

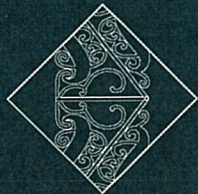


(Treasury, 2023a: 86)

# Ngā Kōrero Āhuarangi Me Te Ōhanga

## Climate Economic and Fiscal Assessment 2023

We have used the tukutuku designs from within Ngā Mokopuna ā Tāne in Te Tai Ōhanga, to visually reflect the way the report integrates and impacts people.



**PĀREKEREKE**

depicts intergenerational prosperity



**KAOKAO**

talks to noble behaviour and the protection of people and assets

ISBN: 978-1-99-004592-9 (Online)

© Crown Copyright



This work is licensed under the Creative Commons Attribution 4.0 International licence. In essence, you are free to copy, distribute and adapt the work, as long as you attribute the work to the Crown and abide by the other licence terms.

To view a copy of this licence, visit: <https://creativecommons.org/licenses/by/4.0/>

Please note that no departmental or governmental emblem, logo or Coat of Arms may be used in any way which infringes any provision of the Flags, Emblems, and Names Protection Act 1981. Attribution to the Crown should be in written form and not by reproduction of any such emblem, logo or Coat of Arms.

The URL for this publication on the Treasury website at April 2023 is:

<https://www.treasury.govt.nz/publications/climate-economic-fiscal-assessment/nga-korero-ahuarangi-me-te-ohanga-2023>

Cover Photo Credit: © Fraser Tebbutt (Truestock)

# CONTENTS

<b>Foreword</b>	<b>2</b>
<b>Executive summary</b>	<b>6</b>
1 Introduction	14
2 Framework for assessing climate-related economic and fiscal impacts	20
3 Sources of climate-related economic and fiscal impacts	24
4 Economic impacts from physical climate change	36
5 Economic impacts from the low-emissions transition	50
6 Fiscal impacts	64
7 New Zealand's first Nationally Determined Contribution – scenario analysis of fiscal risk from offshore mitigation	80
<b>References</b>	<b>89</b>
<b>Glossary</b>	<b>95</b>

# FOREWORD

Climate change is here. The scientific evidence is incontrovertible. Temperatures are increasing, rainfall patterns are changing and sea levels are rising.

Over the past century, New Zealand's average annual temperature has increased by 1.1°C, with 2022 being the warmest year on record. Most southern and western areas of the country are becoming wetter and most northern areas drier. The sea level around New Zealand is 20 centimetres (cm) higher on average than a century ago, and the rate of sea-level rise is accelerating.

At the time of writing, New Zealanders are dealing with the devastating impacts of the flooding in the upper North Island and the effects of Cyclone Gabrielle. While the costs of those impacts are not included in this Assessment, these recent events reinforce the breadth and scale with which climate change can impact New Zealand.

The Intergovernmental Panel on Climate Change projects that by 2040 mean temperatures in New Zealand will be 0.7°C to 1.0°C higher than they were between 1986 and 2005 and the intensity of extreme rainfall events could increase by 5% to 7%. By 2050, sea-levels are projected to rise by 23cm to 28cm.

These changes will impact the economy, as well as the physical environment. This report brings together the available information on the future economic and fiscal implications of climate change for New Zealand.

The purpose of doing so is to help decision-makers in both the public and private sectors identify and manage the risks and opportunities of physical climate change and New Zealand's transition to a low-emissions and climate-resilient future.

This report has been jointly produced by the Treasury and the Ministry for the Environment. It is informed by the Living Standards Framework and He Ara Waiora. It is also informed by international perspectives, including work by the United Kingdom Government and the Task Force on Climate-related Financial Disclosures. The report therefore reflects what we observe in our current economic landscape and what we might see in the future given domestic and international signals on climate action.

The report is clear there will be large economic and fiscal costs. The choices governments, businesses and households make today will influence how prepared we are to manage the impact of climate change and transition to a low-emissions future.

