

ADDENDUM

Note: This RIS contains an addendum to the Targets section on page 33.

Coversheet: Zero Carbon Bill

Advising agencies	Ministry for the Environment
Decision sought	Final policy decisions to introduce the Zero Carbon Bill
Proposing Ministers	Minister for Climate Change

Section A: Addressing the challenges of climate change

Global climate change impacts are increasing, which undermines the overall efforts of the system to safeguard New Zealand's economic, cultural, social and environmental prosperity.

Two-fold decisive action on climate change is required:

- mitigation measures are critical to implement New Zealand's domestic transition to a low-emissions future, in line with the direction of the global economy
- adaptation measures are essential to plan for and build New Zealand's resilience to ongoing climate change impacts.

New Zealand already has a legal and policy framework in place to address climate change, including the Climate Change Response Act (CCRA) 2002, which established the national greenhouse gas inventory and the New Zealand Emissions Trading Scheme (NZ ETS). A 2050 emissions reduction target was also notified by New Zealand Gazette in 2011.¹

Despite this, New Zealand's greenhouse gas (GHG) emissions have increased substantially on 1990 levels. The existing framework has fallen short of providing a stable and credible policy environment to enable necessary long-term planning, decision-making and investment by the private sector and civil society. Furthermore, with the signing and entry-into-force of the Paris Agreement, the global context has changed significantly. The world has committed to keep average global temperature rise well below 2 degrees Celsius (aiming for 1.5 degrees) and to achieve overall GHG neutrality – balancing global emissions and removals – by the second half of the century.

The Intergovernmental Panel on Climate Change's (IPCC) *Special Report on Global Warming of 1.5°C* notes anthropogenic global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. This scenario poses climate-related risks to natural and human systems – including sea-level rise, ocean acidification, biodiversity loss and species extinction, extreme heat and increased probability of drought

¹ To reduce greenhouse gas emissions below 50 percent of 1990 levels by 2050.

and precipitation – but lower relative to a 2°C scenario. The Special Report highlights that pathways limiting global warming to 1.5°C (with limited or no overshoot) would require rapid and far-reaching transitions in energy, land, urban and infrastructure, including transport and buildings, and industrial systems.²

Without clearly signalled goals, and an enduring framework to drive and manage concerted domestic action, there will be little incentive for the New Zealand economy to make these required transitions. The current 2050 target does not provide long-term regulatory certainty or require successive governments to commit resources to achieving it. It also does not provide an enduring pathway to overall GHG neutrality beyond 2050. This compromises New Zealand's ability to continue delivering prosperity in an emissions-constrained future.

At the same time, the potential risks and costs of damage caused by a changing climate are increasing significantly and could be exacerbated without clearer direction for investors and other decision-makers. A targeted and integrated nationwide plan is needed to enable New Zealanders to understand, assess, plan for and adapt to these ongoing risks and impacts.

Acting sooner rather than later on climate change will create opportunities for productive businesses, regions, iwi and others to transition to a sustainable and low-emissions economy. Doing this will also enable early action to mitigate the impacts of climate change action on individual sectors that might be impacted more than others. It could avoid dramatic and abrupt changes further down the track that are likely to exacerbate the overall economic and social costs of the transition. Strong, early climate change action also has the potential to place New Zealand at a comparative global advantage, and there are upsides or 'co-benefits' to be expected, including improved environmental, health and social outcomes.

Government intervention is, therefore, recommended to establish an enduring institutional architecture and set clear emission reduction goals to ensure New Zealand makes continued, well-informed progress towards a low-emissions and climate-resilient future.

Proposed Approach

How will the Government's intervention achieve the desired change?

The Government proposes to introduce the Zero Carbon Bill (the Bill) to provide an enduring framework for the transition to a low-emissions and climate-resilient New Zealand.

