be assigned to each activity accordingly.

Figure 5.3c. Intervention Logic Model.

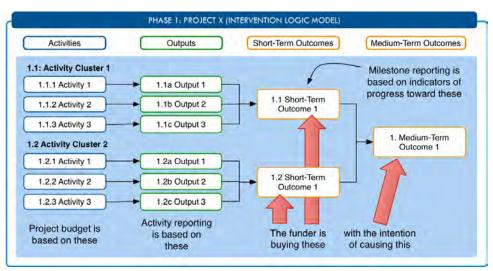


Figure 5.3d. Performance Measurement Model.

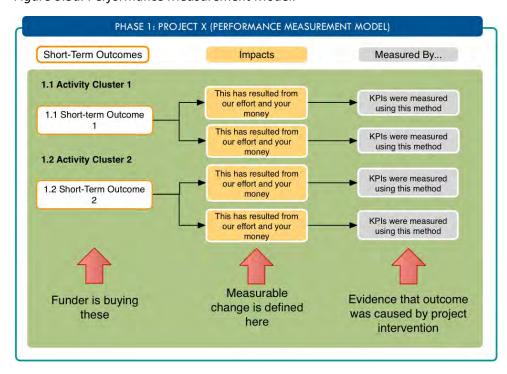
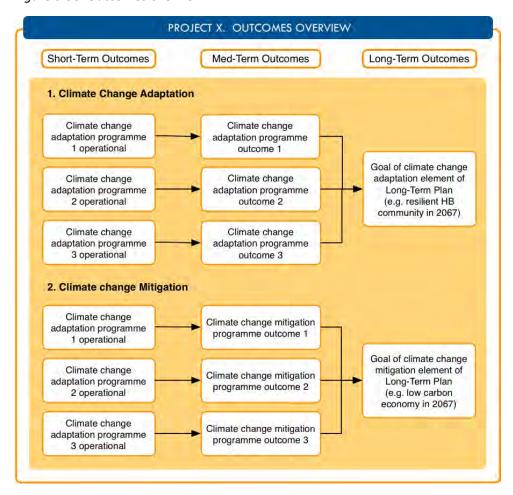




Figure 5.3e. Outcomes overview



The advantage of the State Services Commission model is that it is sufficiently simple for planners and non-planners to follow, and yet sufficiently detailed to enable significant financial discipline, transparency, and the cultivation of an institutional memory and sustained focus on key planning themes. Furthermore, this simple model can be adapted through time, enabling it to be responsive to changing conditions.

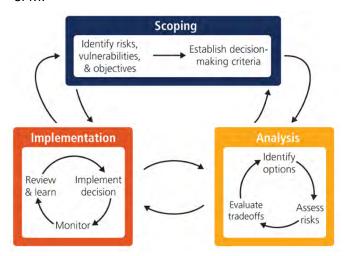
It is recommended that HBRC apply an Intervention Logic Model approach to planning for its climate change programme in line with State Services Commission guidelines and tailored for HBRC conditions. Then MFE guidelines for climate change planning can be incorporated under this framework where appropriate and beneficial.



5.3.1 Integrating Climate Change into Council Decision-Making

The Intergovernental Panel on Climate Change (IPCC) have recommended a cyclic and iterative model for climate change adaptation decision making. This model follows an adaptative management framework where interventions are reviewed and lessons learned are incorporated into updated decision cycles. This can be incorporated into the planning cycle of HBRC, and from what has been seen through interactions with HBRC staff, this process is already reasonably well advanced.

Figure 5.3.1 IPCC Decision making model – Climate Change Adaptation. Source: IPCC AR5 SPM.



The MFE 2008 guide on climate change for local government⁶ states an emphasis on the following three themes:

- 4. Understanding scope and variation of climate change impacts.
- 5. Deciding on priorities for action.
- 6. Applying risk assessment to enable a risk-based response.

Four key stages are identified for assessing climate change influence on Council functions:

- a) Identify which Council functions are vulnerable to climate change.
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⁶ Ministry for the Environment 2008, p27.



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- 7. Are the levels of uncertainty involved in the forecasts of climate change explained, and an estimate of the uncertainty provided?

⁷ Ministry for the Environment 2008, p19.

6.

STOCK TAKE





6 Stock Take

HBRC has been working on climate change issues for several years as part of its core planning activities. This work has not always been labelled "climate change" but fits firmly into the category of climate change adaptation (coping with a changing climate) or climate change mitigation (reducing GHG emissions). Some activities involve both climate change adaptation and mitigation actions.

Appendix 8.1 provides details of climate change relevant projects and activities that are either on-going or have been completed in recent years. The activities relevant to climate change included in this stock take fall under the following categories:

- **Facilities Management**
- Air Quality
- Transport
- Sustainable Farming
- Research, Monitoring & Planning Tools
- Reforestation
- **Biodiversity & Biosecurity**
- Flood and Coastal Protection
- Water Management



6.1 FACILITIES MANAGEMENT



HBRC has made a lot of progress in energy efficiency and carbon emission reductions through facilities management at the Dalton St premises. Poor performing heating systems and inefficient building design and management (including leaks, poorly installed insulation and insufficient HVAC maintenance) led to energy inefficiencies that created an avoidable operating cost burden, and lowered the quality of the work environment for staff. It was also found that the original heading boilers were installed incorrectly at the time of office construction.

HBRC installed three new boilers in 2013 as part of building remedial work. These more efficient boilers were set up to respond to heating demand, enabled also through outdoor air temperature sensors. This led to a significant decline in consumption of LPG gas and consequent reduction in GHG emissions.



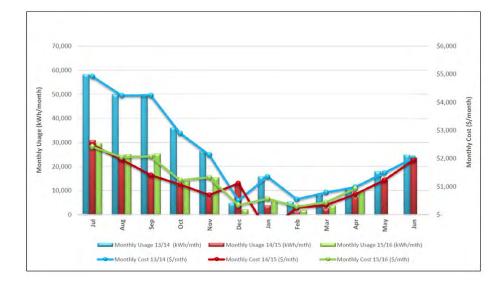


Figure 6.1a Energy consumption before and after new boiler installation (2013). Blue line = before boiler upgrade.

Table 6.1a. CO2 emission reductions at Dalton St comparing 2014 and 2017 financial years.

	FY 2014	FY 2017	Variance
Electricity (kWh)	390,319	332,878	Down 14.7%
Gas (kWh)	308,991	138,808	Down 55.1%
Carbon emissions (tCO₂e)	113.109	45.604	Down 59.7%

Climate change mitigation actions undertaken by HBRC facilities management to date:

- New boiler system installed.
- Switched air con maintenance providers to gain a more efficient service.
- Energy use is monitored on a monthly basis and graphed. Any spikes in energy use can be investigated as it could indicate poor performing plant.
- Boilers have been put on a staging process to respond to heating demand.
- Outside air temp sensor installed to improve air conditioning efficiency.
- Lightbulbs have been replaced with LED models where practicable.



- Upgraded PC monitors to energy efficient models that use less electricity.
- Projectors replaced with LED models.
- Changed cleaning contractors to a service provider that only uses NZ made, ecofriendly products.
- Established vehicle tyre management system to increase fuel efficiency of HBRC vehicle fleet.
- 18% of stationery and furniture requirements are environmentally accredited or NZ
- Installed vehicle GPS system to deliver better staff driving behaviour resulting in a reduction in speed limit exceedances, and consequent increase in fuel efficiency.

Climate change mitigation actions planned:

- Electric Vehicles: An "electric first" vehicle procurement policy is soon to be introduced that requires electric vehicles to be considered first when making new fleet purchases. If EV's are not practical (e.g. not available for off-road vehicle types), vehicles with low emissions and high fuel efficiency will be selected.
- Energy Audit: HBRC energy audit to be undertaken, to identify opportunities for energy efficiency gains. The last energy audit was undertaken in 2010.
- Solar Energy: Revisit past solar panel proposals and gain updated quotes to put a small PV system on Dalton St building to support our energy demand. (Note: have been advised that Dalton St hot water demand is not great enough to get benefit from solar hot water system. Investigate whether we can install solar EV charging stations.)
- "Switch off" Campaign. Undertake a "switch off" campaign with staff in an effort to drive energy efficient behaviour.
- Enviromark Gold Accreditation: Complete Enviromark Environmental management programme and aim for gold accreditation.
- Better driving campaign. Incentivize fuel saving driving habits for staff through the EROAD safe driver leader board to encourage heathy competition for the safest, most efficient driver.
- Responsive air conditioning. Encourage staff to advise Facilities of leave arrangements to enable air conditioning to be switched off in offices while staff are away to reduce energy wastage.
- Monitor vehicle idle time. Encourage staff to switch vehicle off between sample stops or pulling to the side of the road to use their cell phone or RT.
- Teleconferencing. Investigate better teleconferencing facilities for meeting areas to enable a reduction in staff travel footprint and cost.
- Paper-free. Encourage staff to use tablet for taking notes rather than paper notepads.
- Recycled paper products. Explore the possibility of procuring stationery items sourced from recycled paper and/or environmentally accredited items.



6.2 AIR OUALITY

HBRC have undertaken Air Emissions Inventories every 5 year for the Napier/Hastings airsheds. This quantifies a range of harmful pollutants as well as CO2. The pollution sources considered are domestic heating, transport and industry.



A very successful emissions reduction programme operated by HBRC is the Heatsmart programme. The purpose of the Heatsmart programme is to improve air quality by reducing air pollution from household wood burners and open fires. Heatsmart offers grants and loans for heat pump installations, and insulation, and is designed as an incentive programme to enable the phasing out of inefficient wood burners that do not meet emission standards.

6.3 TRANSPORT

HBRC commissions a public bus service around and between the urban centres of Napier, Hastings, Havelock Nth, Flaxmere, Taradale, and Bay View. This infrastructure enables reduced emissions from private motor vehicle, particularly for commuters.

HBRC is part of a collaborative project with other councils, the DHB and EIT to promote the uptake of electric vehicles. Note also that HBRC plans to have an "electric first" vehicle procurement policy, whereby it purchases electric vehicles where practicable at the normal cycle of vehicle upgrades.

The Smart Travel website is a car pooling website that matches people seeking car-pooling partners in the Hawke's Bay region.





Cycling has benefits from the Hawke's Bay Regional Cycle Plan as well as the development of local cycle trails. Also, HBRC has been trying to streamline commuter cycle routes between the Napier-Hastings urban centres.

6.4 SUSTAINABLE FARMING

Soil Erosion Planting: In partnership with farmers HBRC has been undertaking soil conservation pole planting in the latest phase of an on-going (inter-decadal) programme. This has involved planting an estimated 2.2 million poplar and willow poles to stabilize an estimated 45,000ha of erodible land.

Riparian Planting: With co-funding from the Sustainable Farming Fund, HBRC has provided native plants at cost to support riparian revegetation efforts. This has included supplying 175,000 plants over the last three years.





Climate Resilience Workshops: Between 2008 and 2010 HBRC worked with farmers to offer workshops, develop fact sheets and case studies for climate resilience on farms.

Catchment groups have also been supported by HBRC in support of catchment management projects around the region. Notable examples are the Huatokitoki Catchment Project and the Whangawehi Catchment Project.

HBRC has also supported a Regional Landcare Scheme (RLS) to provide partial funding for up to 50% for soil conservation, wetland restoration, and riparian plantings.

6.5 RESEARCH & MONITORING TOOLS

A key element of HBRC environmental monitoring and research functions is the State of the Environment monitoring and reporting. This focuses on rainfall, temperature and soil moisture, and extreme weather events, and is continuous and reported monthly, annually and 5-yearly.

HBRC also operates climate modelling through SimCLIM software. This model is used to assess a range of climate variables that need to be understood for climate change adaptation planning.

A number of applied research projects are being undertaken that have climate change adaptation (environmental) benefits, and help in delivering improvements in sustainable land management under a changing climate.

The East Coast Dryland Forages Project involves research looking into alternative forage species for dryland farming. This can help with pasture adaptation to future warmer and dryer conditions.

A research project entitled: 'Mitigating Economic Costs to Farmers Following Severe Rain Storm Events' operated between 2011 and 2016, and looked into the impact of the 2011 Easter storm. The study looked into the cost of the event on infrastructure and the benefits of soil conservation on reducing these costs.

Supporting Robust Regional Decision-Making: This study examined adaptive pathway methodology to understand key decision points require by the primary production sector, to minimise the impacts of climate change on primary industries.



6.6 REFORESTATION

Joint Venture Forestry Projects: HBRC has been involved in a number of reforestation projects that increase resilience to extreme weather events whilst sequestering carbon into forest carbon sinks.

HBRC has also supported the regional deployment of the Afforestation Grant Scheme for afforestation on private land. This replaced the Joint Venture Forestry Projects, whereby HBRC assisted AGS applicants to gain access to central government funds.

Implementation of projects under the Hill Country Erosion Fund has been an active component of the HBRC sustainable land management effort. This includes afforestation projects in the Whakaki and Whangawehi catchments.



HBRC also developed a trial commercial planting of manuka at Lake Tutira, with the purpose of testing the delivery of co-benefits in a) climate change resilience, b) carbon sequestration and c) rural economic productivity.

Plantation forestry has also been a feature of the HBRC sustainable land management effort. This includes forest establishment at Mahia, Tutira, Waihapua, Waipukurau, and Waipawa.

6.7 BIODIVERSITY & BIOSECURITY

Biosecurity Pest Programmes: This includes a wide range of biosecurity programmes across plant and animal pests, marine and horticultural biosecurity. The relevance to climate change relates to the way pest behaviour and associated risk changes under changing climate conditions.



The HBRC Biodiversity Strategy forms a cornerstone of the regional climate change resilience planning effort. The applied focus is on revegetation and habitat restoration in an on-going programme.



The management of HBRC parks and reserves also forms an important component of the biodiversity conservation effort, which protects important ecological infrastructure at a regional scale.

6.8 FLOOD AND COASTAL PROTECTION

Flood protection is a major role of HBRC, through maintenance and capital works to provide design capacity and Level of Service (LOS) review, with climate resilience integrated into review protocols. This includes ensuring that flood defences are sufficient to cope with projected flood frequencies and peak flows. This includes the following schemes: Maraetotara, Te Ngarue, Kopuawhara, Opoho, Wairoa, Central & Southern Hawke's Bay.

Coastal defences require equivalent attention in maintenance and investment. The HBRC Coastal Strategy Project is a major undertaking in climate resilience, with particular reference to sea level rise, coastal inundation, tsunami risk, and coastal erosion.

Hawke Bay Coastal Strategy Coastal Risk Assessment



6.9 WATER MANAGEMENT

Water management is a key feature of HBRC planning activities, and has consistently featured in previous Long-Term Plans. The Ruataniwha Dam project was a core element in the previous LTP, but was blocked by the High Court in 2017.

Other water management work by HBRC includes ongoing programmes of groundwater quality monitoring, streamflow monitoring, water allocation, and water metering.



TANK: (Tutaekuri, Ahuriri, Ngaruroro, and Karamu catchments) is a stakeholder group representing the wider community, responsible for exploring the best way to manage waterways in the Heretaunga plains. This initiative is designed to ensure that the use of rivers in these catchments is done so sustainably.

7.

CLIMATE CHANGE SOLUTIONS





7 Climate Change Solutions

Climate change presents a series of threats and challenges to human wellbeing⁸ in Hawke's Bay in coming decades and beyond. This arises from a climate projected to become warmer, stormier, with higher sea levels, and more intense extreme weather events such as droughts and floods.

This report views these challenges through the lends of ecosystem services (Figure 7 below) and ecological infrastructure, and is informed by the following global analysis:

- Millennium Ecosystem Assessment
- The Economics of Ecosystems and Biodiversity
- The Intergovernmental Panel on Climate Change

Human wellbeing depends on a combination of economic and natural capital in any given area. Like engineering infrastructure, ecological infrastructure delivers beneficial services to human wellbeing ("ecosystem services") such as water quality and reduced flood risk (and associated cost). Like engineering infrastructure, ecological infrastructure can continue to deliver its services only when there has been sufficient investment in maintenance.



 $^{^8}$ This follows the Millennium Ecosystem Assessment model that includes the intrinsic value of nature as a 'cultural services.'

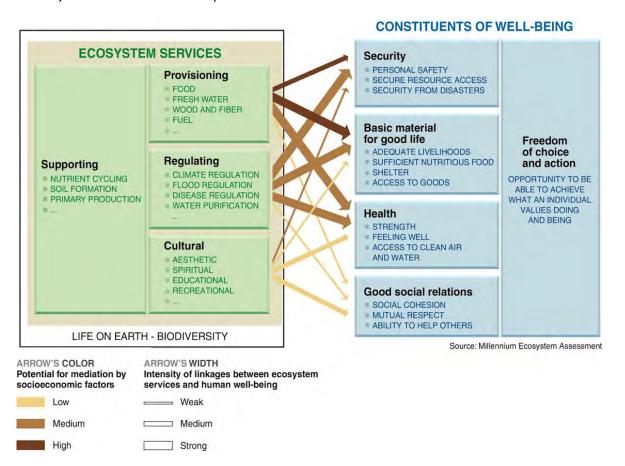


Building resilience to a changing climate is the key consideration for a climate change component of a regional climate change strategy and a Long-Term Plan. This will require investments in both engineering and ecological infrastructure.