The cost of climate change will inevitably be influenced by factors outside our control. For example, our future exposure to physical climate impacts is highly dependent on actions in other countries. The scale, nature and complexity of these costs highlight the need to be flexible and manage our public finances prudently.

New Zealand is in a strong position to face the challenges posed by climate change. In 2020, the Notre Dame Global Adaptation Initiative ranked New Zealand ninth globally in its readiness to improve its resilience. The economy and public finance system have shown remarkable resilience to previous shocks and crises. Available evidence suggests that our strong institutions and high levels of social cohesion are strengths, as noted in Treasury's recent Wellbeing Report, *Te Tai Waiora*.



Importantly, this report highlights concerns about the impacts of climate change on wellbeing in New Zealand. Physical climate change and the transition to lower emissions will put pressure on individuals and communities, institutions and governance. While we are still only beginning to understand the possible wellbeing impacts of climate change, they are likely to be large, wide-ranging and unevenly felt. We intend to update this report in the

future to reflect the latest research and evidence on climate impacts for New Zealand.

We invite readers to reflect on the evidence and analysis presented in this report, including the critical gaps, to think about New Zealand's readiness to face future climate change impacts, and to consider these in the choices we make that will influence our collective future wellbeing.



A handwritten signature in black ink, appearing to read 'Caralee'.

**Caralee McLiesh**  
*Te Tumu Whakarae Mō Te Tai Ōhanga*  
*Secretary to the Treasury*



A handwritten signature in black ink, appearing to read 'James'.

**James Palmer**  
*Manatū Mō Te Taiao*  
*Secretary for the Environment*

# KŌRERO WHAKATAKI

Kua huri te āhuarangi. Tē taea te whakahē i te taunaki pūtaiao.  
E piki ana ngā pāmahana, e huri ana ngā tauira ua, kei te piki te pae moana.

I roto i te rau tau kua pahure, kua piki te pāmahana ā-tau toharite o Aotearoa, tōna 1.1°C, ā, ko te tau 2022 te tau mahana rawa atu kua tāngia ki ngā mauhanga. Ko te nuinga o ngā rohe kei te tonga me te uru o te whenua e haumākū haere ana, ā, ko te nuinga o ngā rohe kei te raki e pakapaka haere ana. Tōna 20 mitarau (cm) te piki toharite o te pae moana mai i te kotahi rau tau i muri, ā, kei te horo haere te pikinga o te pae moana.

I te wā o te tuhinga, e urupare ana ngā tāngata o Aotearoa ki ngā pānga whakangaro o ngā waipuke i te Tai Tokerau, me ngā pānga o te Huripari Gabrielle. Ahakoa kāore e whai wāhi atu ana ngā utu o aua pānga i roto i tēnei Aromatawai, nā ngā raru o inā tata nei i miramira te whānui me te taumaha o te pānga o te hurihanga āhuarangi ki Aotearoa.

Ki tā te Intergovernmental Panel on Climate Change matapae, i mua i te tau 2040, ka piki ake ngā pāmahana toharite o Aotearoa mā te 0.7°C ki te 1.0°C i ō ngā tau i waenga i 1986 ki 2005, ā, ka piki te karawhiu o ngā ua taikaha mā te 5% ki te 7%. Kua matapaetia, i mua i te tau 2050 ka piki te pae moana mā te 23cm ki te 28cm.

Ka pā ēnei panoni ki te ōhanga, tae ana ki te taiao ōkiko hoki. Ka kōhi tēnei pūrongo i ngā pūrongo ka taea te kōhi mō ngā hiraunga ōhanga, ngā hiraunga mō te moni tūmatanui hoki o te hurihanga āhuarangi ki Aotearoa.

Ko te whāinga o tēnei mahi, ko te āwhina i ngā kaiwhakatau whakaaro kei te rāngai tūmatanui me te rāngai tūmataiti ki te tautohu, ki te whakahaere hoki i ngā tūraru me ngā mea angitu o te hurihanga āhuarangi ōkiko, o te whakawhitinga o Aotearoa ki tētahi āpōpō tukuwaro-iti, whakapūioio ki te āhuarangi hoki.