Decisions on the Bill must be in line with the Cabinet-agreed All-of-Government Framework for Climate Change Policy [CAB-18-MIN-0218 refers], which agreed that New Zealand will:

- by the end of 2019, put in place the necessary enduring institutional architecture to enable a just transition to a net zero emissions economy, and
- by 2020:
 - demonstrate its commitment to leadership on climate change and promote global action to achieve the Paris Agreement's temperature goal

² IPCC. 2018. Released 8 October 2018.

- be on track to meeting its first emissions budget under the proposed Zero Carbon Act.

The Framework is also centred on three key objectives:

Leadership at home and internationally:

- putting in place a stable and enduring climate change legal and policy framework
- holding ourselves and others to account for acting consistently with the Paris Agreement
- investing to enable New Zealand to lead innovation in areas of its comparative advantage
- influencing the global response and ensuring global action is in line with NZ Inc. interests
- supporting the Pacific and building the region's capacity for mitigation and adaptation.

A productive, sustainable and climate-resilient economy:

- taking into account the costs, benefits, opportunities and trade-offs of policies aimed at meeting the target and adapting to future climate change impacts
- recognising the different policy pathways and distributional impacts of meeting the target and putting in place support policies to mitigate any downside risks
- using the right evidence base and tools to design the optimal transition pathways that maximise the benefits (and co-benefits) and minimise the costs of the transition.

A just and inclusive society:

- assessing the merits of early action and carefully managing the speed and pathways of the transition
- supporting regions and communities affected by transition policies and those needing to adapt to ongoing climate change impacts
- recognising the rights and needs of future generations, as well as those of iwi/Māori under Te Tiriti o Waitangi.

The Government considers that setting a quantified 2050 target in primary legislation would provide the greatest domestic signal and certainty. This would give New Zealanders confidence that climate change policies and the long-term emissions reduction pathway will remain stable and predictable and continue delivering prosperity. A Climate Change Commission is a transparency and accountability mechanism to provide independent, expert advice beyond short-term considerations and political cycles. It will hold successive governments to account for progress on reducing emissions and building climate resilience.

Over 7 June-19 July 2018, the Government consulted with New Zealanders on a range of proposals for the Bill, which were approved by Cabinet and split into four distinct policy areas: **2050 Target**, **Emissions Budgets**, **Adaptation** and **Climate Change Commission** (the Commission). Public consultation was extensive, including a comprehensive discussion document detailing the Government's proposals, as well as nationwide roadshows and

technical workshops. There was a significant response of over 15,000 submissions, with a clear majority of New Zealanders in favour of strong and ambitious domestic action.

This Regulatory Impact Statement (RIS) identifies the available options in each consulted policy area and also identifies three additional policy areas to assess: the **use of international units** (in the context of the 2050 Target); **interaction with the NZ ETS**; and **adaptation reporting power**. The available options in each area are assessed against the three objectives mentioned above and, in some cases, against more detailed sub-criteria within each objective. The preferred approach will inform final policy decisions on the Bill.

2050 Target

Six new 2050 target options were considered as alternatives to the current gazetted 2050 target. Officials from the Ministry for the Environment propose a domestic target of net zero long-lived gases by 2050 and a [x] percent reduction on short-lived gases below 2016 levels by 2050, with a stated aim of achieving overall greenhouse gas (GHG) neutrality in the second half of the century.

This option is consistent with New Zealand adopting a leadership position in global efforts to keep the average temperature increase to below 1.5 degrees above pre-industrial levels.

Setting a requirement that the target be met through domestic emissions reduction only would provide a clear signal of domestic ambition and regulatory certainty for stakeholders. However, if New Zealand faces unforeseen circumstances in the future, such as another Global Financial Crisis (GFC) or significant change in trade patterns, it will be useful to retain the ability to use international emissions reduction units. This is an important flexibility mechanism, allowing the target to be achieved without disproportionately affecting different social sectors. For that reason, it is recommended that offsetting through international units is only allowed if deemed necessary, and up to a level mandated, by the Commission.