Reducing emissions to lower the regional contribution to climate forcing is of secondary importance in this analysis, particularly as emission reductions are the responsibility of central and not local government, and New Zealand already has a national emission reduction programme in place in the form of the Emissions Trading Scheme.

This does not mean that GHG emission reductions are not included here - they are - it just means that emission reduction actions are integrated into an overarching climate change resilience agenda, as well as reducing exposure to carbon pricing risk through actions leading to a low carbon regional economy.

Figure 7. Linkages between ecosystem service and human wellbeing. Source Millennium Ecosystem Assessment - Conceptual Framework.





The national debate on climate change has tended to focus on reducing emissions, with little emphasis the need to adapt to a changing climate. Controversies over allocation of emission reduction responsibilities, particularly across the urban-rural divide have led to an impasse that is ultimately detrimental to progress in climate resilience planning and investment.

This analysis focuses instead on a potentially more unifying narrative, recognising that the Hawke's Bay community faces collective risk to its collective wellbeing from a changing climate. It also recognises that region-wide infrastructure and primary production are based on a climate system and seasonality that is changing. This means that existing systems delivering human wellbeing are not necessarily adapted to a future climate (e.g. longer and more intense droughts, more intense rainfall events, more powerful storm events and storm surges). The absence of climate change adaptation adjustments to engineering and ecological infrastructure and primary production expose the regional economy to climaterelated risk, which in turn poses a risk to future human wellbeing.

The purpose of a regional climate change strategy and associated Long-Term Plan is to strategically reduce exposure to the risk of avoidable human suffering for current and future generations, and reducing avoidable environmental degradation and biodiversity loss. This is especially relevant to the agriculture, horticulture, and forestry sectors, as well as those exposed to flood and coastal erosion risk.

Under a climate change adaptation framework, climate change mitigation actions (actions that reduce GHG emissions) can be brought into the service of climate change adaptation and resilience. For example, a climate resilient landscape is one with significantly more permanent indigenous forest on erosion-prone hill country. Forest carbon financing can then be seen as a climate change mitigation financing pathway for the delivery of climate change adaptation outcomes.

The following sections explore a range of climate change resilience solutions that integrate science and information, with economics and financing for the purpose of delivering the greatest benefits at the least cost, and in a politically durable manner in the form of a Climate Resilience Programme.

A Hawke's Bay Climate Resilience Programme could be enabled by climate financing modalities, and include several sub-programmes targeting resilience in a set of key sectors. These could include:

- **Climate Resilient Farming**
- Climate Resilient Forestry
- **Climate Resilient Rivers**
- Climate Resilient Biodiversity & Biosecurity
- Climate Resilient Flood Defences
- Climate Resilient Coastal Management

An effective programme of action is best informed by reliable information on causes, threats, and possible solutions to climate challenges in the above sectors. This can be delivered through a Hawke's Bay Climate Resilience Assessment.



7.1 HAWKE'S BAY CLIMATE RESILIENCE **ASSESSMENT**

Climate resilience under a changing climate will require considerable public and private investments in resilience building. Public confidence in the nature and scale of the problem and the options for effective solutions will increase with the availability of tailored information on:

- 1. Scientific basis of climate change in Hawke's Bay.
- 2. Impacts and threats posed by climate change in Hawke's Bay.
- 3. Climate resilience solutions in a Hawke's Bay context.9

These themes could form the basis of a Hawke's Bay Climate Resilience Assessment undertaken every 5 years as a result of a multi-stakeholder consultation between key affected groups including:

- HBRC science team.
- HBRC policy and planning team.
- Other local authorities.
- Primary industry representatives (agriculture, horticulture, fisheries, forestry).
- Civil Society Organisations.

Much, if not all, of the content of the first version of a Climate Resilience Assessment already exists in other forms and could be collated in a manner that expands upon material presented in Section 4 above. But an information resource intended to steer regional action on climate resilience needs a communication and community engagement strategy.

A process of structured consultations organised as formal meetings could result in the 5yearly publication of a Hawke's Bay Climate Resilience Assessment Report, with HBRC acting as the secretariat to this process.

The 'Climate Resilience Solutions' chapter of the Hawke's Bay Climate Resilience Assessment Report could then form the basis for climate change updates in the HBRC planning cycle.

 $^{^{9}}$ This structure is modelled on the Intergovernmental Panel on Climate Change assessment reports.













7.2 CLIMATE RESILIENCE FINANCING

Building climate resilience in order to cope with future climate change threats necessitates actions at scale, and these actions need to be financed. Such actions are best implemented prior to the onset of the worse climate change challenges. These include more intense drought, sea level rise, high rainfall events and associated floods, and pest outbreaks that in aggregate pose a significant threat to human wellbeing, the economy and future remedial cost.

"Stitch in time" early action solutions that help to "future-proof" the regional economy can be significantly lower in cost than:

- a) Repair, rebuilding and possible litigation following catastrophic extreme weather events (e.g. flood, sea level rise and storm surge events that breach flood defences).
- b) Lost productivity as a result of catastrophic events (e.g. floods and severe droughts).
- c) Large scale future engineering solutions that could otherwise be avoided or significantly delayed.

7.2.1 Performance-Based Financing

A performance-based model for climate resilience outcome delivery is favoured, for a number of reasons. Firstly, performance-based financing focuses the activity business model on the delivery of measurable outcomes rather than activities and effort.

This is in line with the Public Service Commission guidelines on performance measurement. This also has the effect of driving out inefficiencies and focusing on innovation in order to deliver the greatest gains at the least cost.

Secondly, a performance-based model ties performance measurement to financing. This reduces non-delivery risk to the buyer/funder by shifting a larger share of risk to the outcome provider. In turn, this supply side risk can be reduced through development of supply side standards and quality control and quality assurance protocols. This also enables measurement, reporting and verification (MRV) to become embedded into to activities, with consequent benefits for transparency and accountability.



Performance-based financing uses a 'payment on delivery' model. This means that an outcome buyer only pays for these outcomes after they have been delivered, or where payment is disbursed in instalments (e.g. yearly) in line with instalments of delivered outcomes. This may sound foreign to some environmental managers, but it is not foreign to private sector commercial activities the world over.



For example, a winery first has to produce and deliver wine (the outcome) to the market before it can receive payments (finance) sufficient to cover the cost of production. This is an example of an ex post (performance-based) financing model. In the wine example, there is no risk of non-delivery to the buyer because the finished product has to delivered before the buyer will pay for it. This also means the outcome supplier has to invest in production before they can be in a position to receive production finance in the form of unit sales. This year's sales revenue finances next year's production, with the entire system dependent on the seller focusing their model not on activities or effort (days spent planting and pruning) but on measurable outcomes (volumes of delivered wine).

Using a wine metaphor to illustrate traditional forms of environmental finance would see wine buyers receiving applications from wineries for funding for wine production based on a promise of delivering 50 cases of wine in two years' time. Then in two years' time there is a risk that instead of receiving 50 cases of wine, the buyer only receives 40 cases along with an apologetic report explaining why 10 cases could not be delivered. This financing model presents considerable non-delivery risk for the buyer, where the buyer is funding inputs (activities) rather than outcomes (wine). Under a performance-based financing model, the person making the non-delivery loss is the seller rather than the buyer.

A performance-based model cultivates entrepreneurship and a culture of drawing the shortest line between a source of finance and measurable outcomes delivered. This is especially important for environmental financing, where the imperative is to cause as much good per dollar spent as possible, so that a community can gain maximum benefit from a limited supply of funds.



7.2.2 Engaging The Private Sector

According to the UNEP Gap Report, the predicted 2030 emissions will (even if the Paris pledges are fully implemented) place the world on track for a temperature rise of 2.9°C to 3.4°C this century. Meanwhile, the World Bank's Economics of Adaptation to Climate Change (EACC) study estimates that the cost of adapting globally to a 2°C warmer world by 2050 comes with a price tag of US\$70-100 billion per year (Narain et al. 2011). This implies massive investment in climate change resilience, against a background of diminishing public sector financial resources available to meet this financing challenge.

For this reason, the private sector needs to play a significant role in meeting global, national and local climate change resilience needs. But globally the private sector has tended to only contribute to climate change mitigation through activities in the carbon markets. As a result, there is a need for financing modalities capable of incentivizing private sector investment in adaptation and climate resilience in partnership with government entities.



Performance-based financing has become a norm in the climate change mitigation sector, through the functioning of carbon market instruments in the compliance and voluntary carbon markets. The common denominator is the delivery of measured, reported and verified beneficial outcomes sold to buyers/funders ex post.



The performance-based finance model has also been used internationally (and to a lesser extent domestically 10) in the non-carbon 'Payment for Environmental Services' (PES) markets. More recently the African Development Bank commissioned a proposal for a performance-based climate change adaptation financing mechanism (the Adaptation Benefit Mechanism) now currently under negotiation at the United Nations Framework Convention on Climate Change (UNFCCC)¹¹.

7.2.2.1 Institutional Investors And Risk

A key potential source of private sector finance at scale is the corporate and institutional investment communities. The cost of capital varies across different investment sub-sectors. Those with an appetite for risk (e.g. hedge funds) make their funds available at a relatively high cost of capital (aligned with higher risk), whereas more conservative entities (e.g. pension funds) provide funds at a lower cost of capital, but are mandated to reduce and avoid risk.

Adaptive development business models, however, can often carry higher financial risk compared with BAU development. This is because climate change risk exposure tends to be externalized in BAU development, which is why it presents a more favourable short-term investment proposition to institutional investors compared with more resilient (more conservative) development. This leads to a key potential role of government in relation to climate resilient investment flows both at a large (institutional investor) and a small (individual business) scale. The potential role of government is to help reduce the financial risk profile of private investment in resilient development by sharing financial risk with the private sector. This can help to unlock private capital at scale for climate resilient development.

7.2.3 Market-Linked Mechanisms

Performance-based financing is not synonymous with markets but is certainly compatible with market-based and market-linked mechanisms. True markets involve a seller and a buyer but also a situation where price is determined by supply and demand, with opportunities for secondary markets linked to market speculation through securities and derivatives, as well as a profit motive driving the system.

Performance-based financing, however, can function effectively in non-market or marketlinked settings. Importantly, the pricing of outcome delivery need not entirely follow wine example mentioned above, where unit prices are pushed as high as possible in a market

 $^{^{10}}$ The author operates projects that sell 'Habitat Hectare Units' to buyers in the Corporate Social Responsibility market, and has designed four internationally certified carbon accounting methodologies.

 $^{^{11}}$ The author was one of the four international consultants who developed this proposed mechanism.



tempered by competition and price sensitivity. Also, if unit prices fall below break-even rates or sales volumes fall below a certain threshold, then the production system cannot be financially sustained and the winery goes out of business.

A market-linked performance-based financing model could remain insulated from the full set of market pressures, whilst retaining efficiency benefits of a market model. This could be developed in a mechanism where transaction rules include transparent cost-based pricing, commercial and non-commercial financing support, technical support, and regulatory measures that stimulate private sector participation and demand.

Politically, some may argue that market-linked mechanisms rely on the commodification of nature. But a transparent cost-based pricing model does not commodify or put a price on nature or human suffering. Instead it commodifies and prices the human labour and technology cost of looking after nature and people.

7.2.4 Cash Flow

Performance-based financing models can lead to cash flow challenges for some outcome suppliers. This is because they need to deliver the first batch of measurable outcomes before they can be paid to cover the costs of outcome production. This is the same problem for entrepreneurs the world over. This problem can be solved in a similar fashion to private sector financing models: gain access to investment capital to fund start-up development (including the first batches of outcome production), and thereafter use sales revenues to recover these costs (including the cost of capital where relevant). Here too is where marketlinked funding models can include direct or indirect investment support. This start-up investment support can be financed either by grant, debt, or potentially equity finance, as with commercial start-up business models.

One way to structure performance-based financing systems for project-based approaches is to break down the project business cycle into three financing stages:

- 1. Project development (funded by grant, debt, or equity).
- 2. Supported project implementation (funded through performance-based payments through non-market, market-linked and/or market channels).
- 3. Self-financing project implementation (self-financing new regime of changed behaviour).





7.2.5 Climate Resilience Projects

Climate resilience projects are discrete projects with specific geographic and temporal boundaries. Examples include reforestation projects, riparian revegetation projects, coastal and flood defence projects, water supply projects, and pest management projects. Some project-based activities lend themselves to being deployed in a 'programme of activities' as a means of scaling up.

Financing project-based activities can include a combination of grants, loans, market-based mechanisms, technical and marketing support to stimulate uptake of project activities by individuals, community organisations, and businesses. A sector particularly well suited to deliver project-based climate resilience activities in response to incentives and support is the social enterprise sector.

If Hawke's Bay were to develop a commercial environment that was friendly to climate resilient social entrepreneurship, it would stimulate:

- Community organisations upgrading to a social enterprise business model thus reducing or eliminating dependency on grant funding cycles.
- Existing businesses to develop climate resilience social enterprise spin-off businesses or projects.
- Attracting social entrepreneurs to the region.

Different kinds of business development support could be offered to climate resilience social enterprises, tailored to different needs during different stages of business development, and different entry points to the social enterprise sector.

For example, commercial debt finance is a relatively low-cost way of gaining access to capital for climate resilient development. Furthermore, avoiding the need for equity financing means that social enterprises can maintain greater control over their governance, strategic direction, purpose, and business rules. This is because equity investors typically require a significant share of business ownership, and associated governance rights. This can lead to conflicts of interest where a social purpose business is steered more towards a profit purpose, and this can (but not always) lead to a reduction in social impact delivery.

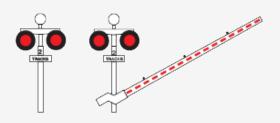
If on the other hand, a social enterprise could gain access to investment capital through debt financing from a commercial lender, the social enterprise can maintain control and purpose. The trouble is that commercial loans require collateral in order to mitigate financial risk to the lender. Social enterprises may not have assets or cash that can be offered as collateral, and this shuts them out of debt financing in the commercial finance marketplace. This is why non-commercial seed financing can bridge the financing gap with social enterprise models that encompass a blend of public and private financing.



7.2.6 Mainstreaming Climate Resilient Development

Climate resilient development means shifting economic activity into a "new normal" mode, so it is resilient to future climate conditions. Unlike specific projects, mainstreaming climate resilient development typically involves strategic deployment of economic instruments combined with regulation designed to cause a "sea change" in certain sectors.

Furthermore, it is in the nature of resilience that effort and investment is needed in order to make sure "nothing happens". This can be dissatisfying to some, but not for those who recognise the value in putting a stop to future calamity. As such, resilience-building is somewhat conservative, but conserving what we have spent more than a century building still requires an investment.



The willingness-to-pay for resilience to future climate conditions prior to the onset of those climate conditions will tend to be low in any economy. This is because the need, demand and political appetite for resilient development has not been stimulated by politically or economically tangible consequences of not doing so. This is a fundamental dilemma in climate change response measures the world over.

Investments in pre-emptive resilience to future threats are somewhat more common in military contexts, with particular regard to defence spending in the absence of war conditions. But the principle is the same. If sufficient investments in military or climate defences are not made, the population and the economy is exposed to a heightened level of risk. Civil defence, policing, road safety, and fire protection also share the principle of investments in risk reduction infrastructure and capability.

The free market does deliver resilience at a small scale through the voluntary actions of market participants with foresight and sufficient funds to allocate to resilience. For example, a minority of home owners will elect to purchase rainwater harvesting technologies even when they also have access to reticulated municipal water supply. But for the majority to voluntarily purchase rainwater harvesting technology, this foresight needs to migrate into the mainstream, against significant head winds.



These headwinds include a) average home buyers preferring to allocate such funds to luxury items, b) buyers who need all the funds possible to afford the desired house or housing in the first place, and c) absence of clear and present risk/hardship of not having such technology.



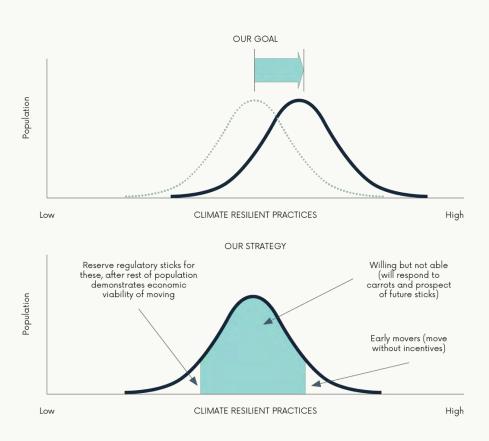
These individual buyer headwinds translate up the food chain to housing developers. To extend the example, new build housing developments with rainwater harvesting, solar hot water, and double glazing is more climate resilient (and more expensive) than without. This, coupled with price sensitivity in a housing market means that the market may not be willing to pay a premium on climate resilient homes. In turn, housing investors are more likely to direct their funds towards the development of less climate resilient housing stock as a more competitive investment. These examples show how climate resilient development needs financial incentives to become mainstream, and where such incentives make sense to home owners, developers and investors.