Kua whakaputaina tēnei pūrongo i te mahi tahi a Te Tai Ōhanga me te Manatū Mō Te Taiao. Kua whai mōhiotio i Te Anga Paerewa Oranga, i He Ara Waiora hoki.

Kua whai mārama anō hoki i ngā tirohanga o tāwāhi,

tae ana ki ngā mahi o te Kāwanatanga o te United Kingdom me tō rātou Task Force on Climate-related Financial Disclosures.

Nā reira, ka whakaata te pūrongo i ō mātou kitenga i ngā āhuratanga ōhanga o nāianei, me ngā kitenga pea o āpōpō e ai ki ngā tohu o te kāinga, o tāwahi hoki mō ngā tū āhuarangi.

He mārama te pūrongo, ka nui ngā utu ōhanga, ngā utu moni tūmatanui hoki.

Ka whakaaweawe ngā whiringa o ngā kāwanatanga, ngā hinonga, me ngā kāinga i te kaha o tō tātou rite ki te whakahaere i ngā pānga o te hurihanga āhuarangi me te whitinga ki tētahi āpōpō tukuwaro-iti.

Kāore e kore ka whakaaweawetia te utu o te hurihanga āhuarangi e ngā āhuratanga tē taea e mātou te whakahaere. Hei tauira, ko ngā pānga mai o te āhuarangi ōkiko hei ngā tau kei te heke mai he mea ka kaha whakaaweawetia e ngā mahi i whenua kē. Nā te nui, ngā tūmomo me te matatini hoki o ngā utu, ka miramira te matea kia pīngohengohe, kia āta whakahaeretia hoki e tātou ngā ahumoni tūmatanui.

Kua kaha te tū a Aotearoa ki te papare i ngā wero o te hurihanga o te āhuarangi. I te tau 2020, nā te Notre Dame Global Adaptation Initiative i whakarārangi a Aotearoa hei tuaiwa i te ao mō te rite ki te whakakaha i tōna manawaroa. Kua kitea te manawaroa whakaharahara o te taiōhanga me te pūnaha ahumoni tūmatanui i ngā mōrearea me ngā whētuki o mua. I roto i ngā taunaki ka taea, e kitea ana he pūmanawa nui ō tātou tōpūtanga me te kotahitanga i te pāpori kua kōrerohia i te Wellbeing Report nō nā tata nei, arā, *Te Tai Waiora*.

Ko te mea nui, ka miramira tēnei pūrongo i ngā māharahara mō ngā pānga o te hurihanga o te āhuarangi ki Aotearoa. Ka pēhia ngā tāngata takitahi, ngā hapori, ngā tōpūtanga me te mana whakahaere e te hurihanga āhuarangi ōkiko me te whitinga ki te tukuwaro-iti. Ahakoa e tīmata noa ana tātou ki te whai mārama ki ngā pānga toiora o te hurihanga āhuarangi, ko te āhua nei ka nunui, ka whānui hoki, ā, kā pāhikahika te pānga ki tēnā, ki tēnā.



**Caralee McLiesh**  
*Te Tumu Whakarae Mō Te Tai Ōhanga*  
*Secretary to the Treasury*

E hiahia ana mātou ki te whakahou i tēnei pūrongo ā tōna wā, hei whakaatu i ngā rangahau me ngā taunaki hou rawa mō ngā pānga āhuarangi ki Aotearoa.

Ko tō mātou whakahau ki ngā kaipānui, kia āta whaiwhakaaro ki ngā taunaki me te tātari i roto i tēnei pūrongo, tae ana ki ngā āputa arohaehae, kia whakaaro ki te rite o Aotearoa ki te papare i ngā pānga o te hurihanga āhuarangi kei te haere mai, me te whaiwhakaaro ki ēnei i roto i ō tātou kōwhiri e whakaaweawetia ai te oranga tonutanga o tātou katoa ā muri ake nei.