A range of economic modelling and analyses suggests that New Zealand's transition to a low-emissions economy will be challenging but achievable, if specific assumptions made in the modelling on innovations and transitions across energy, transport and agriculture come to fruition. The quantitative economic impacts reported should be read with caution: they are likely to overstate the challenges of the target options and underestimate the costs of the 'do-nothing baseline', as well as the status quo. This is because the modelling:

- presupposes that New Zealand's growth rate would be unaffected if the rest of the world acts and New Zealand does not
- does not take into account the potential cost of damage a changing climate could cause to the economy
- does not quantify the potential upsides of a stronger target, including faster innovation and wider co-benefits.

The recommended target option sets clear emissions reduction goals for all of New Zealand to reach in 2050 and beyond; however, it does not specify policies or plans. A long-term, low-emissions development strategy will also be necessary to signal government policies required to drive the transition, with support arrangements to avoid or ease uneven distributional impacts across regions and society.

Emissions Budgets

It is proposed that the Bill establish a system of five-year long emissions budgets to act as 'stepping stones' over 2021-2050 and ensure steady action and accountability over the short to medium term. Three budgets will be in place at any one time, which translates to a 'look-ahead' period of 10-15 years in order to measure progress towards meeting each budget.

To provide for flexibility and changing circumstances, future governments will be able to revise the level of the second and third budgets in the sequence, but only under certain conditions. In the case of the second budget, this would be in the event of exceptional circumstances, which would be deemed as such by the responsible Minister. The third budget could only be revised if one or more of the following criteria was met: scientific and technological developments; methodological improvements; accelerating global temperature rise; or changes to international law or policy. The Commission must provide advice on any proposed revisions, and will need to be notified by Gazette notice using the standard Parliamentary process.

Similar to the UK model, the Bill would permit banking and limited borrowing across consecutive budgets. This would make it easier for the government to adhere to the optimal abatement pathway and manage the social, economic, cultural and environmental impacts of the transition to a low-emissions economy. Ultimately, the responsible Minister will decide whether banking or borrowing will occur, and at what level, based on advice received from the Commission and subject to a statutory cap on borrowing at 1 percent of the overall budget.

The Commission will have an active role in relation to emissions budgets, including:

- advising on the appropriate level of emissions budgets and plausible pathways for New Zealand to achieve them
- advising on plans and policies to meet the emissions budgets
- monitoring New Zealand's progress towards emissions budgets and, ultimately, the 2050 emissions reduction target.

The Commission's advice must be tabled in Parliament. The government will also be required to respond to that advice within a 12-month period (extending to 15 months in an election year). If accepted by the government, the emissions budget will be notified in the New Zealand Gazette. If not, the government will propose an alternative budget and provide reasons for departing from the Commission's advice. Transitional provisions will apply to the setting of the first three emissions budgets to ensure these are in place by no later than 31 December 2020.

This approach to emissions budgets aims to provide regulatory certainty and contribute to the establishment of enduring institutional architecture. It strikes the right balance between providing a stable policy environment and sending a strong signal to households, businesses and industry, while remaining flexible to changing circumstances and future uncertainty.

Interaction with the NZ ETS

Every five years, the Commission will recommend emissions budgets (with a mandated government response) and advise on macro-level policy to meet the budgets set by the government, including an outlook for the NZ ETS unit supply settings.

Decision-making on the NZ ETS settings will remain with the elected government. However, the Commission would have an 'Advisory-plus' role, in which it will be required to recommend the technical NZ ETS settings annually (within the constraints of the set 2050 target and emissions budgets) and on the presumption that its recommendations will be given effect unless government provides otherwise and gives reasons for that decision.

The Commission will report annually on government's progress towards each budget and the target, with regular five-year reviews. In addition to considering the 2050 target and set budgets in its recommendations, the Commission will need to:

- take account of the government's other policies for the period and the effect that these will have on the level of abatement that can, and should, be achieved through the NZ ETS (using information provided by the government in a transparent manner)
- consult broadly in preparing its recommendations.