This absence of clear and present risk of not building resilience poses the most significant challenge both economically and politically. The challenge with climate change is that it involves change not merely in the weather, but in the climate system itself. This includes changes in seasonality, mean annual rainfall, mean annual temperature, average storm intensities, and average drought intensities and durations, where this change is a long-term (essentially permanent) phenomenon. If the economy waits until the climate has changed to a new condition before it adapts to those conditions, then it has shut the stable door after the horse has bolted, and is destined to adapt in the way nature adapts in the process of evolution: where maladaptive businesses die out, leaving only pre-adapted ones to rebuild the economy under new conditions that they are aligned to.

But human societies, unlike the rest of nature, have foresight combined with science and engineering, and are therefore capable of adapting ahead of major changes in climatic conditions. This can serve to avoid a significant amount of foreseeable economic hardship and associated human suffering. But this will require investments in strategic climate resilience against the headwinds described earlier. This provides a clear role of government (nationally and locally) to facilitate resilience-building in the form of a market correction. Policy options include regulation (stick), and incentives (carrot).



Among the most effective policy and planning tools for mainstreaming more durable behaviour is the strategic combination of carrot and stick. Carrots in the form of a range of financial and non-financial incentives can cause voluntary uptake of climate resilience actions among the mainstream of the population, with the rate of uptake enhanced when faced with the prospect of a future regulatory stick. For example, a regulation enacted in year 1 of a voluntary incentive scheme, but that does not come into force until year 11 - providing a 10year window for voluntary response to incentives. This sends a strong market signal as well as enabling conditions for a transition towards a new normal.



Carrot & Stick Approach To Policy



7.3 CLIMATE RESILIENCE MECHANISM

A Climate Resilience Mechanism (CRM) is proposed as an integrated financing framework designed to help cause beneficial climate resilience at scale, at least cost, and leveraging external public and private financing and co-financing where practicable. Ekos proposes a CRM that is operated as a partnership between HBRC, Ekos (an environmental finance social enterprise charitable trust), and other strategic partners where relevant and appropriate. It is envisaged that some elements will be operated by HBRC (and include existing HBRC initiatives), some by Ekos and other partners, and some jointly. Furthermore, different elements of a CRM model could be developed and deployed at different stages along a timeline with highest priorities developed sooner.

By supporting the private sector and community organisations to contribute to climate resilience, HBRC would also be stimulating innovative entrepreneurship and growth in the Hawke's Bay economy. In addition, HBRC could define priority activities for the Climate Resilience Mechanism to ensure that all are no-regrets actions that will benefit the region anyway, and help deliver on a range of other planning goals.



Potential elements of the Climate Resilience Mechanism could include the following:

Table 7.3 Climate Resilience Mechanism Financing Instruments

Operated by HBRC

Instrument	Description	Potentially funded by:
ClimateSmart	Expand the HeatSmart financing model to include other household climate resilience technology uptake (e.g. solar hot water, home insulation, solar electricity, and rainwater harvesting).	HBRC & home owners
Water allocation trading	HBRC could establish and operate a system of tradable water rights allocations in the rural water supply. This could function as a cap-and-trade system where allocation units can be traded. This creates an incentive for farmers to become more water efficient (e.g. utilizing more on-farm water storage), and then selling surplus allocation units to other farmers who are unable or unwilling to invest in more water efficiency. The revenue from the sale of surplus allocation units can be used to finance the increase in on-farm water storage.	Landowners
Plantation Forestry Profit Sharing	HBRC could operate its plantation forestry assets to maximise profit and allocate these profits to an element of the Climate Resilience Mechanism (e.g. the Climate Enterprise Start-Up Fund or Climate Enterprise Loans). Long-term model with financial benefits designed to flow post 2030.	HBRC

Operated by external partner (depending on the financing model)

Instrument	Description	Potentially funded by:
Indigenous Forest Carbon Programme	A programme that aggregates carbon credit production from indigenous reforestation on erosion-prone land. Programme designed to facilitate transactions with large scale carbon buyers. Programme leverages central government funding, structures disbursement rules to reduce landowner risk, stimulating a greater rate of landowner.	Investment by HBRC, central government, and private investors. Carbon revenues from NZETS buyers.



Operated/coordinated by social enterprise and impact investment partners and HBRC endorsement

Instrument	Description	Potentially funded by:
Climate Enterprise Start Up Fund	Contestable, performance-based seed funding grants for start-up enterprises delivering climate resilience projects and services. Grants designed to enable entrepreneurs to co-finance business start-up costs with non-commercial finance where they can demonstrate that commercial finance (debt or equity) is not accessible at this stage in the business development.	HBRC, central government and impact investors.
Climate Enterprise Loans	Contestable concessionary (e.g. interest free) loans to climate resilience social enterprises. This is for private sector climate resilience start-up initiatives that have graduated from the start-up phase and are moving to the scale-up phase.	HBRC, central government and impact investors.
Climate Enterprise Investment Readiness	'Investment readiness' capacity building programme to enable climate resilience social enterprises to meet eligibility criteria for Climate Enterprise Loans or commercial debt or equity financing. This programme could be offered by a partner agency with experience in social enterprise incubation.	Social enterprise incubator partner (e.g. Akina Foundation).
Climate Collateral	Contestable, refundable collateral grants to enable social enterprises to access private investment at a low cost of capital (i.e. bank interest rates instead of equity terms). Under 'Climate Collateral', HBRC would provide repayable grants to enable entrepreneurs to collateralize bank debt financing. HBRC carries financial risk to stimulate private sector investment in climate resilience enterprise initiatives. NB: the term "grants" is used because the Public Finance Act 1989 prevents public sector agencies from collateralizing private investment.	HBRC, central government, and impact investors.
Climate Impact Investment	A register of profiled climate resilience social enterprises seeking private investment at a low cost of capital. Businesses on this register are promoted and marketed to the impact investor community as investment targets that have the blessing of HBRC and a Hawke's Bay regional climate resilience programme.	Impact investors and leveraging central government support



Operated/coordinated by Ekos (in partnership with other suitable entities) with HBRC endorsement

Instrument	Description	Potentially funded by:
Climate Resilience Exchange	A Climate Resilience Exchange (CRX) underpinned by the production of Climate Resilience Units (CRUs), and modelled on the UNFCCC Adaptation Benefit Mechanism currently in development, and Payment for Environmental Services (PES) markets operating internationally. ¹²	Central government and philanthropic investment support for establishment. CRUs purchased by private and public sector.
Carbon Neutral Hawke's Bay	A 'bottom-up' carbon neutrality programme designed to stimulate private sector energy efficiency initiatives, to reduce regional exposure to future carbon pricing, transition toward a low carbon economy. Also used to stimulate local demand for carbon offsets sourced from local indigenous forest carbon projects under the Indigenous Forest Carbon Programme. ¹³	Participating businesses.
Carbon- Biodiversity Market	A carbon credit bundling programme that bundles carbon credits from the Indigenous Forest Carbon Programme (IFCP) with non-carbon climate resilience outcomes issued as CRUs under the Climate Resilience Exchange.	Participating businesses in Carbon Neutral Hawke's Bay
Climate Cents	A voluntary surcharge programme operating among the Hawke's Bay retail sector to crowd-fund for community-based climate resilience projects with high community and biodiversity cobenefits. For example, a 'Ten Cent Campaign' could run annually to support performance-based community resilience projects.	Participating retail customers via participating retailers.

 $^{^{12}}$ Ekos already operates in this space, has a registry account with the world's leading environmental registry (Markit Environmental Registry, NY, London), and has already scoped the registry infrastructure protocols required to establish a CRX.

¹³ Ekos (a charity) is a carbon neutrality service provider in the NZ and international voluntary offsets market, is developing carbon neutrality campaigns in other urban centres and would operate this as a not-for-profit social enterprise designed to enable participating businesses to go carbon neutral at least cost.



7.3.1 Role of HBRC

Some elements of a Climate Resilience Mechanism for Hawke's Bay do not require HBRC funding, but would simply benefit from HBRC endorsement, promotion, and/or participation as a partner entity or customer.

Other elements require HBRC participation as a funder or partner in seeking external funding from central government or private philanthropic and/or impact investors. This includes those elements proposed to be operated by social enterprise partners with HBRC endorsement.

The Indigenous Forest Carbon Programme could be run as a public good enterprise by an external partner with HBRC providing financial and regulatory support.

Finally, HBRC already runs excellent and innovative programmes with Heatsmart, water allocation, and plantation forestry. Ekos simply recommends expanding on these activities, integrating them potentially with other elements of a CRM, and venturing into the territory of water allocation trading.

7.3.2 Staged Deployment

Some CRM elements are high priority and are best put in motion as soon as possible. Others are most suitably rolled out gradually through time (if HBRC wishes to pursue or support them). This approach can enable HBRC to focus its near-term attention on high priority actions, and incorporate other elements through time, but potentially supporting some early piloting activities.

For example, should HBRC decide to become carbon neutral without delay, as a keystone participant in a Carbon Neutral Hawke's Bay programme, and in so doing it would stimulate early action by other participating entities, that can then develop without HBRC effort or resources.

A big-ticket item like the Indigenous Forest Carbon Programme would need to be mobilised relatively promptly, in order to expeditiously engage central government.



7.3.3 Sources Of Capital For CRM Components

Funding will be needed to enable some CRM elements to develop. These and others will also benefit from HBRC "regulatory capital" in the form of market signals of future regulation sufficient to stimulate voluntary uptake. Others will benefit from "marketing capital" in the form of HBRC participation and endorsement.

Potential sources of funds for allocation to some CRM elements include:

- > HBRC plantation forestry assets with profits channelled into the CRM (following a period of asset growth - e.g. after 2030).
- > HBRC leasehold land asset in Wellington could be sold to provide \$13 million in cash
- A portion of funds previously allocated to the Ruataniwha Dam development but which could be targeted for water resilience and water supply projects (e.g. \$7 million).
- ➤ HBRC safe carbon credits of 110,906 tCO2e sold in 2021 @ \$23 would yield approximately \$2.5 million.
- > HBRC may have assets it plans to liquidate that could free up capital to contribute to CRM elements.
- Requirement for Hawke's Bay plantation forestry industry to take out a public liability insurance policy run by HBRC for forestry slash risk during high rainfall events. This could involve a premium sufficient to enable HBRC to have liquid funds to deploy rapid remediation response following movement of forestry slash in high rainfall events. Aggregated deposits could yield interest allocated to co-finance the CRM.
- Existing central government funding including Afforestation Grant Scheme, Sustainable Farming Fund, Freshwater Improvement Fund, Waste Minimization Fund, MFE Partnerships Fund, Sustainable Land Management and Climate Change Research Programme, Irrigation Acceleration Fund, Sustainable Land Management Hill Country Erosion Programme, EECA funds.
- > Central government match-funding through negotiation with MFE, MPI, MBIE, MSD, EECA, and Treasury. If HBRC can demonstrate financing innovation capable of delivering climate resilience at least cost to the public purse, central government may be willing to invest in the development of such innovation so that it can eventually be deployed nation-wide.



7.3.4 Climate Resilience Exchange (CRX)

A Hawke's Bay "Climate Resilience Exchange" (CRX) could function through transactions of Climate Resilience Units (CRUs) representing measured, reported and verified resilience outcomes. These could be sold to public entities, Corporate Social Responsibility (CSR) buyers, impact investors, and institutional investors. Structuring climate resilience outcomes in the form of measured, reported and verified units also enables such units to integrate with a range of public and private sector finance systems. This can include voluntary surcharges on retail products (e.g. a ten-cent campaign run by local supermarkets), bundled carbon credit sales to carbon buyers in the compliance and voluntary offsets markets, as well as 'alternative asset classes' for integration into institutional investment platforms.

The performance-based character of CRUs enables a range of public and private buyers to have confidence in the value of these non-tangible assets. The non-tangibility is offset by means of systematic discipline inherent in the alignment of a unit of value, the resilience outcomes they represent, and the unit price aligning transparently with the cost of producing those outcomes.



A transparent cost-based pricing model means that such units do not involve the commodification of nature or human suffering. Instead they involve the commodification of the human labour and technology cost of looking after nature and reducing human suffering.

Climate resilience outcomes would be quantified, verified, issued as units ex post (i.e. after full or incremental outcome delivery), and monetized through individual or syndicated sales to buyers with a strategic interest in a climate resilient regional economy and/or financial risk reduction. CRUs would be issued by a registry 14, on the basis of project reporting that includes tightly constrained methodologies, implementation plans, additionality assessment, measurement reporting and verification protocols, and a cost declaration. The cost declaration is then used to price CRUs transparently at cost to ensure that buyers are receiving units representing a least-cost outcome, are getting what they pay for and getting value for money.

¹⁴ Ekos has undertaken scoping discussions with Markit Environmental Registry concerning the potential to develop a CRU issuance platform.



Examples of CRX project activities include:

- Wetland restoration
- Rainwater harvesting
- Biodiversity corridor
- Riparian revegetation
- Indigenous reforestation not eligible for registration under the NZETS (e.g. on pre-1990 land)
- Agricultural/horticultural pest and/or weed resilience.

The CRX would not determine the actual project activities, but instead provide a standard, eligibility criteria and methodological guidance for project proponents to present proposals for Climate Resilience Exchange registration.

Example of a CRX Project: Wildlife Corridor

Protecting biodiversity under a changing climate will require establishment and maintenance of habitat corridors enabling species migration from one habitat to another. Such corridors typically need to be located on private land, linking different (sometimes publicly owned) protected areas.

Nature conservation on private land costs money in the form of project establishment costs, conservation management costs, monitoring and reporting costs, landownership costs and opportunity costs (e.g. loss of beef and lamb revenue). Add these costs into a project budget and one ends up with the real cost (through a project management period) to deliver the targeted outcomes.

Imagine a 100m wide wildlife corridor proposal for a 30km stretch of farm land, linking a coastal protected area with protected areas further inland and at higher altitudes. Then imagine that establishing this corridor is budgeted to cost \$2,500/ha, and with a maintenance, measurement and verification cost of \$400/ha/yr for a 20-year project management period. The indigenous forest habitat planted could have a significant proportion of manuka, and the manuka honey revenue could offset the loss of beef and lamb revenue for the farmer. If the corridor were also concentrated along waterways, the farmer would be delivering on a current or future compliance obligation in their own sector, either at no establishment cost (or effort) to themselves or where they participate in forest establishment and get paid the \$2,500/ha for their work. Then being the owner of part of an important regional wildlife corridor could add to the feel-good factor of farming (and potentially marketing advantages).

If project development costs were annualised over the first 10 years of the 20-year management period, and the maintenance costs spread over the whole 20-year period (and adjusted for inflation), the project would cost a total of \$3.3 million over 20 years.

Imagine this project produced Climate Resilience Units (CRUs) representing a hectare of wildlife corridor habitat established and managed for one year (of a 20-year project). The project would therefore produce 300 CRUs annually. If the CRUs were priced at 'cost-of-production', they would be priced at the annualised cost of outcome delivery (\$650 each in year 1; \$670 in year 2; \$690 in year three etc).



Producing CRUs is a way of cutting up this project into a large collection of smaller pieces, so that these pieces can be sold to more than one buyer. Furthermore, the CRUs cannot be sold until they have been delivered - e.g. 2018 CRUs cannot be sold until 2019. In practice, CRUs would be issued in something like 3-yearly batches to economise on measurement, reporting and verification costs. So, the first CRU sale for a project starting in 2018 would take place in 2021 and would sell three CRU vintages at their respective annual break-even prices.

To generate cash flows sufficient to undertake establishment and management activities during 2018, 2019, and 2020, the project could borrow the necessary funds from a bank, provided it had signed supply contracts to buyers (e.g. one corporate buyer, and two philanthropists) for the first three vintages. The bank will require collateral for this loan and the collateral could be gained from the Climate Collateral Fund in the form of a repayable grant by HBRC, or another philanthropist or corporate sponsor. The CRU unit price would then need to be adjusted upwards to accommodate the cost of capital.

The appeal of this kind of financing for the corporate or philanthropic buyer is that it takes away nondelivery risk, and embeds the project with a level of discipline sufficient to satisfy other financial stakeholders (e.g. bank, Climate Collateral fund), thereby spreading (and reducing) risk.

This is just a conceptual example of how a voluntary incentive scheme can operate in tandem with regulatory instruments to create conditions for politically durable policy and planning that can survive local government electoral cycles. It is also an example of how the financing burden of such a voluntary incentive scheme need not rest with a single entity, and where some of this burden could (in theory) be shared with the private sector. CRUs could take many different forms and could be used to facilitate private sector co-financing of a range of different climate resilience activities.





7.3.5 Staged Retreat From High Climate Risk Zones

An example of non-resilient development is housing development on a flood plain or at/near an eroding coastline. While it is the responsibility for local authorities to zone areas in relation to natural hazard risk, it is also the responsibility of the private sector to conduct business prudently in relation to foreseeable private risk. But risk thresholds are migrating geographically under a changing climate from things like sea level rise and flood risk.