**James Palmer**  
*Manatū Mō Te Taiao*  
*Secretary for the Environment*

# EXECUTIVE SUMMARY

Climate change is accelerating, and its effects are being felt more and more by New Zealanders. We are experiencing more severe and frequent droughts, floods and storms, higher temperatures and rising sea levels.

Large impacts from future warming are already locked in, driven by historic global emissions. The future trajectory of global emissions will affect how much more temperatures rise beyond this level. Assuming policies are unchanged globally, studies have shown that mean temperatures in New Zealand in 2090 could be as much as 4.6°C higher than pre-2005 levels. An increase of this size could cause catastrophic damage to our economy and society. It is therefore important for New Zealand to consider how to adapt to already unavoidable global temperature rises, alongside how to contribute to efforts to constrain future temperatures within acceptable ranges.

Government, businesses, communities and households are already taking action to respond to and prepare for climate change and its impacts. New Zealand has committed to a 50% reduction of net emissions below our gross 2005 levels by 2030. This represents the country's contribution to the global effort under the Paris Agreement to limit the mean temperature rise to 1.5°C above pre-industrial levels.

## **This report brings together what we know about the economic and fiscal impacts of climate change on New Zealand**

Both climate change itself, and how New Zealand responds to the risks and opportunities it presents will have material economic and fiscal implications. Ngā Kōrero Āhuarangi me te Ōhanga – the Climate Economic and Fiscal Assessment (CEFA) – brings together available information on these implications in one document to better inform decisions by government, businesses, communities and households. It adds to a growing body of reporting on climate-related impacts, risks and opportunities.

The CEFA also identifies areas where future work would be valuable to both deepen and broaden our understanding of the fiscal and economic impacts of climate change, including to fill gaps in our current knowledge.

While there are things we know for certain, there are things that remain uncertain. This is driven by dependence on policy and strategic decisions yet to be made and factors that New Zealand has limited control over. These include future global emissions, the resilience of the natural environment, and the pace at which mitigation technologies develop.

Tables 1 and 2 summarise both the expected impacts of climate change set out in this report and key sources of variability.



## The economic and fiscal impacts of climate change are expected to be large, wide-ranging and unevenly felt

It is clear that the size and breadth of the economic and fiscal costs of climate change to New Zealand will be large. The physical impact of climate change and the choices the country makes to transition to a low-emissions future will affect every aspect of the economy and society for generations. These impacts

will have flow-on implications for the Crown's fiscal position.

Climate change represents both economic risks and opportunities for different sectors and population groups.



### Physical climate impacts

- › Agriculture, forestry, fisheries and tourism are particularly exposed given their direct dependence on climate-sensitive natural resources. The transport and energy sector are also exposed due to their reliance on extensive physical networks.
- › Some aspects of climate change may benefit some sectors (for example warmer temperatures and increased CO<sub>2</sub> concentration could increase primary sector productivity). Due to New Zealand's relatively high latitude, its primary agriculture may be less affected than in other countries, which could create demand for this country's products.
- › Regions with high populations located in low-lying coastal areas (such as Northland and Tairāwhiti) or those dominated by vulnerable sectors (such as Waikato and the West Coast) will also be more affected.
- › Households in areas with high natural hazard risk are likely to find it harder to get affordable insurance.



### Impact of transitioning to a low-emissions economy

- › Sectors with comparatively high abatement costs and/or limited options to make deep emissions reductions are likely to face potentially large disruption. Those that are less emissions-intensive or have more economic options to reduce emissions may grow.
- › Regions such as Southland, Tairāwhiti, Taranaki and the West Coast, whose economies are reliant on emissions-intensive industries (such as agriculture, heavy manufacturing, food manufacturing, and extraction and distribution), will be more affected.
- › Impacts on consumer prices (such as fuel and food) are over time likely to disproportionately affect lower-income households.
- › Over time investments in low-emissions technologies could lead to cost savings, for example electric vehicles (EVs) having lower operating costs. Other potential co-benefits from the transition to a low-emissions future (such as improved public health, environmental outcomes and reduced household bills from resource efficiency) could be substantial.