The overall proposed approach contributes to:

- enduring institutional architecture by building trust in the effectiveness of the NZ ETS
- holding New Zealand to account on meeting its international commitments, due to decreased political influence on the NZ ETS
- driving behaviour change, due to greater improvements in trust and predictability of the NZ ETS settings.

Adaptation

Greater national direction is needed to assess the risks of, and priorities for, climate change adaptation in New Zealand. The preferred approach is for the Bill to mandate the regular preparation, monitoring and review of a National Climate Change Risk Assessment (the Risk Assessment) and National Adaptation Plan (the Plan), as well as allocating responsibility for monitoring and evaluation of the Plan to the Commission.

Together, these elements provide a necessary integrated, nationwide approach to adaptation. An adaptation reporting power will also be used to collect information from organisations on climate change risks to public infrastructure and services. This power will support the Risk Assessment and Plan and will enable providers of public infrastructure and services, and affected communities, to improve their resilience.

The Risk Assessment would provide a nationwide overview of risks owing to climate change impacts to raise awareness and inform effective and prioritised adaptation action. The Bill will assign the preparation of the first Risk Assessment to the responsible Minister, after which the Commission will be responsible for ongoing periodic updates of the Risk Assessment.

The Bill would allocate responsibility for the Plan to central government and direct its implementation by local authorities and communities. The Plan would need to be prepared by the responsible Minister in consultation with iwi/Māori and key stakeholders. The Plan will:

- articulate a common set of goals and priorities for taking action to prepare for the effects of climate change in New Zealand
- identify specific actions that will be taken to achieve the goals and priorities, such as making modifications to existing or proposed government policies.
- be updated at least every six years, with each update being informed by the most recent Risk Assessment
- provide more certainty about roles and responsibilities of various actors.

Periodically, the Commission will evaluate the Plan to check whether it is achieving its objectives and ensure that the actions it stipulates remain relevant and effective in reducing risks and improving climate resilience.

This integrated approach is considered the best option as it would align with international best practice, drive coordinated and efficient adaptation action and increase accountability by clarifying roles and responsibilities for climate change adaptation. Situating climate change adaptation responsibilities in the Bill alongside those for mitigation is designed to contextualise and coordinate policies and drive better long-term investment decision-making.

Climate Change Commission

Cabinet agreed to establish an independent Climate Change Commission through the Bill. This is a way of addressing the intergenerational challenge of climate change and ensuring transparency and accountability throughout New Zealand's transition to a low-emissions and climate-resilient economy.

An independent Commission would endure beyond short-term political cycles and decision-making and provide independent, expert advice to hold current and future governments to account on New Zealand's long-term climate change goals.

The preferred approach is for the Bill to establish the Commission as an independent Crown entity with advisory and monitoring functions. The Commission will comprise 6-8 Commissioners, whom the Governor-General will appoint based on the recommendations of Ministers.

As noted, the Commission will be required to:

- prepare a recommended emissions budget, with the government having the responsibility of setting budgets and giving reasons where it differs from the recommended budget
- monitor and report on government progress towards emissions budgets, with the government required to respond to that report within 12 months
- recommend technical supply settings of the NZ ETS
- prepare and regularly update the National Climate Change Risk Assessment on an ongoing basis (after it is first prepared by the responsible Minister)
- monitor and report on government progress in implementing the Plan and managing risks from climate change.

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The Commission will be supported by a secretariat of its choosing and will have the ability to appoint subcommittees to advise on specific matters as necessary. The Commission will also be supported by a Māori Advisory Committee to build a strong Crown-Māori partnership that takes into account Māori interests and equity outcomes.

Section B: Summary Impacts: Benefits and costs

Who are the main expected beneficiaries and what is the nature of the expected benefit?

Non-monetised benefits:

The benefits and co-benefits of stronger climate change action are difficult to quantify, due to limited available research, and were not able to be included in the economic modelling.

However, the Ministry has commissioned and compiled a range of evidence and analysis that suggests the benefits of the proposed approach may be significant and contribute to the New Zealand Government's wider economic, social and environmental policy objectives.