Steering development away from areas of high climate change risk and towards low risk areas is one component of a long-term strategy to adapt to climate change. Another component of climate-resilient development is a strategy to assist private property owners in the staged retreat from high risk areas, but where the risk is carried by the private citizen and not the local authority (as made clear by Local Government NZ). In this situation, there is an opportunity cost to the property owner of what may be their single biggest asset. If local authorities want to implement realistic staged retreat from high risk areas early enough to avoid crisis conditions eventuating, they will need to proactively engage with this issue, if only to minimize electoral risk.

A strategy could be developed in consultation between property owner groups, developers, the insurance industry, investors and local authorities. The goal: staged retreat from high risk areas in a manner that minimizes cost to private property owners, but which recognises the risk that such property owners exposed themselves to when investing in property located in high risk areas.

Financing this staged retreat in a way that minimizes electoral risk for local authorities could encompass a co-financing blend between several stakeholders including property owners, institutional investors, corporate social responsibility buyers, and the insurance sector (i.e. incentivising shifting situations of risk).



A practical solution for some property owners could be the physical relocation of the house or building to areas especially allocated to such relocations. One low-cost way to do this is where a council purchases farmland at a low cost per ha, and then changes the zoning to residential (increasing the value per ha). It could then develop a subdivision or suburb capable of accommodating property relocated from an eroding coastline. Coastal property owners could relocate their home to the subdivision, thereby not losing the above ground asset, with the land exchanged in an asset swap. The council would then be at liberty to use its newly acquired coastal land for whatever purpose it chose.

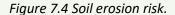
This exercise could potentially be co-financed by:

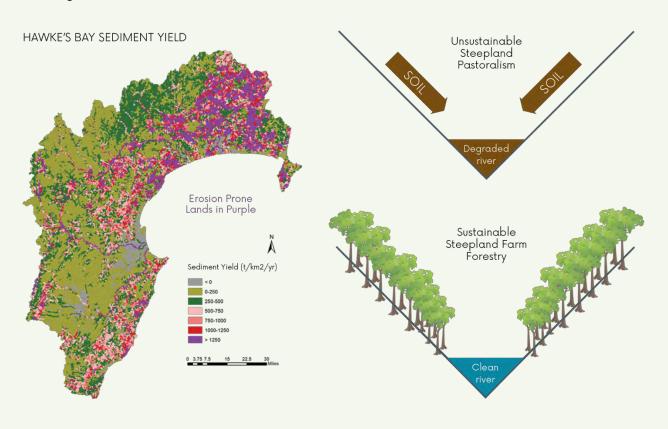
- The home owner (who covers the cost of the relocation and benefits from gaining access to a home much less exposed to climate risk).
- The insurance sector (who offers a reduced premium because they are less exposed to risk whilst retaining a customer who did not go bust).
- The banking sector (who offers a reduced interest rate on the mortgage because it is less exposed to risk because there is less risk of mortgage foreclosure).
- The Council (who arranged the land swap and benefits from reduced electoral risk).
- The Crown (who benefits from reduced electoral risk, and who could give a tax deduction based on the cost of the relocation).
- Corporate Social Responsibility CRU buyers (who benefit from publicity for helping to solve a pressing local problem, and who purchase Climate Resilience Units to help cover the cost of the relocation).



7.4 INDIGENOUS FOREST CARBON PROGRAMME

Hawke's Bay has between 150,000¹⁵ to 270,000¹⁶ ha of high erosion risk land that is seriously vulnerable to climate change, is currently degrading the region's rivers and urgently needs afforestation. An indigenous forest carbon programme is proposed to establish diverse forest cover at scale to address this problem.





¹⁵ The 2015 HBRC Long-Term Plan states: "64% (about 900,000 ha) of the region's land is classed as erodible to highly erodible hill country; of that about 150,000 ha is in land use that is likely to esxeed the sustainable capacity of the soil."

¹⁶ HBRC SedNet analysis 2017.



Carbon farming presents a unique opportunity to drive afforestation at scale. Because of the steepness, remoteness, and sensitivity of these erosion-prone lands, the majority of such afforestation needs to comprise permanent forest with no intent (or permission) to harvest.

Economic production from these lands can change from predominantly beef and lamb to carbon and manuka honey production with the latter likely matching the former on a per hectare

The need for external financing for reforestation of erosion-prone lands in Hawke's Bay is significant, and an indigenous reforestation programme co-financed through carbon markets presents a potential solution at scale. Carbon financing is needed in order to cover the costs of forest establishment and management, as well as providing an alternative revenue stream that beef and lamb revenues on these lands.

For an Indigenous Forest Carbon Programme to succeed at scale, it needs design features and a financing model that can deliver desired benefits in a manner that can overcome existing barriers to uptake. There are two barriers to uptake worth noting:

- 1. Indigenous forest carbon business models.
- 2. Forest establishment cash flows.

7.4.1 Indigenous Forest Carbon Business Models

A key challenge for indigenous carbon forestry is the economics of indigenous carbon forestry in comparison with business-as-usual (typically beef and lamb production). Unlike plantation forestry, indigenous reforestation does not tend to be associated with commercial timber harvesting and associated cash flows. It can, however, generate cash flows from a combination of carbon credits and honey (particularly if planted in manuka or a combination of exotic hardwoods and manuka).

The carbon credit yield per ha per year from indigenous reforestation is the lowest in the carbon market. As seen in Table 7.4.1 indigenous forest carbon yields are very much lower per annum compared with Douglas-fir, radiata pine, and especially exotic hardwoods.

In practice, carbon revenues from indigenous forest are pedestrian at best, which challenges any business model for indigenous reforestation at scale using carbon financing - even with carbon prices around \$20/tCO2e.



Table 7.4.1 Cumulative carbon stock per hectare for different forest types (tCO2/ha). Source: MPI Carbon Look-up Tables for forestry emissions in the NZETS.

Table 2: Carbon stock per hectare for Douglas-fir, exotic softwoods, exotic hardwoods and indigenous forest (expressed as tonnes of carbon dioxide per hectare)

Age (yrs)	Douglas-fir	Exotic softwoods	Exotic hardwoods	Indigenous forest
0	0	0	0	0
1	0.1	0.2	0.1	0.6
2	0.1	1	3	1.2
3	0.4	3	13	2.5
4	1	12	34	4.6
5	2	26	63	7.8
6	4	45	98	12.1
7	7	63	137	17.5
8	20	77	176	24.0
9	33	87	214	31.6
10	50	95	251	40.2
11	69	106	286	49.8
12	90	118	320	60.3
13	113	132	351	71.5
14	138	147	381	83.3
15	165	163	409	95.5

Two broad options exist in practice that can enable business models sufficient to enable carbon financed indigenous reforestation at scale:

- 1. Passive indigenous regeneration
- 2. Using a nursery crop of exotic hardwoods

7.4.1.1 Passive Indigenous Reforestation

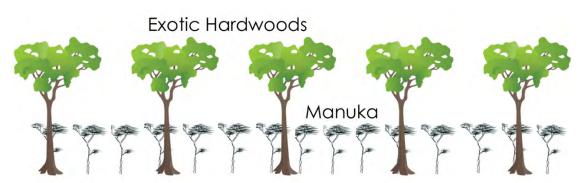
Passive indigenous forest reforestation involves protecting a site from pest, weeds and fire, and then letting nature do the planting. This significantly reduces forest establishment and management costs and even with relatively low carbon yields can (and do) lead to costeffective indigenous forest carbon projects. The key is to undertake this kind of activity on lands with a robust localized indigenous forest seed source, and ideally use eligible land that is already scrub land. Scrub land is a common feature of hill country back paddocks, particularly when beef and/lamb/wool prices are low. Instead of the farmer spending money and effort to deforest scrub land, there is an option to keep stock out and let nature take its course and reforest the area passively at a low cost. If the scrub is already composed of significant proportions of manuka, a carbon/manuka revenue stream can be sufficient to address opportunity costs for farmers and enable indigenous reforestation to be economically viable at smaller scales.



7.4.1.2 Exotic Hardwood Nursery Crops

A pathway for indigenous forest establishment that can yield cash flows and internal rates of return sufficient to raise capital or justify public sector financing at scale, is to plant a widely spaced nursery crop of suitable, fast-growing exotic hardwood species yielding three times the carbon revenues in comparison with indigenous-only planting. If exotic hardwoods are planted at the minimum allowable stocking rate per ha under the ETS (i.e. wide plantings with lots of gaps in between), and inter-planted with indigenous species (see Figure 7.4.1.2) such as manuka, the project would earn carbon revenues close to three times that of indigenous forest¹⁷, even though the largest number of stems planted would be indigenous species.

Figure 7.4.1.2 Concept diagram of exotic hardwood inter-planted with manuka to maximise carbon credit cash flows in transition to permanent indigenous forest.



This form of land management would rapidly create a micro-environment and forest stand structure suitable for natural indigenous forest establishment via bird dispersal (i.e. a wide range of indigenous tree species would enter the site with no human effort), whilst delivering cash flows sufficient to address opportunity costs to farmers considering voluntary retirement of erosion-prone pasture. Also, areas less than 100ha would qualify to apply the low-cost forest carbon project model that uses the MPI Look-up Table carbon sequestration rates rather than having to undertake detailed site-specific monitoring.

The medium to long-term result would be an indigenous forest, but through a business model more likely to stimulate uptake at scale. The result: more permanent forest in the near term, with rapid delivery of ecosystem service benefits (erosion control and reduced stream sedimentation), and significant delivery of biodiversity co-benefits through time.

¹⁷ This is particularly relevant to reforestation of individual areas of less than 100ha per landowner. Such forests are eligible to use MPI Look-up Tables for carbon sequestration default values instead of undergoing the cost of direct measurement.



Furthermore, once the exotic hardwood crop has become moribund (e.g. 50-80 years), the site will become a permanent indigenous forest without exotic species (provided the exotic hardwoods planted are not wilding species).

7.4.1.3 Riparian Exotic Hardwood Nursery Crop

Riparian revegetation initiatives around the country have often considered the feasibility of using carbon finance as a funding source. The barrier to registering a riparian project under the ETS relates to the fact that most riparian plantings either a) do not meet the eligibility criteria for ETS registration (i.e. because they are less than 30m wide and not planted in sufficient density of tree species), or b) they are not large enough in scale (ha) to generate sufficient carbon revenues to justify the cost of registering a project under the ETS.

One option for overcoming these barriers to carbon financing is to plant exotic hardwoods as a nursery crop for indigenous forest establishment (under-planted with indigenous riparian vegetation), and planted over a wider riparian margin (e.g. 40m).

The ecosystem service value of mixed plantings of this kind would remain high, and the fact that such planting models are economically productive may enable a much greater rate of voluntary uptake than current riparian planting models.

7.4.2 IFCP Investment Strategy

Preliminary investment analysis of a scenario delivering 200,000 ha of carbon-financed permanent afforestation by 2030 indicates a net investment burden of \$385m (gross investment of \$700m) spread over 12 years, with an internal rate of return of 13.9% for a project modelled to 2040. In other words, a net investment of \$385m (i.e. net of revenues) paid in instalments between 2018 and 2030 will:



- 1. Afforest 200,000 hectares of erosion-prone land by 2030 (assuming willing farmer uptake at that rate) with forest that become indigenous forest when the nursery crop dies,
- 2. Pay for itself by 2035,
- 3. Generate a return for investors (e.g. HBRC, central government, and private)
- 4. Fund conservation management.

In contrast, running the same project with indigenous forest plantings requires a net investment of \$620m (same gross investment), an internal rate of return of 0%, and a net present value of -\$200m. So by 2040 an indigenous afforestation programme will still be in debt by \$200m, and will provide no funds for conservation management.



The capital required is very large, especially in the New Zealand context; and certainly beyond the reach of the Regional Council without central government assistance. Even with central government assistance, there is likely going to be a need to create a financing mechanism to fund the project which will entail ~\$30m of net investment each year for a period of twelve years.

A number of financing options are worth considering. Each is complex and would require extensive analysis, but this scoping exercise will help provide a conceptual framework for future consideration.

7.4.2.1 Financing Options

Financing options for the Indigenous Forest Carbon Programme have been scoped with the support of Erik Mass of Green Capital Investment Advisors Ltd, and include:

- 1. Taxation: The central government could raise taxes to fund a project that offers substantial environmental and economic upside over a long period of time. This approach is unlikely to be well received by voters, would entail significant delays, and would be difficult to justify within the current taxation regime. It is therefore not a viable option.
- 2. Government Mandate: Within legal constraints, the government could create a series of laws and financial penalties that coerce farmers to convert marginal farmland to carbon farming/manuka production. This method (if used alone) would be highly confrontational, and could lead to negative outcomes. It would also break the spirit of the social contract between government and citizens, but it would be very cheap.
- 3. Re-allocation: Central government and HBRC could cut funding for other programmes, and reallocate the money to this project. This method is highly political, and is also unlikely to be well received by voters and is therefore also not particularly viable on its own. However, if there are any large projects which were previously budgeted, but are cancelled for other reasons, then it would be efficient to simply reallocate that capital to co-finance this project.
- 4. Green Bond: Central government could seek to sell bonds that are backed by the expected cash flows from the project. This would allow private investors to participate, and therefore open up a large pool of free market capital to invest. This method would raise the cost of capital for the project, since private market investors will seek a higher rate of return than a government. One way to reduce cost of the capital would be for the government to guarantee or credit enhance the bonds, thereby lowering the cost of capital. This would entail risk for the government if pro forma financial projections were to fall short of expectations. Selling green bonds backed by carbon credits is also challenged by the potential high volatility of the carbon credit price.



5. Create an Investment Vehicle: The government could sponsor a public/private dedicated investment vehicle to invest in the project ("Carbon Credit Investment Company, or CCIC"). CCIC could be capitalised by a contribution from both the central government, as well as by private investors. CCIC would take on full responsibility for the project, and would receive the preponderance of economic benefits in return. The entity would be capitalised by equity from the government and private investors, but also by debt in the form of green bonds.

The central government could credit enhance those bonds in order to reduce the cost of capital; but thereby also taking on an off balance sheet contingent liability. The entity could promote local and regional support by offering all ratepayers a small equity stake. In addition, the entity could purchase marginal land from farmers, a strategy not explored in our base case financial model.

The purchase of land could be for cash or in exchange for equity in the entity, thereby enhancing purchase flexibility and creating sale options for farmers. This would give the entity complete control of the land and also allow it to more fully participate in the upside of the both the manuka and carbon credit scheme. The creation of this vehicle would generate substantial synergies and cost/management efficiencies. In addition, a public-private partnership would widen the pool of capital available for the project, lighten the financial burden to the government, and promote local and regional enthusiasm and support.

- a. CCIC would ideally be a private company that was government supported.
- b. The government would be able to leverage the private capital markets and offload execution and management responsibility.
- c. The government should be incentivised to seek a private market solution due to the long-term nature of the project that requires a large capital investment upfront. One way to tap into the future value creation is to bring that value forward to the present. The way to do that is to create an investment scheme that promotes rates of investment return that private investors will find attractive. In that case, investors will endow the investment entity with capital in the present, based upon expectations of future returns. As such, this mechanism can monetise future value creation up-front and thereby finance the creation of the planting scheme.
- d. CCIC could float shares in the public equity markets to access additional capital.
- e. The government would ideally act to de-risk CCIC in order to attract investor demand and to ensure the long-term success of the venture.
 - i. CCIC could float green bonds that were backed with credit enhancement from the government in order to lessen the cost of capital.



- ii. The government could create a bespoke option collar for carbon credits to be issued by CCIC. This contract would write a put option for carbon credits thereby ensuring a minimum price for carbon sold by CCIC in exchange (potentially) for an annual premium paid by CCIC to the government (similar to an insurance contract). In addition, the government would create a call option entitling the government to a negotiated participation in any upside resulting from a future increase in the price of carbon. For the government, this would mean an out-of-pocket cost if carbon prices fell (offset by any accumulated insurance premia paid over time), and the ability to make windfall gains if the price of carbon were to rise over time. For CCIC, this scheme would protect its business model from becoming uneconomic if carbon prices were to decline, but CCIC would have to forgo certain future profits resulting from the increase in the carbon price.
- iii. If the government were to de-risk CCIC, CCIC would have a cheaper cost of capital and surety on carbon price both of which would enhance its investment appeal. As a result, it is likely that CCIC would have a higher chance of success and for attracting private investment capital, both of which would benefit government goals.
- iv. As a result of risk mitigation measures, the cash flow streams produced by CCIC would have less upside potential. These cash flows, however, would incur substantially less volatility and would implicitly carry a government guarantee, thus making them bond/annuity-like in character. In effect, the government would be using its strong balance sheet to allow the private markets to establish a high credit bond with equity upside over time. CCIC could pass along these cash flows in the form of dividends to shareholders, making the investment particularly attractive to retail investors, Kiwisavers plans, pension funds, etc.

7.4.2.2 Conservation Funding

The preliminary investment analysis presented above (including different options for financing) has a positive net present value of ~\$130m, of which some portion will be allocated to farmers participating in the venture. Assuming 70% split to the government, there would be ~\$90m of value creation accruing to government. This value could be re-invested in pest/predator control and conservation measures which are both necessary preconditions to the success of the project as well as positive outcomes that are symbiotic with the goals of the project.