## Some sectors will be particularly exposed to both physical climate change and the transition to a low-emissions future

Agriculture, forestry, fisheries, tourism, and energy and transport networks will be particularly exposed to the physical impact of climate change. For land-based primary industries, this is true for both emissions-intensive land-use activities (such as livestock farming) and other activities with smaller emissions profiles (such as forestry).

Since emissions from agriculture currently account for almost half of New Zealand's total gross emissions, emissions reduction policies are expected to have material implications for land-use change. Historically, New Zealand has undergone significant land-use change. However, recent modelling suggests that climate change could cause the pace of future change to exceed historic trends, toward lower-emissions land uses (such as forestry).

The energy and transport sectors are also expected to be greatly impacted. On the physical side, critical energy infrastructure is exposed to increased flooding, wind damage, droughts and changes in rainfall patterns. A rise in flooding is also expected to affect low-lying airports, and coastal railways and roads. Energy is the second largest source of gross emissions in New Zealand, especially transport energy. Decarbonising the economy is likely to require more electrification, alongside greater levels of renewable electricity generation. While efforts to decarbonise will incur costs, they are also expected to present opportunities for potentially significant co-benefits (such as improved air quality).

## The economic impacts on Māori from climate change could be material

Māori are especially vulnerable to impacts from the transition to a low-emissions economy and the physical risks of climate change. Māori are over-represented among low-income households and account for around 23% of the workforce in emissions-intensive industries (compared to being 17% of the national population).

However, a number of businesses in the Māori economy are likely to be well placed to leverage economic opportunities from the transition (for example, expanding businesses that are already low-emitting, such as in forestry and low-emissions horticulture).

## At a macro level, the combined effect of climate change and the transition to a low-emissions future is expected to be negative

Treasury modelling from 2021 suggests that the New Zealand economy is relatively resilient to more frequent droughts or storms. The average of the modelled simulations showed that at the end of a 40-year projection period, higher frequency of droughts could reduce gross domestic product (GDP) by 0.5%, and a scenario with increased storms and floods could decrease GDP by about 0.7%. For context, the New Zealand Institute of Economic Research (NZIER) estimated that the drought associated with the 1997 to 1998 El Niño event resulted in a loss of GDP of 0.9%.

However, the physical impacts of climate change are expected to be greater than droughts or storms alone. In addition to other physical impacts that will occur here, New Zealand is exposed to climate impacts

abroad, affecting trade, migration and financial flows, and global economic activity.

As New Zealand takes action to meet its emissions targets, modelling indicates that the economy will continue to grow, but at a slower rate. The Climate Change Commission (CCC) has estimated that achieving New Zealand's domestic targets would result in GDP in 2050 being 1.2% lower than would otherwise be the case. This impact sits within the range of estimates from other studies that were carried out before New Zealand's domestic targets were set.

While some new sectors are likely to be created (bringing economic and wellbeing benefits), some existing sectors are anticipated to shrink and, in some cases, disappear altogether, causing disruption for affected communities.

## The overall cost of climate change will be influenced by how flexible and adaptable both the economy and decision-makers are

Effectively tackling the challenges presented by climate change and the transition to a low-emissions future, and making steady and timely progress toward New Zealand's climate-related objectives, will require actions and decisions over an extended period.

Effectively mitigating and adapting to climate change will require adaptability and flexibility on the part of both decision-makers and the economy as a whole. The greater the ability of the economy and decision-

makers to recognise and act on opportunities to reduce net emissions or adapt to the physical impacts of climate change in a timely way, the more efficient the overall climate response, with benefits for aggregate economic growth and broader wellbeing. For example, the more effectively the economy reallocates resources and adopts productivity-enhancing technologies and practices, the more resilient New Zealand's economy is likely to be, and the smaller the impact on GDP.

## The economic and fiscal costs of physical climate impacts are expected to grow over time

The costs from the increased severity and frequency of natural hazards due to climate change are likely to increase over time, expanding New Zealand's already significant natural hazard risk profile. Modelling shows that sea-level rise of 30 centimetres (cm) – expected to occur between 2045 and 2070 – could expose an additional \$6 billion worth of buildings to at least a 1% chance of flooding in a given year, beyond the \$12.5 billion exposed at the present sea level.

Other modelling shows that around 10,000 houses could become uninsurable by 2050 because of coastal flooding hazards from sea-level rise.

While such risks are anticipated to bring additional cost, government, businesses, communities and households face adaptation choices that have the potential to mitigate long-term costs.

Strengthening our understanding of these impacts and their economic and financial implications is an important area of further work.

## Meeting New Zealand's first NDC represents a large fiscal cost, and depends on domestic and international factors

New Zealand's Nationally Determined Contributions (NDCs) represent its commitments to contribute to global efforts to limit warming to within 1.5°C. To meet the first NDC (NDC1), New Zealand's domestic net emissions over 2021 to 2030 less mitigation New Zealand supports overseas must not exceed 571 megatonnes of carbon dioxide equivalent (Mt CO<sub>2</sub>e). Based on New Zealand's domestic emissions budgets over the same period, supporting offshore mitigation will be required to meet NDC1.

This report explores a number of scenarios for the cost of offshore mitigation purchases required to meet NDC1 (in addition to domestic action). These costs represent a significant fiscal risk under all scenarios considered.

The size of the cost of offshore mitigation will depend on whether New Zealand under-, exactly or over-achieves its domestic emissions budgets, but more critically on what price New Zealand pays for these international reductions. The future price of international reductions is unknown, reflecting that many markets are at early stages or yet to be developed.

## New Zealand's economy and public finances have shown resilience in the past, but climate change will test this

New Zealand has shown flexibility and resilience in response to past shocks. Its fiscal and economic resilience, and the strength of its institutions, mean that it may better absorb and respond to climate impacts than many other countries.

However, climate change is an unprecedented challenge. How future changes arising from climate change will compare with prior experience and the economy and society's capacity to adjust is difficult to predict and will depend on the choices of Government, private sector, and broader society. Early modelling suggests New Zealand may be fiscally resilient to an increase in the severity and frequency of certain extreme weather events.

The combination of physical impacts and the low-emissions transition will create cost pressures for the Crown and is likely to negatively affect its revenue bases.

- › Due to increased storms and droughts, Treasury modelling shows that net core Crown debt could be higher by 3.77% of GDP in 2061.
- › NZIER estimates that climate change could cause an increase in the annual growth of the Crown liability for natural hazards from 5.3% to 5.5%-5.7% through to 2050.
- › Calculations based on CCC modelling illustrate the fiscal cost of direct support for additional investment in a range of key mitigation technologies through to 2050 could be around \$4 to \$12 billion, assuming the Crown contributes 10% to 30% of investment costs. The degree to which the Crown directly funds or supports such investments depends a lot on how present and future governments choose to balance spending and non-spending levers.

Climate change presents a unique challenge to the Crown due to the combination of discrete, slowly developing risks, alongside other acute and fast-moving risks. The nature and scale of climate adaptation and the transition to a low-emissions future is likely to have implications for the assets and liabilities the Crown holds on its balance sheet, and how it manages these.

The balance sheet is a tool, alongside policy and regulations, to enable timely investment while smoothing the risks and costs of the transition.

Alongside climate change, New Zealand will also face other long-run fiscal pressures (such as health and superannuation) in the future. Making informed fiscal choices will be an important part of helping to mitigate long-term economic and fiscal costs.

Areas where governments may choose to increase climate spending are diverse (for example research, science and innovation, transport, infrastructure, foreign aid and investment, civil defence and conservation). Choices made by present and future governments about both spending priorities and the balance of fiscal and non-fiscal levers they use will affect future fiscal impact.

For example, current and future governments face choices between the level of investment in domestic action (potentially with broader social, cultural and economic benefits) and investment in offshore mitigation that can be counted towards our NDC1 (potentially at a lower cost).