7.4.2.3 Role of Government

To finance this, HBRC will need to secure central government finance, but would need to put up some of its own money for match-funding. An average inflation adjusted investment of \$30 million annually is required between 2018 and 2030, with HBRC perhaps meeting 25% of this burden and central government supplying the balance. Justification for this level of central government funding can be asserted on the basis that the IFCP is solving a national problem located regionally, and that the government will get its money back with interest if the programme performs at the modelled rate.

To compensate for a lower contribution of financial capital, HBRC could contribute regulatory capital in the form of a regulation enacted in 2018 that comes into force in 2030 whereby pastoralism on the most erosion-prone land will no longer be a permitted activity. This will stimulate landowner uptake in a voluntary afforestation programme that pays for afforestation activity externally (i.e. through carbon finance). In addition, landowners will have the opportunity to offset opportunity costs (loss of net annual beef and lamb revenue) through manuka honey revenue.

From a policy perspective, the IFCP will enable the HBRC to change the land use of 200,000 ha of erosion-prone land by 2030 at low electoral risk - because the majority of affected landowners will have retired their 'high erosion risk' lands voluntarily under the IFCP by the time any regulation came into force.

7.5 CLIMATE RESILIENT FORESTS

Forests play a key role in both climate change resilience, climate change mitigation (emission reductions), and climate financing (carbon credits). HBRC have plantation forest assets that need to be climate resilient, but which can also be used to co-finance climate resilience in other sectors (more below). The private sector also has substantial plantation forest assets that are both vulnerable to climate change, and which pose a liability to waterways under a changing climate.

7.5.1 Reducing Vulnerability

Climate projections of a warmer, dryer and stormier climate in coming decades are relevant to the lifespan of plantation forest assets in the region either in this or future rotations. Plantation forest estate owners have the opportunity to increase the resilience of their carbon forestry portfolio and consequently reduce natural and financial risk. Higher-risk configurations include little or no variation in forest stand age and the location of the plantation estate in a single climatic zone. This exposes the entire estate to natural risk events like drought, fire and storm damage (Scenario 1 in Figure 7.5.1).



A lower risk situation is to have a wide variation in the age of individual plantation forest stands (Scenario 2 in Figure 7.5.1). The next tier of risk reduction is to acquire plantation forestry assets in one or more different local government (and climate) regions (Scenario 3 in Figure 7.5.1). Further risk reduction can be delivered through shifting the species mix to include species with longer rotations and those capable of recovering quickly after disturbance (Scenario 4 in Figure 7.5.1). This helps to further reduce your risk of natural losses should something like a region-wide severe and prolonged drought event strike. More resilience is added to a portfolio when some forest blocks or subsets are allocated to "no harvesting" (Scenario 5 in Figure 7.5.1). Even more resilience comes with adding native forest regeneration to the carbon forest estate (Scenario 6 in Figure 7.5.1).

Another risk factor is the risk of plantation forestry on other land uses and resource systems. Of particular relevance is the high risk of sedimentation and forestry slash downstream movement in high rainfall events coinciding with harvesting.

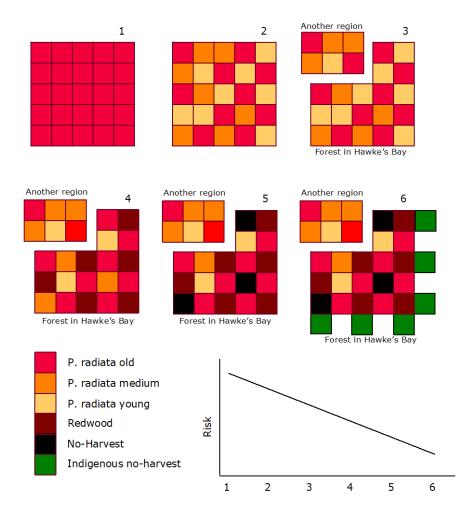
During certain high rainfall events (and earthquakes) some larger landslide types will happen regardless of the vegetation on that land, and regardless of human activity. Here localised soil liquifaction occurs down to bedrock and the slope fails, taking everything above with it. Such events will happen in a plantation forest, natural forest or on pasture (they have been happening for many thousands of years as evidenced by sediment profiles in the bed of Lake Tutira). In the same rainfall events, smaller scale erosion can be lower under forest cover than under pasture where (in the latter) surface and rill erosion rates can be higher.

In the absence of extreme rainfall events, plantation forestry and pastoral agriculture both contribute to soil erosion but at different rates at different times. Suspended sediment in streams flowing through pastoral farmland can be 4 times higher than in streams flowing through a well-managed plantation forest. This higher pastoral sedimentation rate continues annually for decades and escalates on erosion-prone hill country.

Suspended sediment concentrations in streams flowing through plantation forest will spike during activities associated with harvesting (road building and harvesting) to around 3 times the rate of sedimentation under pastoral farming. But this increase in the sedimentation rate in plantations lasts for the 2-3 years of the harvest window, after which time sedimentation rates return to pre-harvest levels and correspondingly higher water quality.



Figure 7.5.1 Building a resilient carbon forestry portfolio



Current climate projections show a stormier climate with higher impact rainfall events. When high rainfall events coincide with timber harvesting, there is an increased risk of downstream movement of forestry slash (logs and woody debris) as well as erosion sediment. Such rainfall events will also move logs and woody debris from pastoral land stream margins.



Reducing stream sediment overall, will benefit from:

- a. Afforestation of erosion-prone pastoral hill country.
- b. Plantation forestry management practices that reduce erosion risk associated with:
 - Forestry road engineering including river crossings.
 - ii. Retaining riparian margins of protected forest vegetation.
 - iii. The use of best practice timber-harvesting technologies that reduce soil disturbance.
 - iv. Rapid replanting following harvesting.
 - v. Catchment-based harvest planning to enable a significant proportion of a plantation catchment to remain under vegetation at any one time.

These actions will also reduce but not eliminate the risk of downstream movement of forestry slash, which pose a significant public liability to downstream property, infrastructure, and amenities.

The conditions contained in the National Environmental Standard for Plantation Forestry (NES-PF) that comes into effect on 1 May 2018, will support climate resilience to some extent, and provide councils with greater opportunities to impose stricter controls on plantation forestry activities in high erosion risk areas.

Some of the conditions in the NES-PF are:

- For afforestation, permitted activity conditions setbacks for tree planting from rivers, lakes, wetlands, coastal areas and significant natural areas. Setbacks provide a buffer between forestry activity and these areas, providing shading and habitat for aquatic species and helping to avoid erosion of stream banks.
- For harvesting to be a permitted activity, foresters must submit a harvest plan to their local council if requested. The plan should identify environmental risks, including erosion susceptibility using the Erosion Susceptibility Classification tool, and must list the mitigations to be used to respond to those risks and achieve compliance with permitted activity conditions.
- For earthworks, permitted activity conditions include the requirement to install and maintain storm water and sediment control measures. Spoil, the by-product of excavation and earthworks, cannot be deposited where it may readily enter or deliver sediment into a water body, coastal area or significant natural area.



7.5.2 Plantation Forest Carbon Financing

HBRC has an existing plantation forestry estate from which carbon credits have already been issued under the New Zealand Emissions Trading Scheme (NZETS). Ekos was contracted by HBRC in 2016 to provide advice on the volume of carbon credits it could safely monetize without sustaining a contingent liability on HBRC books. In short, plantation forests earn carbon credits (carbon assets) while they are growing, but then carry a carbon liability at the time of harvest. This is because a growing forest will absorb CO₂ from the atmosphere, while a harvested forest will emit CO₂ to the atmosphere.

A sure way to lose money is to sell all of your carbon credits as your forest grows (at today's carbon prices), and then have to buy most of them back at harvest time at tomorrow's (often higher) prices. A prudent carbon credit monetization strategy in the plantation forest sector is to only sell the volume of carbon credits that will not be needed at harvest time. This can be most easily understood when considering a single forest plantation over its growth and harvest cycle (see Figure 7.5.2. below).

Average long-term carbon stocks postforest establishment (carbon project) Harvest Harvest Harvest Carbon Stocks (sell, then buy-back post harvest) Risk Carbon Safe Carbon (one-off issuance; sell, no buy-back requirement) 2009 2039 2069 2099 Average long-term carbon stocks prior to forest establishment (baseline - non-forest BAU)

Figure 7.5.2 Safe Carbon

If you earn carbon credits annually as your forest grows but only sell those that you won't need at harvest time, then you are trading safe carbon. Then if the price of carbon goes up through time, so too does the value of your unsold carbon credit stock that you have banked for a rainy (harvest) day. You can then surrender your credits to the Crown without taking a potentially heavy loss.



The fine print of safe carbon is that it cannot be sold twice – i.e. it is a one-off benefit. The reason for this is because you can only increase your average long-term carbon stocks once (e.g. by changing land use from pasture to plantation forestry). The other form of safe carbon relevant to HBRC forest estate is the carbon credits received by HBRC for its pre-1990 plantation forests. This carbon credit volume is "safe carbon" so long as the pre-1990 plantation forest area is not deforested.

7.5.2.1 Safe Carbon For HBRC Plantations

HBRC has approximately 110,907 "safe carbon" credits in its plantation forestry carbon portfolio that can be sold without the risk of having to buy them back at a higher price in future years. This is split between approximately 96,000 credits from plantations established after 1989, and 14,907 credits from plantations established prior to 1990. This volume is equivalent to all the carbon credits received by HBRC up to 2021. If this volume is all sold by 2021 then HBRC will have realized all the risk-free carbon to be issued to HBRC across the lifetime of its existing plantation forest estate including multiple future rotations on these lands.

There is a possibility that the Government will change its rules on Harvested Wood Products (HWP) that could increase the volume of safe carbon that can be sold.

Different sales strategies can be considered for the HBRC safe carbon portfolio of 110,907 credits. If monetised at the spot price of \$17.50 this sale would yield \$1.9 million. Maximizing the financial returns on sale of these credits could consider delaying sales until carbon prices rise in response to potential rising demand. For example, the Ministry for the Environment Regulatory Impact Statement on the interactions of the NZ Emissions Trading Scheme and New Zealand's 2030 emissions reduction target states: "The Government and therefore taxpayers may have to fund the purchase of 150 million international units to ensure that the [2030] target is met." This may drive up demand (and prices) for domestic carbon credits between now and 2030.¹⁸

The revenue from carbon credit sales could be reinvested in plantation forestry asset growth, to increase the size and economic returns arising from this asset base, with profits eventually redirected into climate resilience spending (e.g. allocated to the Climate Resilience Mechanism after a certain date).

Alternatively, HBRC could consider a carbon credit sales strategy focused on strengthening a potential relationship with large scale carbon buyers. For example, a large-scale carbon buyer may be interested in entering into a long-term carbon credit supply arrangement with HBRC through the Indigenous Forest Carbon Programme (more detail below). But the Indigenous Forest Carbon Programme will require a period of programme development (e.g. 3-5 years) to build up carbon credit volumes to meaningful levels.

 $^{^{18}}$ The Indigenous Forest Carbon Programme would deliver $^{\sim}14$ million carbon units by 2030.



Furthermore, as part of the initial credit supply arrangement, the NZUs supplied by HBRC could be packaged as "bundled credits", bundled with biodiversity co-benefits arising from specific performance-based biodiversity projects. Here, a portion of the sales revenue is directed to the biodiversity co-benefit project, with the link to biodiversity designed to cultivate a strong relationship with a keystone buyer with a particular appetite for biodiversity co-benefits in their forest carbon portfolio (more on NZU bundling with biodiversity in Section 7.6 below).

7.5.2.2 New Plantation Establishment

If The value of potential revenue from the sale of safe carbon can be added to cash flow forecasts and investment plans for plantation forest establishment alongside timber revenue (commonly running at >6% returns¹⁹). This can be compared with forecasted cash flows from beef and lamb. If/when the forestry cash flows and asset value is higher than beef and lamb, then conversion from non-forest to forest land use can be justified on purely economic grounds. When combined with the elimination of external costs of pastoralism on steep lands (e.g. water sedimentation, soil erosion, and greenhouse gas (GHG) emissions), the plantation forestry land use (if operating in line with the National Environmental Standards for Plantation Forestry and any additional safeguards imposed by HBRC - more below) can present an even better business model (even when farming is not treated the same as forestry in relation to emissions liabilities).²⁰

But the economics of carbon forestry remain relevant to both HBRC land asset management strategy (i.e. with the prospect of afforesting more HBRC lands), and to pastoral farmers of marginal land in the region. HBRC could promote and facilitate plantation forestry establishment on suitable lands as part of its overall regional forest carbon programme.

¹⁹ Information gathered from discussion with forestry consultants.

²⁰ At present, intergovernmental GHG emission liabilities to NZ from agriculture are covered by the taxpayer and not the farmer. This is not the case for forest owners or the energy, waste and transportation sectors. Furthermore, biological emissions may come under the NZETS as a result of policies arising from the previous ETS review, combined with the NZ strategy to meet its commitments under the Paris Agreement.



7.5.2.3 HBRC Forestry Profits And Climate Resilience

HBRC could manage and grow its plantation forestry estate to use as a source of finance for elements of the Climate Resilience Mechanism. The HBRC plantation forestry estate could be managed to maximise estate growth, through maximising profits and channelling these profits into acquiring additional plantation forests. Then following a period of growth HBRC could shift strategy to channel plantation forest estate profits into the Climate Resilience Mechanism.

As part of its plantation forest estate strategy, HBRC may need to consider selling some or all of its plantation forests in order to finance the purchase of plantation forests in other regions with lower fire risk (e.g. west of the main divide). This would reduce risk exposure for these assets and as a result increase long-term profitability.

Forest Fire Risk Prevailing Wind Wetter Dryer Taranaki Hawke's Bay North Island East West Buy forests here Sell forests here Reduce long-term asset risk

Figure 7.5.2.3 Regional Forest Fire Risk Concept Diagram



7.6 CLIMATE RESILIENT BIODIVERSITY & BIOSECURITY

Climate change is a leading cause of extinction and biodiversity loss. Biodiversity resilience and adaptive capacity is closely linked with habitat availability and habitat corridors across a range of climate zones. HBRC is currently operating biodiversity conservation programmes designed to strengthen biodiversity habitats in the region, and has aspirations to expand on this base through the implementation of the Hawke's Bay Biodiversity Strategy. A significant component of this strategy focuses on enabling climate resilience for biodiversity habitat in the face of a changing climate.



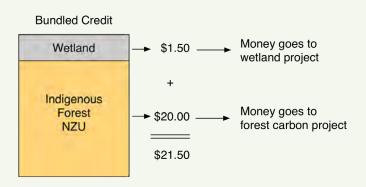


Among the most pressing challenges in biodiversity conservation on private land is conservation financing. The cost of conservation includes conservation management costs and opportunity costs for private landowners who are invited to give up economic production to enable land allocation to conservation outcomes. Financing these costs sufficiently to cause biodiversity conservation at scale, necessitates moving beyond philanthropy and into more challenging economic territory. Otherwise biodiversity conservation occurs only at a small scale and among a minority of landowners who are willing to not be compensated for opportunity costs.

Financing conservation opportunity costs at scale by means of grants will rapidly exhaust grant funding sources. For this reason, market-based mechanisms need to be deployed where possible, to enable the funding burden to be shared across grant and market actors. The challenge for market-based conservation financing is the absence of any compliance market for biodiversity. This leaves the entire biodiversity market to voluntary actors in what is essentially philanthropy and expressed by a minority of private sector entities. Whilst this can provide a marginal gain for conservation, it will fail to enable conservation to take place on private land at scale.



One example of a market-based conservation financing mechanism capable of operating at scale is the New Zealand Emissions Trading Scheme (NZETS) channelled through a regional Indigenous Forest Carbon Programme (see above). This financing mechanism can deliver conservation gains beyond BAU, but is restricted to those activities where carbon sequestration is sufficient in scale to be turned into a carbon project, and on land that is eligible for registration in the NZETS.



Many biodiversity conservation priorities lie outside the scope of carbon financing and for this reason need another mechanism. One option is biodiversity co-benefit bundling with NZUs. Here NZUs are sold at a premium where the unit price reflects the cost of production of NZUs plus a margin directed to a non-carbon biodiversity project.

Another option for a market based mechanism for climate resilient biodiversity projects is a variation on biodiversity offsetting. Biodiversity offsetting (like carbon offsetting) involves an opportunity to offset negative impacts of development (e.g. roading, housing, certain farming practices) with equivalent positive impacts at another location. A key element of biodiversity offsetting is the need to deliver an offset solution at 'no net loss' to the original biodiversity under threat. This necessitates substantial investment in ecosystem accounting on the supply and demand side of an offset transaction, and this, in turn, can dramatically increase transaction costs. It also opens a can of worms about putting a price on nature and how this price can be appropriately assigned.

The variation on biodiversity offsetting proposed here is a market-based biodiversity resilience programme integrated into the Climate Resilience Marketplace. Here Climate Resilience Units (CRUs) are issued to projects that deliver eligible, measured, reported and verified climate resilience outcomes.