Options to make greater use of fiscal levers include:

- › direct funding to achieve New Zealand's domestic climate transition
- › offshore mitigation that can be counted towards NDC1
- › emergency preparedness and response and recovery
- › direct funding for economy-wide adaptation measures
- › direct support and compensation for disrupted households, businesses and communities.

Within these options, current and future Governments will also face choices regarding how they balance the focus of fiscal levers between them. For example, between domestic and international investment to achieve New Zealand's international commitments under the Paris Agreement.

## The recently established Climate Emergency Response Fund leverages cash proceeds from NZ ETS auctions to fund the Government's climate response

The Climate Emergency Response Fund (CERF) was set up for Budget 2022 with initial funding equal to the forecast cash proceeds from the NZ Emissions Trading Scheme (NZ ETS) auctions. Illustrative modelling in this report indicates that, depending on future auction prices, the cash proceeds from NZ ETS auctions over the period 2023 to 2026 could range from \$2.4 billion to \$6.2 billion.

As a core lever to reduce domestic emissions, the NZ ETS is a fundamental element of New Zealand's transition. It is also a source of Crown revenue and the issuance of units yet to be surrendered represents a

liability on the Crown's balance sheet. The broader fiscal impact of the NZ ETS is explained more in Section 6. The overall impact depends on factors, such as:

- › supply and demand interactions in the market, including expectations of future prices
- › signals provided through regulated auction price control and volume settings
- › the general cost relativities of low-emissions investments and activities in the market.

## The choices made by governments, businesses and households, domestically and internationally, will have implications for how these impacts play out

Most global climate change is driven by emissions outside of New Zealand. The choices and investments of international businesses and governments will therefore greatly affect the climate change this country ultimately faces and the resulting economic and fiscal impacts.

While the broader international context will also affect New Zealand's transition-related impacts, the choices and actions of government, businesses and households in this country will have relatively more influence on the size of impacts and how they are distributed across the economy and society.

Key areas of policy choice include:

- › The mix and timing of policies to build resilience to climate change and how the responsibilities and costs of natural hazard risk management are shared across individuals, the private sector, local authorities and central government.

- › The mix and timing of policies to drive domestic emissions reductions, including the balance of effort toward net and gross emissions (in particular choices around land-use change and the role of sequestration in achieving New Zealand's targets), and the mix of spending and non-spending levers used.
- › The balance of domestic and offshore mitigation toward New Zealand's NDCs.
- › What sources of offshore mitigation New Zealand pursues and when, affecting the options available, and the cost and the achievement of NDC1.
- › The ambition of future emissions reduction targets, including domestic budgets and future NDCs.
- › To what degree and how governments choose to address the equity impacts of climate change.

## Next steps

We intend to update this report over time to present the best available information for the economic and fiscal impacts of climate change on New Zealand. Areas where future research would be valuable include.

- › Building a more robust view of the long-term macroeconomic implications of physical risks from climate change for New Zealand's economy.
- › Updated modelling on the wider macroeconomic impacts of climate change (such as on New Zealand's trade balance) and building better understanding of the potential macroeconomic implications from investment in domestic action (such as innovation and growth benefits).
- › How the impacts of physical climate and the low-emissions transition could interact and compound, particularly at a sectoral level.
- › Improving understanding of the unique implications of climate change for Māori and exploring how different impact channels could interact.
- › Building a better understanding of risks to the Crown's balance sheet from assets exposed to climate change risks.
- › Better understanding the potential non-emissions implications from investments in domestic action (including any innovation or growth benefits).

## 7.3 Analysis

Table 7.4 provides estimates of the total fiscal cost of purchasing offshore mitigation to achieve New Zealand's NDC1 under each of the nine considered scenarios, based on different combinations of the three volume and three price scenarios. Figure 7.2 presents the same information, in chart form.

Estimates from our analysis vary substantially, with costs ranging from \$3.3 billion to \$23.7 billion. Variation across the price scenarios is a key driver of this range.