But to create demand in a biodiversity resilience market, HBRC could require certain classes of resource consent to mitigate negative impacts through purchasing a proportionate volume of biodiversity CRUs from the Climate Resilience Marketplace. By avoiding defining these as "biodiversity offsets" and instead focusing on the notion of mitigating (but not offsetting) negative impacts, one avoids the high transaction costs of "no net loss" biodiversity offsetting. The gains are delivered in the form of additional private sector capital for biodiversity projects registered under the Climate Resilience Marketplace (i.e. projects that comply with the measurement, reporting and verification requirements of that mechanism). While avoiding a "no net loss" outcome could lead to less-than-equivalent transactions in some settings, the upside is the ability to operate a compliance market-based mechanism at low transaction cost, that nonetheless channels additional private sector finance to local biodiversity at scale (and where some situations arise where the biodiversity gains are higher than the original losses). Moreover, a compliance instrument like this is additional to BAU that does not require the same.

The biosecurity implications of climate change remain relatively under-studied both in Hawke's Bay and nationally. This warrants deeper and further investigation by HBRC. This is where a regional climate change adaptation assessment process will assist council to better inform future policy.



7.7 CLIMATE RESILIENT FARMING

A stormier and more drought-prone climate with more extreme rainfall events, less frost nights and higher average temperatures in coming decades presents a range of significant risks to agricultural and horticultural productivity in the Hawke's Bay region. Drought, in particular, poses a significant threat to farm businesses and the wellbeing of farming families. It also puts significant pressure on the surface and ground water resource.

This theme is somewhat understated in the regional and national rural climate change conversation. Instead this conversation has focused predominantly on pushes for and against biological emission reductions from ruminant animals, and has led to an urban-rural divide that has divided the nation. But climate change threats to agriculture pose a threat to the entire regional and national economy.

Hawke's Bay Regional Council has an opportunity to provide leadership both regionally and nationally on climate change resilience in agriculture/horticulture, and help to steer this debate into a more community and nation-building territory. When faced with a common threat, communities often come together to meet the challenge in a united manner for the common good.

7.7.1 Approach

Recognition of the value of farming (agriculture & horticulture) to the regional and national economy is fundamental to a durable climate change resilience effort. Part of this recognition needs to include an appreciation of the financial pressures on farming families, and the fact that climate resilience solutions need to ease rather than escalate these pressures. While farming is a business like any other, it faces unique and more acute climate risks compared with urban businesses not directly reliant on agricultural productivity. It is because of these unique risks (e.g. drought) that agriculture needs special attention when it comes to public contributions to climate resilience efforts. Furthermore, when urban ratepayers recognise these unique risks faced by agriculture - arising from an inclusive and informed regional conversation on this topic - they will be more likely to consent to the special treatment that agriculture needs in this arena. Not least because when agriculture is thriving, the rest of the regional economy thrives (the opposite is also true).



7.7.2 Threats And Responses

Climate resilient agriculture has adapted to changed climate conditions. The changed climate conditions, threats and possible responses in Hawke's Bay include:

Table 7.7.2 Climate Resilient Farming Priorities

Threat	Resilience Response	Example
	Drought resistant farming practices	Changed pasture species composition focusing on deeper rooted species able to access water deeper in soil
Drought: Increased	Increased water use efficiency	Automated variable irrigation with soil moisture monitoring
frequency and severity	Increased water storage capacity	Larger and higher number of on-farm water reservoirs
	More efficient water allocation	Water rights allocated proportionate to reduced surface and groundwater recharge capacity
Warmer mean temperatures leading to infestation by pest and weed species new	Pest and weed control measures in place tailored to new pest and weed challenges	Research into new weed threats incorporated into agricultural weed control plans, enabling control operations to be budgeted and effectively implemented.
to region or newly abundant in region		Pest and weed control service providers provide specialised services to farmers co-financed through a Climate Resilience Mechanism.
Increased soil temperatures leading to pasture dieback for longer periods during summer	Pasture composition changed to species mix capable of coping with higher average soil temperatures during peak summer months	Changing from ryegrass clover mix to multiple species including ryegrass, clover, coxfoot, chicory, and plantain that can cope with higher soil temperatures and also access moisture deeper in soil horizon.



Threat	Resilience Response	Example
	Level of service for flood protection schemes proportionate to peak flow events	Stop bank sufficiently high and robust to cope with new flood event frequency and severity
	Reforestation of high erosion risk pasture land	High level of hill country farmer participation in voluntary reforestation incentive scheme during 10-year voluntary uptake period
		Pastoralism on highly erosion prone land no longer a permitted activity following voluntary uptake period
Flooding: Increased rainfall intensity		10m permanent forest riparian margin setbacks either side of all streams
during extreme rainfall events leading to increase flood risk	Plantation forestry management practices that reduce risk of forestry slash movement in flood events	Higher plantation forestry road, bridge and culvert standards, and more effective compliance
		Harvesting 100% of a catchment no longer permitted in any given year.
		Forestry companies all have forestry slash public liability insurance sufficient to enable rapid response to flood damage events
	Farm infrastructure location and design sufficient to cope with peak flow events	On-farm bridges, culverts, and buildings built and located to cope with new flood event frequency and severity

7.7.3 Role of HBRC

Moving an entire sector in a strategically beneficial direction that markets alone will not deliver, necessitates a government role in correcting a market failure. The purpose of the correction is to deliver beneficial outcomes to the sector, by assisting it to adapt to changing conditions faster than it would do from market signals. Given that the purpose is benevolent rather than punitive, it is important that the means of delivering targeted outcomes for this (or any) sector is also not punitive. The fact that moving to a "new normal" will require investment, and given limited financial resources, it is important to design a leastcost/highest impact delivery mechanism at the policy and planning level.



Among the most effective policy and planning tools in this regard is the strategic combination of carrot and stick as signalled earlier. Also, given that maladapted farms in the future will be punished by the market, in many cases the stick will not need to be administered by HBRC anyway. In other words, farms that do not adapt will go bust. But to minimize productivity risk for the region, beneficial HBRC intervention can be warranted, and justified in local body elections (provided there is minimal or no impact on rates).

Situations where a regulatory stick can be justified is where maladapted farming practices pose significant risks (and costs) to the wider community. These costs may be external to the farm balance sheet, but are not external to the ratepayer. Examples of the latter include:

- Failure to convert erosion-prone steep land pasture into permanent forest, and thereby pose a significant water quality, flood and erosion risk to downstream property.
- Inefficient use of limited surface and groundwater supply.

When used together, combinations of voluntary incentives and delayed regulatory penalties can move significant portions of a population in the desired direction.

Policy tools that can work well in carrot and stick systems include:

- Changing consent conditions (including non-permitted activities).
- Non-compliance penalties.
- Performance-based consents.
- Performance-based incentives (including rate relief).
- Differential rating.
- Cap-and-trade systems (used in water and emissions trading in some jurisdictions).
- Baseline and credit systems (used in forest carbon trading and market-based mechanisms for conservation).

Performance-based consents operate whereby the regulator requires the consent holder to provide third party evidence of compliance as a condition of continuation of consents in a system involving periodic consent renewal (e.g. 3-yearly).

Performance-based incentives can involve regulatory holidays following demonstration of over-compliance with good/best practice. An example might include a forestry company who demonstrates that they are building their roads, bridges and culverts to good practice standards, and as a result receive a permitted activity consent with low evidence-of-compliance burden.

Differential rating could involve higher rates on activities that generate higher risk of external costs to the rate payer but where those costs are not external to the regional economy. For example, rates could be charged at a higher rate per hectare on pastoral farming on steep high erosion risk land. Evidence of a shift to reforestation of such lands in permanent forest could then be rated at a lower rate per hectare than pasture on non-erosion-prone land.



The higher rate per hectare among farmers electing to not change can finance the lower rate for those farmers that do change in a system that is revenue positive at first, then revenue neutral, and then (when the majority retire erosion-prone lands) revenue negative. If HBRC banked the revenue positive surplus, it could use this to finance the revenue negative phase of such a rating regime.

Cap-and-trade systems function by defining a participating community, a relevant natural boundary (e.g. a water supply scheme), and a cap relevant to the resource in question. For example, an aggregated water allocation cap could be imposed on a water supply scheme. Then allowances are issued to users in the form of water units with the total number of allowances equal to the cap. Users can then trade their allowances. Users who use more units than their allowance can buy spare allowances from users who use less than their allowance. This creates an incentive for water use efficiency investment (practices and technologies), because such investments cause efficiencies that enable over-compliance, and this results in ownership of surplus allowances that can be sold to co-finance the efficiency investment. This is the supply side gain from trade. The second gain from trade comes from the demand side, where a farm business it to be more efficient to buy allowances than invest in new technologies or practices.

A geographical trend can develop in water trading systems, whereby upstream pastoral farmers have an opportunity to build more on-farm water storage (generating increased water independence from a scheme), and can then trade water allowances to horticulturalists who do not have spare land on which to construct additional water storage. In this manner, pastoral farmers can also become water farmers as part of their business model.

The cap can be adjusted through time (e.g. 10-year management periods) as the HBRC monitoring system reveals that the volume of target resource changes. A cap-and-trade system could be used for water and nitrogen as a way to move a community of farmers towards higher water efficiency combined with higher stream water quality.



7.8 CLIMATE RESILIENT FLOOD & COASTAL DEFENCES

Flood and coastal defences are already well served through the Level of Service (LOS) review process, and the Hawke's Bay Coastal Strategy. This analysis cannot add much value apart from recommending that sufficient attention is paid to both planning and financing for the medium-term and long-term risks.

Part of the flood mitigation effort in relation to climate resilience is to steer certain forms of development away from high flood risk areas and zones. Especially important in this regard is avoidance of either future litigation and/or electoral risk to HBRC or other councils.

The 2015 LTP identified a number of council infrastructure issues expected to be resolved over the next 30 years. These included: climate change, Level of Service reviews, land use change, and flood channel capacity management.

Climate change impacts assessments on infrastructure strategy are based on the prediction that Hawke's Bay will be dryer but with the potential for increased storminess, bringing greater rainfall resulting in increased flood flows. Sea level rise will also impact on coastal assets and services.

7.8.1 Heretaunga Plains Flood Control and Drainage Scheme

Status

- Design Level of Service (LOS) (1% Annual Exceedance Probability (AEP)) for major
- Current assessment: 100% effectiveness low risk of failure.
- Level of Service (LOS) review scheduled for 2014/15.

Comments:

HRBC committed to increasing the level of protection provided by the Heretaunga Plains Scheme – Rivers infrastructure to convey flood water with a 0.2% chance of occurrence in any one year over the next 15-20 years.



Climate Change Review Questions

- Is current LOS sufficient to meet projected flood risk for this Scheme under NIWA climate projections for the expected life of this infrastructure?
- Is upgrade needed during 2018-2028 LTP or beyond?
- If an upgrade is required:
 - o what is the projected staging of such an upgrade
 - o what is the additional cost?
 - o how will such additional costs be financed?

7.8.2 Upper Tukituki Scheme

Status

- Design LOS (1% AEP capacity) is provided over 95% of stopbank reaches.
- Level of Service (LOS) review scheduled for 2014/15.

Climate Change Review Questions:

- Is current LOS sufficient to meet projections of flood risk for this Scheme?
- Is upgrade needed during 2018-2028 LTP or beyond?
- If an upgrade is required:
 - o what is the projected staging of such an upgrade
 - o what is the additional cost?
 - o how could such additional costs be financed?

7.8.3 Small Schemes

Status:

LOS estimated at 95% or higher allowing for periodic flood damage.

Climate Change Review Questions:

- Is current LOS sufficient to meet projections of flood risk for this Scheme?
- Is upgrade needed during 2018-2028 LTP or beyond?
- If an upgrade is required:
 - o what is the projected staging of such an upgrade
 - o what is the additional cost?
 - o how could such additional costs be financed?



7.9 CLIMATE RESILIENT WATER SUPPLY

Safeguarding a climate resilient water supply in Hawke's Bay remains unresolved. With the cancellation of the Ruataniwha Dam proposal, the HBRC now needs to rethink water supply, water allocation and water allocation trading.

Emphasis needs to focus on climate resilient water use, where water use is matched with water availability. This will enable the best use of the water resource overall, whilst avoiding the allocation of water unsustainably. The planning process needs to avoid creating incentives for water intensive land uses in areas that are, or will become, water stressed. In some areas, this will involve incentivizing water use away from water intensive agriculture and towards horticulture.



7.10REGIONAL CARBON NEUTRALITY PROGRAMME

HBRC could lead a Regional Carbon Neutrality Programme targeting the following:

- > Carbon neutral or carbon negative HBRC business operations.
- Carbon neutral Hawke's Bay public service (where HBRC provides leadership by showing others how it is done)
- Carbon neutral Hawke's Bay Businesses (HBRC providing leadership and support).
- Carbon neutral household transport (driving and flights).

7.10.1 Carbon Neutral HBRC

Contrary to popular opinion, carbon neutrality is not particularly difficult. It requires defining a carbon accounting boundary (e.g. HBRC business operations), defining the scope of emissions to be measured (Scope 1,2,3)²¹ measuring the CO_2 emissions footprint for each relevant emissions activity type (e.g. electricity, fuel, flights, waste), reducing this CO_2 emissions footprint where possible, and offsetting the remaining CO_2 emissions footprint through acquiring and cancelling carbon credits to match the volume of the remaining emissions. Offsetting need not wait until all emission reductions have been delivered, but instead both offsetting and emission reductions can continue concurrently through time with the volume of offsets purchased reducing as the emissions footprint reduces.

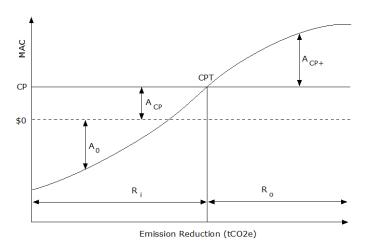
Reducing emissions (abatement) comes at a cost. Sometimes this cost is negative, sometimes positive. An example of cost negative abatement is reducing the number of flights undertaken each year (saving on air fare costs). An example of cost positive abatement is switching to low carbon technologies and infrastructure whose capital expenditure and operational costs are greater than BAU technologies.

The cost of abatement for any organization will follow a marginal abatement cost curve (the cost of the next abatement action). The most cost-effective emissions reduction strategy for an organisation (i.e. deliver the largest volume of emission reductions per dollar spent) will target lowest cost abatement first, and then progressively target higher cost actions.

²¹ Scope 1 = direct emissions from fossil fuel burning (e.g. boiler, fleet); Scope 2 = indirect emissions from purchased electricity; Scope 3 = other indirect emissions (e.g. flights, taxis, freight, waste).

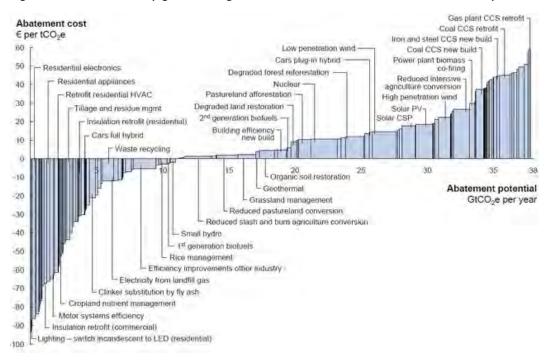


Figure 7.11.1a. Marginal Abatement Cost Curve Model



Where: MAC = Marginal Abatement Cost (\$/tCO₂e); CP = carbon offset price; CPT = Carbon price threshold (emission reduction cost = carbon offset price); AO = Cost negative abatement; ACP = Cost positive abatement that is below the carbon price; ACP+ = Cost positive abatement that is above the carbon price; Ri = Emission reduction ideally undertaken in-house; Ro = Emission reduction ideally undertaken through purchasing carbon offsets.

Figure 7.11.1b. McKinsey global marginal abatement cost curve. Source: McKinsey & Co.²²



Available here: http://petrolog.typepad.com/climate change/2009/09/the-cost-of-abating-greenhouse-gases.html



7.10.1.1 Emission Reduction vs Offsetting Dynamic

The ability to purchase carbon units at the carbon price (e.g. \$19/tCO2e) provides the opportunity to reach a carbon emissions management goal (e.g. carbon neutrality) through a combination of in-house reductions and purchasing offsets (emission reductions or removals that take place outside the organisational boundary). An efficient carbon neutrality strategy would do as follows:

- 1. Abate emissions in-house where this can be done through
 - a. Cost negative actions (e.g. reducing flights), and
 - b. Cost positive actions but below the carbon price per tCO₂e abated.
- 2. Purchasing carbon credits for all emissions abatement above the carbon price (i.e. paying no more than the carbon price for that abatement).

In the absence of a detailed marginal cost analysis of carbon emissions reduction options, an organisation can adopt a common-sense approach that reduces emissions where practicable, ²³ and offset the remaining emissions footprint through purchasing and cancelling carbon credits.

7.10.1.2 CO2 Footprint Measurement - Dalton St

A CO_2 footprint measurement exercise was undertaken (as part of the preparation of this report) for Dalton St business operations for the 2015 and 2016 calendar years. The preliminary result of these calculations are follows:

Table 7.10.1.2 CO2 Footprint Dalton St 2015/16

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Emissions Type	tCO₂e	tCO₂e			
	2015	2016			
Electricity	43.4	48.9			
Natural Gas	30.3	31.5			
Diesel	232.3	243.0			
Petrol	45.8	56.5			
Flights	27.6	59.9			
Waste	*[5]	[5]			
Freight	[10]	[10]			
Total CO₂ Footprint	394.4	454.8			

^{*[}Square brackets] signify conservative placeholder estimate in lieu of completed calculations.

²³ E.g. Upgrade technology to the most energy efficient possible at normal timing of infrastructure renewal.



These results are presented in a histogram for the 2016 calendar year in Figure 7.10.1.2 below:

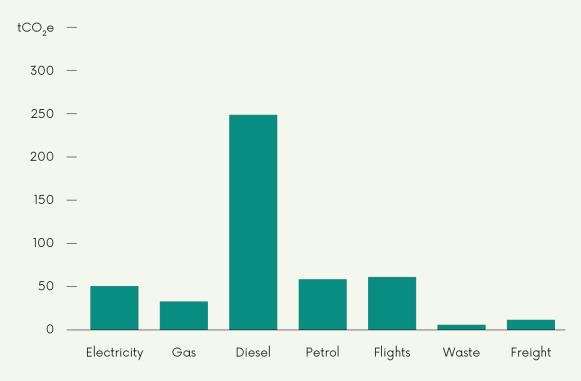


Figure 7.10.1.2 CO2 Footprint Dalton St 2016.

7.10.1.3 Dalton St Emission Reduction Strategy

As can be seen in Figure 7.10.1.2 the vast majority of CO2 emissions for Dalton St business operations arises from the vehicle fleet followed by flights. Figure 7.10.1.2 also shows where the greatest emission reduction gains can be made at least cost. An emission reduction plan for Dalton St, therefore, would target those activities where the marginal cost of abatement is the lowest. Emission reductions in diesel and petrol could be delivered through increased efficiency in vehicle use and through a transition to more energy efficient vehicles as these become available and when renewed at the normal time for fleet upgrade. Electric vehicle purchases will assist this, but suitable electric vehicles are not current available for off-road activities. Reducing flights will tend to be cost negative, but can also involve investment in better teleconferencing technologies. Electricity emission reductions have already been delivered since the 2013 upgrade of the Dalton St boiler system and other energy efficiency measures undertaken by facilities management.



7.10.1.4 Carbon Neutral Dalton St

Emission reductions are not capable of delivering carbon neutrality alone. Even with considerable effort and cost, Dalton St business operations will continue to have a significant CO_2 emissions footprint. This is where offsetting becomes relevant. Furthermore, offsetting need not wait until an emissions reduction plan has been implemented. In the private sector carbon neutrality arena, carbon offsetting typically takes place concurrently with an emission reduction effort. This means that an organisation or business can assert carbon neutrality immediately following CO_2 footprint measurement and offsetting. Emission reduction efforts have the effect of reducing the volume of carbon offsets required in order to maintain a net neutrality position.

HBRC Dalton St have already undertaken many actions to reduce its CO_2 emissions through energy efficiency actions in recent years. It is now in a position where it could go carbon neutral by offsetting its current (e.g. 2016) CO_2 footprint. Assuming the conservative placeholder values are correct in Table 7.10.1.2 above (they are an over estimate in lieu of the completion of emission calculations), the CO_2 footprint in need of offsetting for Dalton St is 455 t CO_2 e. Offsetting this volume of emissions through purchasing 455 carbon units from the carbon market (assuming a carbon price of \$18/t CO_2 e) would cost in the order of \$8,200 annually. Should HBRC purchase and cancel 455 t CO_2 e carbon units tomorrow, it can assert carbon neutrality for the 2016 calendar year the day after (i.e. be the first carbon neutral regional council in the country).

7.10.1.5 Sourcing Carbon Offsets

HBRC already owns a large volume of NZUs from its commercial forestry operations. For this reason, it already has possession of more than enough carbon credits to declare carbon neutrality if elected to cancel a volume of NZUs equivalent to its CO2 emissions footprint. These carbon credits include credits that were allocated for free from the Crown for pre-1990 plantation forest assets, and as such HBRC did not exercise any additional land management effort in acquiring them. For this reason, the public reaction from using the council's own plantation forestry carbon credits to offset its emissions would likely be less favourable compared with carbon credits sourced from activities that a) involved real additional effort, and b) contributed to a broader set of benefits. A type of carbon credit that would satisfy a) and b) would be NZUs generated from indigenous reforestation activities in the region.

If HBRC were to undertake new indigenous reforestation activities to satisfy its demand for carbon units for carbon neutrality purposes for Dalton St operations, it would need to undertake a carbon project of approximately 70 ha if it were to plant in indigenous forest. If it planted a forest carbon project with an exotic hardwood nursery crop inter-planted with indigenous species, the project would need to be approximately 30 ha. These project scenarios would take into account a 20% annual credit buffer for self-insurance. It would take a few years for such a project to be developed, and for this reason HBRC could adopt a carbon neutrality strategy whereby it purchased carbon offsets from existing indigenous forest carbon projects (where available) until its own project became operational (e.g. purchase credits in years 1-5 and use its own units from year 5 onwards).



When a business entity undertakes its own carbon project for offsetting purposes, that business avoids having to buy carbon credits at the going carbon price, once the carbon project becomes operational (i.e. starts issuing credits). This eliminates exposure to future (potentially rising) carbon pricing under a long-term carbon neutrality strategy, where instead carbon credits are acquired at cost. Producing one's own carbon credits from your own project is called "carbon insetting".

A carbon insetting project would also enable HBRC to go further than carbon neutral and head into "carbon negative" territory at a relatively low cost.

7.10.1.6 A Carbon Negative Council

"Carbon negative" arises when an entity offsets more that it emits (i.e. where carbon removals inside the business boundary are greater than carbon emissions). The reason carbon negative has a significant impact is because it models the kind of low carbon economy required if global society is to peak in greenhouse gas emissions and then transition towards carbon negative growth (i.e. in order to stabilise global atmospheric CO₂ concentrations and avoid dangerous climate change).

HBRC has the opportunity to demonstrate global leadership if it were to offset 120% of its annual carbon footprint. It could deliver a carbon negative assertion through undertaking a larger carbon insetting project and perhaps be the first local government entity in the world to do so²⁴. If this carbon negative assertion involved sourcing carbon offsets from an HBRC carbon insetting project, it would need to develop a project at least 20% larger than for carbon neutrality, and accommodated expected growth in emissions until low carbon technologies become sufficiently available to drive HBRC fossil fuel emissions significantly downwards. Accordingly, carbon negative Dalton St operations would require a carbon project of approximately 100 ha if it was planted with indigenous-only species. The same project if planted in exotic hardwoods and inter-planted with indigenous forest would need to be approximately 60 ha (depending on HBRC emissions growth projections even with energy efficiency actions).

If HBRC were committed to being a carbon negative council without delay, it could adopt a carbon management strategy where it offsets 120% of its 2016 carbon footprint by purchasing and cancelling approximately 550 indigenous forest carbon credits. This would cost approximately \$10,000 annually and could be delivered as soon as the Dalton St carbon footprint measurement assertion was externally audited, 25 and offsets purchased (i.e. a matter of weeks following a decision to do so). 26

 $^{^{\}rm 24}$ Bhutan as a nation has asserted that it is a carbon negative country.

²⁵ \$3,000-\$5,000 and needing to be repeated periodically - e.g. 4-yearly.

²⁶ Note that this cost would reduce once HBRC implemented its own indigenous forest carbon project and acquired this volume of credits at the cost of production rather than the carbon price.



7.10.1.7 Carbon Management Roadmap

Carbon neutrality and/or carbon negativity can be implemented in stages, where a business entity ring-fences a particular business unit and makes that carbon neutral (e.g. Dalton St operations), and then progressively increases the scope of the activity to include more and more of the organisation (e.g. Guppy St, contractors, outsourced services). This can happen according to a carbon management roadmap to provide a sensible progression along a trajectory of positive change, with each step being relatively easy.

7.10.2 Carbon Neutral HB Public Service

As a council achieving success on the path to partial or full carbon neutrality (or carbon negative), HBRC would be in a strong position as a carbon management leader in the region, nationally, and internationally (particularly among the public service). To this end, HBRC could promote carbon neutrality to other public service entities within and beyond Hawke's Bay, and provide support and leadership to enable carbon neutral/negative programme development for other organisations (in other regions and/or countries). HBRC can thereby promote the model of local forest carbon offsetting/insetting projects with significant sustainable land management, biodiversity and water quality co-benefits. There may also be an opportunity to supply other public service entities with carbon credits from the Indigenous Forest Carbon Programme supply projects in Hawke's Bay (at least as an interim measure until those councils develop their own local projects and programmes), and thereafter collaborate with other councils to expand the IFCP to other regions.

HBRC can show how a market mechanism for carbon neutrality can deliver gains from trade on both the demand and supply side of the equation. Gains made on the demand side include getting to carbon neutrality or carbon negative at least cost (i.e. where one avoids emission reduction actions that have a high marginal cost well above the price of carbon or the cost of developing one's own carbon project). Supply side gains from trade include the sustainable land management and water quality benefits from new indigenous reforestation activities.

A staged carbon management plan or carbon neutrality plan for other councils could involve progressing carbon neutrality through organisational business units, with business unit 1 becoming carbon neutral in year 1, business units 1 and 2 carbon neutral in year 2, business units 1-3 carbon neutral in year 4 etc. This kind of staged carbon neutrality could focus early action on those business units or activities that are easy to measure and with high beneficial impact from offsetting, and then progressing towards business units or activities that are progressively more difficult (i.e. harvest the low hanging fruit first, and then progress to where the marginal cost is higher). For example, Council x could begin with carbon neutral activities that are the easiest to measure and where easy gains can be made. These include air travel, fleet, and electricity & gas. This would also likely encompass the majority of council emissions anyway, with remaining activities with relatively small CO₂ footprints (e.g. office waste, taxis, freight).



Public appetite for easy wins in emission reduction and carbon neutrality is likely to be relatively high, and early easy wins can generate a sense of hopeful and inspiring progress in an organisation (increasing staff morale), and an electorate (increasing morale in an entire community).

7.10.3 Carbon Neutral Private Sector

HBRC could also promote and support a programme for a carbon neutral private sector for Hawke's bay businesses, and follow the same procedure as defined for public sector agencies. This could involve a carbon neutrality programme for Hawke's Bay businesses offered by a partner entity. This carbon neutrality programme could source its carbon credits from a pool of local projects with particularly high co-benefits. This credit supply could be sourced from riparian revegetation indigenous forest carbon projects, and bundled with non-carbon biodiversity projects.

7.10.4 Low Carbon Households

The biggest bang for buck in individual and household carbon management is when the most carbon intensive and easiest-to-measure, and least-cost-to-reduce activities are targeted for carbon reduction and offsetting. For households and individuals, these activities are air travel, driving, electricity, and gas.²⁷ In contrast, CO₂ footprint measurement for less carbon intensive household activities (e.g. waste, freight/postage, public transport) is more onerous, the cost of emission reductions is much higher per unit effort, and the volume of emissions reduced and offset is relatively small.

Rather than describe this programme as a "carbon neutrality" programme, it could instead be described as a "low carbon" programme and then only target the carbon intensive and easy to measure activities mentioned above.

The value of a low carbon household programme is that it provides a sense of community buy-in to a common regional and local purpose. Furthermore, when the source of carbon credits for offsetting is local indigenous riparian reforestation projects, bundled with local biodiversity projects, the sense of common good is enhanced in what can become a vibrant community-building exercise. Voluntary participation in reforestation projects (e.g. planting days) will also be an option, which will also provide a stronger sense of community engagement.

²⁷ This is from our experience at Ekos, through our carbon neutrality service.



A positive, "feel-good" climate resilience programme of this kind can also serve to focus community attention on the positive aspects of local climate resilience actions and empowerment. This, along with a broader climate resilience programme aimed at reducing climate risk to Hawke's Bay farmers, can help pave the way towards a strong, inclusive community approach to the broader climate change issue in the region.

8.

APPENDICES





8 Appendices

8.1 APPENDIX 1 STOCK TAKE OF HBRC CLIMATE CHANGE ACTIONS

Climate change actions undertaken to date by Hawke's Bay Regional Council. Data supplied by HBRC staff.

8.1.1 Facilities Management

Project	Boiler Upgrade						
Scope	Mitigation	Start date	2013	End date	2013		
Purpose	Infrastructure renewal to more energy efficient option. Included installation of boiler plant and temperature monitoring technology.						
Relevance	High	Location	Dalton St				
Reporting	Electronic copy	Data	Complete				
Impact	Reducing emissions; low car	rbon economy					
Funding	HBRC funded						
Co-Benefits	Warmer building; reduced of	energy-related	operating cost	S			

Project	Air Conditioning Service Upgrade							
Scope	Mitigation	Start date	2013	End date	2013			
Purpose	Switched to a more efficient operating costs.	Switched to a more efficient service provider to increase energy efficiency and reduce operating costs.						
Relevance	High	Location	Dalton St					
Reporting	Electronic copy	Data	Complete					
Impact	Reducing emissions; low ca	arbon economy						
Funding	HBRC funded	HBRC funded						
Co-Benefits	Better indoor environment	t; Reduced energ	gy-related ope	rating costs				

Project	Energy Efficiency Installations							
Scope	Mitigation	Start date	2013	End date	2013			
Purpose		Installation of the following: LED light bulbs where practicable; energy efficient PC monitors; LED light bulbs for projectors						
Relevance	High	Location	Dalton St					
Reporting	Electronic copy	Data	Complete					
Impact	Reducing emissions; low ca	rbon economy						
Funding	HBRC funded							
Co-Benefits	Reduced energy-related op	erating costs; Le	adership in sı	ustainable ene	rgy.			



Project	Energy Consumption Monitoring						
Scope	Mitigation	Start date	2013	End date	On-going		
Purpose	Installation of energy monitoring system to track trends in energy consumption to enable better energy management.						
Relevance	High	Location	Dalton St				
Reporting	Electronic copy	Data	Complete				
Impact	Reducing emissions; low ca	rbon economy					
Funding	HBRC funded						
Co-Benefits	Reduced energy-related op	erating costs; Lea	ndership in su	ıstainable ene	ergy.		

Project	Sustainable Office Procurement						
Scope	Mitigation	Start date	2013	End date	On-going		
Purpose	Sourcing of low environmental footprint office products including cleaning products & services, stationery, furniture.						
Relevance	High	Location	Dalton St				
Reporting	Electronic copy available	Data	Complete				
Impact	Reducing emissions; low ca	rbon econom	У				
Funding	HBRC funded						
Co-Benefits	Leadership in corporate soc	Leadership in corporate social responsibility					

Project	Energy Efficient Fleet							
Scope	Mitigation	Start date	2015	End date	On-going			
Purpose	Demonstrating leadership in low carbon fleet procurement and management. Procurement policy of purchasing most energy efficient vehicles at normal time of renewal (including electric vehicle purchasing where practicable). Vehicle tyre management system to increase fuel efficiency. Installation of vehicle GPS system to monitor staff driving behaviour and encourage more efficient use of fleet.							
Relevance	High	Location	Dalton St					
Reporting	Electronic copy	Data	Complete					
Impact	Reducing emissions; low ca	rbon economy	/					
Funding	HBRC funded							
Co-Benefits	Leadership in low carbon fl	eet managem	ent					

Project	Dalton St Carbon Footprint Measurement						
Scope	Mitigation	Start date	2017	End date	2017		
Purpose	Measure CO2 emissions footprint for Dalton St operations to enable a) identification of low cost emission reduction options, and b) carbon neutral or carbon negative HBRC operations.						
Relevance	High	Location	Dalton St				
Reporting	Electronic copy available	Data	Complete				
Impact	Reducing emissions; low carbon	economy					
Funding	HBRC funded						
Co-Benefits	Demonstration activity for other	public services	s in HB region.				