These costs range from 3.9% to 28% of the new operating expenditure that will be made available

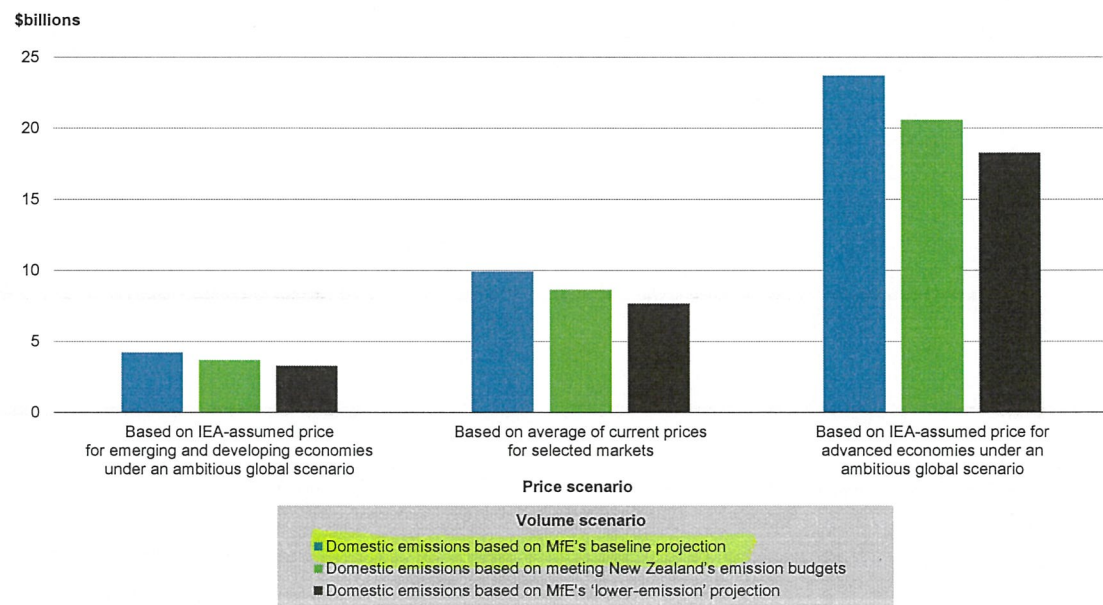
through Budgets 2024 to 2030 from 2024/25 to 2030/31.<sup>151</sup> However, the source of funding for these costs is subject to future policy decisions; comparison to the operating allowances is used here to provide a sense of scale.

Technical Appendix 2 tests the sensitivity of estimated costs under each scenario to changes in assumptions for other variables in our analysis (beyond the price and volume of offshore mitigation purchases), such as the discount rate used and the assumptions underlying our construction of purchase price time series.<sup>152</sup>

**Table 7.4:** Estimated fiscal costs of anticipated offshore mitigation purchases required to achieve NDC1 (\$NZD, 2022 dollars)

		Price Scenarios		
		Based on IEA-assumed price for emerging and developing economies under an ambitious global scenario	Based on the average of current prices for selected markets	Based on IEA-assumed price for advanced economies under an ambitious global scenario
Volume scenarios	Based on MfE's baseline projection for domestic emissions	\$4.2 billion	\$9.9 billion	\$23.7 billion
	Based on domestic emissions meet New Zealand's domestic emissions budgets	\$3.7 billion	\$8.6 billion	\$20.6 billion
	Based on MfE's 'lower-emission' projection under current policies	\$3.3 billion	\$7.7 billion	\$18.3 billion

**Figure 7.2:** Estimated fiscal costs of anticipated offshore mitigation purchases required to achieve NDC1 (\$NZD, 2022 dollars)



<sup>151</sup> Indicative Budget allowances over the period from 2024 to 2030 are \$3 billion per annum over the forecast period. The allowances then grow by 2% each Budget in the projection period (from Budget 2027 to Budget 2030).

<sup>152</sup> The discount rate used for the analysis is based on Treasury's risk-free discount rate, adjusted for inflation (using Treasury's projected Consumer Price Index). The assumptions underlying our construction of purchase price time series are based on the rate of change in international carbon prices modelled by the High-Level Commission on Carbon Prices (2017).