8.1.2 Air Quality

Project	Air Emissions Inventories (AIEs)						
Scope	Mitigation	Start date	2017	End date	2017		
Purpose	AEIs are undertaken every 5 years and quantify anthropogenic emissions to air of CO2, as well PM10, CO, NOx, SO2 and VOCs. The sources considered are domestic heating, transport and industry.						
Relevance	Low	Location	Napier	Napier/Hastings airsheds			
Reporting	Electronic copy available	Data	Compl	ete			
Impact	Allows HBRC to track trends in en play a role in climate change. Inv		•	•	its that also		
Funding	HBRC funded						
Co-Benefits	Air quality improvements						

Project	Air quality monitoring and Heatsmart					
Scope	Mitigation	Start date	2017	End date	2017	
Purpose	Air quality monitoring measures trends in particulate concentrations and other air quality contaminants (CO, NOx, ozone, SO2); and Heatsmart aims to reduce particulate emissions for the purpose of improving air quality but in the process black carbon contributions to climate change.					
Relevance	Medium	Location	Napier/Hasti	ngs/Awatot	o airsheds	
Reporting	Electronic copy available	Data	Complete			
Impact	Decreases in emissions from do climate change.	mestic heating	g that directly	or indirectly	contribute to	
Funding	HBRC and home owners					
Co-Benefits	Improved air quality					

8.1.3 Transport

Project	Napier-Hastings Bus Service						
Scope	Mitigation	Start date	On-going	End date	On-going		
Purpose	Daily bus services between and around Napier, Hastings, Havelock Nth, Flaxmere, Taradale, Bay View.						
Relevance	Medium	Location	Napier & Hastings				
Reporting	Electronic copy available	Data	Data comple	te			
Impact	Reduced emissions – low o	arbon econom	/				
Funding	HBRC/User/Central Govern	nment					
Co-Benefits	Alleviating road congestion; improved access to employment, education, social and health services for HB residents						



Project	Electric Vehicles Promotion					
Scope	Mitigation	Start date	2017	End date	On-going	
Purpose	Collaborative project with other councils, DHB, & EIT to promote the uptake of electric vehicles in the region.					
Relevance	Medium	Location	Napier & Hastings			
Reporting	Electronic copy available	Data	Data comp	lete		
Impact	Reduced emissions – low carbo	on economy				
Funding	HBRC/Regional Partners	HBRC/Regional Partners				
Co-Benefits	Cost savings to businesses and	individuals tha	t adopt EV t	echnology		

Project	Cycle Trails						
Scope	Mitigation Start date 2017 End date On-going						
Purpose	Increase uptake of cycling for commuting and recreation.						
Relevance	Medium	Location	Napier & Hastings				
Reporting	Electronic copy available	Data	Data complete				
Impact	The Hawke's Bay Trails network covers 200km of cycling and walking off-road pathways the largest network of easy cycle paths in New Zealand.						
Funding	HBRC & central government						
Co-Benefits	Community well-being, hea	alth, fitness.					

Project	Smart Travel Website						
Scope	Mitigation	Start date	2017 End date On-going				
Purpose	Carpooling website that matches people seeking carpooling partners.						
Relevance	Medium	Location	Napier & Hastings				
Reporting	Electronic copy available	Data	Data complete				
Impact	Reduced emissions – low car	bon economy					
Funding	HBRC/Regional Partners						
Co-Benefits	_	Cost savings to individuals that carpool, transport network/parking demand benefits to road controlling authorities and councils					



8.1.4 Sustainable Farming

Project	Soil conservation pole planting programme							
Scope	Adaptation & mitigation	Start date	1988 End date On-going					
Purpose	This programme has been operating since 1947 and has involved the planting of an estimated 2.2 million poplar and willow poles over that time to stabilize an estimated 45,000ha of erodible land. While trees have relevance to climate change, the space planted nature of soil conservation pole planting means that they cannot be credited in the same way as a forest.							
Relevance	High	Location	Regional 4	15,000 ha				
Reporting	Electronic copy available	Data	Incomplet	:e				
Impact	Keeps soil carbon on the slope a resilience to extreme weather e	_	ving plant-b	oased carbon. P	rovides			
Funding	HBRC & farmers.							
Co-Benefits	Erosion control, water quality, potential stock fodder, animal welfare (shade). climate variability and storm events are likely to increase. Soil conservation measures will become more important as the soil erosion risk events increase.							

Project	Riparian planting programme							
Scope	Adaptation & mitigation	Start date	2015 End date On-going					
Purpose	Scheme providing native plants at cost price to landowners for riparian work. This has started at a small scale and is based on the Taranaki model. In the last two years' we (land management) has dealt with the ordering of riparian plants for most council activities beyond our own farmer scheme. Total number of plants here includes "Cape to City" and operations group planting. Total plants over 3 years are 175,000.							
Relevance	Medium	Location	Regional 125	ha ha				
Reporting	Data available but no report	Data	Complete					
Impact	Increasing resilience to drou	ight and flood e	vents.					
Funding	HBRC & SFF							
Co-Benefits	Stream habit improvements	and contribution	on to water qu	ality improver	nents.			

Project	Workshops and case studies factsheets for climate change resilience						
Scope	Adaptation	Start date	2008 End date 2010				
Purpose	Workshops, factsheets and case studies for climate change resilience on farms						
Relevance	High	Location	Catchment scale				
Reporting	Hard copy reporting available	Data	Complete				
Impact	Developing capacity for ac	laptation and re	silience				
Funding	HBRC & SFF						
Co-Benefits	Improvements in sustainable land management.						



Project	Huatokitoki catchment project "Creating a climate of success"						
Scope	Adaptation & mitigation	Start date	2009 End date 2011				
Purpose	Project to work with a catchment community in a summer dry, winter wet (extreme) part of HB to test if economic and environmental success and resilience can exist together.						
Relevance	High	Location	Catchment	scale			
Reporting	Hard copy reporting available	Data	Complete				
Impact	Developing capacity for ada	ptation and re	silience				
Funding	HBRC & SFF						
Co-Benefits	Improvements in sustainable	e land manage	ment.				

Project	Regional Landcare Scheme (RLS)							
Scope	Adaptation & mitigation	Start date	1988 End date On-going					
Purpose	This programme is able to provide partial funding up to 50% for soil conservation, wetland restoration, riparian work etc. This work relates to CC mitigation at a small scale.							
Relevance	Medium	Location	Regional					
Reporting	No reporting available	Data	Data avai	lable				
Impact	Carbon sequestration							
Funding	HBRC & farmers							
Co-Benefits	Erosion control, water quali	ty, biodiversity						

8.1.5 Research, Monitoring & Planning Tools

Project	State of the Environment Monitoring & Reporting, Climate Briefings						
Scope	Adaptation	Start date	On-going End date -				
Purpose	SoE monitoring of rainfall, temperature and soil moisture is continuous and reported monthly, annually and 5-yearly. Extreme events are identified. While many sites have a short record and it's therefore difficult to attribute trends, more can be done as records lengthen.						
Relevance	Low	Location	Napier/Hastin	gs airsheds			
Reporting	Electronic copy	Data	Complete				
Impact	Allows HBRC to track cl adaptation.	Allows HBRC to track climate trends, including extreme events, to help with future adaptation.					
Funding	HBRC funded						
Co-Benefits	Data for sustainable re	source managem	ent.				



Project	Climate Change RCP modelling using SimCLIM software						
Scope	Adaptation	Start date	On-going	End date	-		
Purpose	SimCLIM is a climate change model that downscales IPCC RCPs using statistical methods. HBRC has a software licence that is renewed annually. The model is used to assess potential changes in temperature, rainfall, moisture deficits (i.e. rainfall-PET), GDDs and return periods of extreme rainfall and temperature events on regional and catchment scales.						
Relevance	Medium	Location	Regional				
Reporting	Electronic copy	Data	Complete				
Impact	Provides HBRC with scenario	os of climate c	hange for ada	ptation planr	ning.		
Funding	HBRC						
Co-Benefits	An annual licence enables prompt and cost-effective delivery of each IPCC Assessment, especially compared to the length of time NIWA takes to downscale projections and its charges for obtaining region specific assessments. There is no specific report, instead it has been used to contribute to various reports (e.g. RWSS and Mohaka Reports, Council updates).						

Project	Climate change adap	Climate change adaptation and mitigation research projects						
Scope	Adaptation & mitigation	Start date	2007	End date	On-going			
Purpose	benefits and continue	We have invested in a number of applied research projects that have environmental benefits and continue to do so. They increase understanding of management to reduce losses to the environment.						
Relevance	Medium	Location	Regional					
Reporting	No reporting available	Data	Incomplete					
Impact	Activities and knowled farm has a relationship	•			se and loss on			
Funding	HBRC & other agencies							
Co-Benefits	Improvements in susta	inable land mar	nagement.					

Project	SFF East Coast Dryla	SFF East Coast Dryland Forages Project						
Scope	Adaptation	Start date	2012	End date	On-going			
Purpose	Research project looki	Research project looking at alternative forage species for dryland farming						
Relevance	Medium	Location	Regional					
Reporting	No reporting available	Data	No data available					
Impact	Carbon sequestration							
Funding	HBRC	HBRC						
Co-Benefits	Increased farm produc	tivity						



Project	Mitigating Economic Costs to Farmers Following Severe Rain Storm Events (GRAAS)					
Scope	Adaptation	Start date	2011	End date	2016	
Purpose	Research project looking at the impact of the 2011 Easter storm, and in particular the costs of the event on infrastructure and benefits of soil conservation works on reducing this cost.					
Relevance	Low	Location	Regional			
Reporting	Electronic copy available	Data	No data available			
Impact	Enhanced climate resilie	ence; emission re	emovals			
Funding	Multiple funders including HBRC					
Co-Benefits	Biodiversity, erosion co	ntrol, water qual	lity, water supply			

Project	SLMACC Applied A Decision-Making	daptation Pat	hways: Sup _l	porting Rob	ust Regional				
Scope	Adaptation	Start date	2011	End date	2016				
Purpose		SLMACC funded project using adaptive pathways methodology to understand key decision points required by HB primary sector to minimise the impact of climate change on industries							
Relevance	High	Location	Regional						
Reporting	No report yet	Data	No data avai	ilable					
Impact	Enhanced climate resili	ence; emission re	emovals						
Funding	Multiple funders includ	Multiple funders including HBRC							
Co-Benefits	Increased farm product	tivity.							

8.1.6 Reforestation

Project	Joint venture forestry projects								
Scope	Adaptation & mitigation	Start date	1988	End date	2009				
Purpose	There were a number of these projects carried out under the umbrella of the RLS. They were funded up to 50% by HBRC on erodible land. Council had a contracted interest in the forestry blocks, so that some level of control could be assured at harvest time. Details would take some time to assemble.								
Relevance	Medium	Location	Regional						
Reporting	No reporting available	Data	Incomplete						
Impact	Carbon sequestration; afforestation.	increasing resi	lience to extre	eme weather	events through				
Funding	HBRC & farmers								
Co-Benefits	Erosion control, water	quality							



Project	Afforestation Grant Scheme support							
Scope	Adaptation & mitigation	Start date	2010 End date On-going					
Purpose	Afforestation grant scheme has replaced joint venture forestry projects. We are able to provide help to applicants in the form of advice to help with AGS applications.							
Relevance	High	Location	Regional					
Reporting	No reporting available	Data	Data availa	able				
Impact	Carbon sequestration efforts	over 300ha						
Funding	HBRC & farmers							
Co-Benefits	Erosion control, water qualit of manuka planting	Erosion control, water quality, biodiversity in some cases, honey crop in the case of manuka planting						

Project	MPI SLM Hill Country Erosion Fund							
Scope	Adaptation	Start date	2011 End date 2016					
Purpose	In collaboration with MPI via their SLM funding - these projects (based at Whakaki and Whangawehi) are for on-ground works that minimise the loss of soil through soil erosion - and fund pole planting, riparian strips, fencing & catchment group work							
Relevance	Medium	Location	Northern H	В				
Reporting	Electronic copy available	Data	Data compl	ete				
Impact	Enhanced climate resilience	; emission rem	novals					
Funding	MPI/HBRC/landowners							
Co-Benefits	Increased farm productivity							

Project	Lake Tutira manuka plantings							
Scope	Adaptation & mitigation	Start date	2011 End date 2013					
Purpose	Trial reforestation with manuka.							
Relevance	High	Location	Lake Tutira catchment; 130ha					
Reporting	Electronic copy available	Data	Data compl	ete				
Impact	Enhanced climate resilience;	emission remo	vals					
Funding	HBRC funded as part of PGP	for High Perfor	mance Manu	ka Plantatior	ıs			
Co-Benefits	Biodiversity, erosion control,	water quality,	research, ho	ney revenue.				

Project	HBRC Investment forests (excluding manuka)							
Scope	Adaptation & mitigation	Start date	1991 End date 2014					
Purpose	Plantation forestry.							
Relevance	High	Location	470ha at v	arious locatio	ns			
Reporting	Electronic copy available	Data	Data com	olete				
Impact	Forests at Mahia, Tutira, Waihar resilience; emission removals	oua, Waipukura	ıu, Waipawa	a. Enhanced cl	imate			
Funding	HBRC funded investments							
Co-Benefits	Biodiversity, erosion control, wa	iter quality, res	earch.					



8.1.7 Biodiversity & Biosecurity

Project	Biosecurity pest programmes									
Scope	Adaptation Start date 1996 End date On-going									
Purpose	Wide range of biosecurity programmes across plant and animal pests, marine and horticultural biosecurity. Varies with programme. Roughly 70% of programmes spend would be large scale or regional, roughly 30% site based. Project is ongoing. Climate change is likely to cause changes in pest behaviour and risk. While risk scanning is important some of these pest-based risks will be difficult to foresee. In that context, the ability for regional programmes to be adaptable and flexible will be very important.									
Relevance	High	Location	Regio	nal						
Reporting	Electronic copy available	Data	Data	complete						
Impact	Enhanced climate resilience	e to climate ba	sed risks as	sociated with p	oests					
Funding	HBRC funded									
Co-Benefits	Biodiversity, erosion contro	ol, water qualit	y, cultural							

Project	Biodiversity Strategy							
Scope	Adaptation & Mitigation	Start date	On-going	End date	On-going			
Purpose	Re-vegetation & rehabilitation works							
Relevance	Medium Location Regional							
Reporting	Electronic copy available	Data	Data comp	lete				
Impact	Enhanced climate resilience of	of biodiversity	; carbon seq	uestration				
Funding	HBRC funded							
Co-Benefits	Biodiversity conservation							

Project	Parks and Reserves Management							
Scope	Adaptation & Mitigation	Start date	On-going	End date	On-going			
Purpose	Re-vegetation & rehabilitation works							
Relevance	Medium Location Regional							
Reporting	Electronic copy available	Data	Data complete	е				
Impact	Enhanced climate resilienc	e of biodiversi	ty; carbon sequ	estration				
Funding	HBRC funded							
Co-Benefits	Biodiversity conservation							



8.1.8 Flood and Coastal Protection

Project	Flood Control Schemes							
Scope	Adaptation	Start date On-going End date On-going						
Purpose	Maintenance and capital works to provide design capacity and Level of Service (LOS), including LOS review with climate resilience integrated into review protocols.							
Relevance	High	Location	Kopuawha	ra, Te Ngarue ra, Opoho, W Southern Haw	airoa,			
Reporting	Electronic copy available	Data	Data comp	lete				
Impact	Enhanced climate resilienc	e						
Funding	HBRC funded	HBRC funded						
Co-Benefits	Rural and urban economic	performance						

Project	Westshore Coastal Works							
Scope	Adaptation	Start date On-going			End date	On-going		
Purpose	Maintenance and capital works to provide design capacity and Level of Service (LOS) including LOS review with climate resilience integrated into review protocols.							
Relevance	High		Location	Westshore				
Reporting	Electronic copy available		Data	Data comple	te			
Impact	Enhanced climate resilience	e						
Funding	HBRC funded							
Co-Benefits	Urban economic performa	nce						

Project	Rivermouth Openings							
Scope	Adaptation	Start date	On-going	End date	On-going			
Purpose	Maintenance and capital works to provide design capacity and Level of Service (LOS) including LOS review with climate resilience integrated into review protocols.							
Relevance	High	Location	Regional					
Reporting	Electronic copy available	Data	Data comple	te				
Impact	Enhanced climate resilience							
Funding	HBRC funded							
Co-Benefits	Flood protection	Flood protection						

Project	Coastal Strategy Project					
Scope	Adaptation & Mitigation	Start date	On-going	End date	On-going	
Purpose	Coastal defence solutions					
Relevance	High Location Regional					
Reporting	Electronic copy available	Data	Data complete			
Impact	Enhanced climate resilience					
Funding	HBRC funded					
Co-Benefits	Coastal property protection					



8.1.9 Water Management

Project	Groundwater Quality Monitoring					
Scope	Adaptation	Start date	On-going	End date	On-going	
Purpose	Keep track of groundwater quality in relation to land use in the region					
Relevance	Medium	Location	Regional			
Reporting	Electronic copy available	Data	Data complete			
Impact	Enhanced ability to respond to climate change related changes in groundwater quality, especially in coastal and estuarine areas.					
Funding	HBRC					
Co-Benefits	Irrigation, biodiversity					

Project	Stream Flow Monitoring				
Scope	Adaptation	Start date	On-going	End date	On-going
Purpose	Data that can inform water allocation				
Relevance	High	Location	Regional		
Reporting	Electronic copy available	Data	Data complete		
Impact	Enhanced ability to respond to climate change related changes in stream flows, especially in drought conditions.				
Funding	HBRC				
Co-Benefits	Agricultural sustainability, biodiversity conservation.				

Project	Water Management						
Scope	Adaptation	Start date	On-going	End date	On-going		
Purpose	Allocation of water resource in a sustainable manner						
Relevance	High	Location	Regional				
Reporting	Electronic copy available	Data	Data complete				
Impact	Management of regional water availability under a changing climate.						
Funding	HBRC						
Co-Benefits	Agricultural sustainability, biodiversity conservation.						

Project	Water Metering					
Scope	Adaptation	Start date	On-going	End date	On-going	
Purpose	Allocation of water resource in a sustainable manner					
Relevance	High	Location	Regional			
Reporting	Electronic copy available	Data	Data complete			
Impact	Management of regional water availability under a changing climate.					
Funding	HBRC					
Co-Benefits	Agricultural sustainability, biodiversity conservation.					

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