These potential benefits are summarised below and discussed in further detail in the **2050 Target** section and **Appendix 3** as part of the overall economic impact analysis.

Regulated parties:

- Improved planning and coordination of emissions reduction efforts – medium impact, low evidence certainty
- Stronger market signal and greater investment predictability – high impact, low evidence certainty
- Innovation, competitiveness and productivity gains – medium impact, low evidence certainty.

Regulators:

- Improved planning, coordination and delivery of climate change adaptation action – medium impact, medium-high evidence certainty
- Reduced duplication and increased cost-effectiveness of climate change adaptation interventions – medium impact, medium evidence certainty
- Improved awareness and understanding of climate change risks and interventions – low impact, low evidence certainty
- More investment in climate change adaptation measures across New Zealand society – medium impact, low evidence certainty.

Other parties:

- Wider public health, environmental and social co-benefits of climate change policies – medium impact, medium evidence certainty, eg:
 - health benefits from better home insulation: 4:1 benefit-cost ratio
 - combined co-benefits of switching freight from road to rail (congestion, maintenance and safety – estimated at approximately \$346 million per year)

- reduced air pollution and congestion and improved safety
- improved health benefits from increased active transport (\$15 billion estimated net benefit of cycling infrastructure, benefit-cost ratio of 24:1)
- water quality, biodiversity and other environmental co-benefits from land-use change (added ecosystem-service value (per hectare, per year) estimated at \$6,092 for exotic forestry, \$6,677 for indigenous forest, and up to \$37,636 for wetlands and mangroves).

Wider government:

- Long-term direction, including plans and policies, for climate change mitigation and adaptation.

All affected parties:

- Greater certainty and predictability for long-term investment decision-making and prioritisation – high impact, low evidence certainty.

Where do the costs fall?

Monetised costs

Regulated parties:

- Economic modelling is imperfect and does not predict the future, but it can give an indication of the potential economic cost of new policies to implement the 2050 target:
 - The economic impacts of different targets were assessed. The modelling allows for comparison of the impact of achieving each proposed 2050 target against the 'do-nothing' baseline as well as the policy status quo, which is the current domestic target of a 50 percent reduction on 1990 emissions by 2050.
 - The economy-wide impacts of officials' recommended 2050 target option were assessed as follows:
 - The economy continues to grow but at a slower rate than expected for the current gazetted 2050 target.
 - The New Zealand Institute of Economic Research (NZIER) finds that the recommended target option could slow economic growth by 0.07-0.18 percentage points compared to the current 2050 target, which is \$5-12 billion per year over 2020-2050. Note that these results are highly sensitive to assumptions about the level of forestry sequestration (modelled as 19-23Mt). Modelled costs fall sharply under higher sequestration assumptions.
 - Emissions prices rise from their current level. The two modelling studies undertaken project a wide range of emissions prices from \$75–885 per tonne of carbon dioxide equivalent (/tCO₂-e) by 2050. The Productivity Commission notes that the range of emissions prices estimated as

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necessary in other developed countries to deliver on the Paris Agreement is \$100-250/tCO₂-e at 2050. Note these are emissions prices that would be faced across the whole of the economy, not necessarily by specific sectors, industries or NZ ETS participants.

- It is critical to note that the impact magnitudes reported above do not consider some important factors that, if also quantified, would be expected to lessen the modelled challenge of the transition. Qualitative and empirical analysis has been undertaken on the impact of a changing climate on New Zealand's economy, on the potential for stronger emissions targets to drive faster innovation and to reap wider co-benefits (eg, health or environmental outcomes). These cannot be fed into NZIER's modelling within the time available and so the challenging impacts reported could well be overstated. An expert peer-reviewer has found NZIER's results to be at the higher end of the plausible range of impact.
- Adaptation costs on regulated parties will relate to the particular adaptation interventions included in the Plan, so are unknown.

Central government response:

- Ministry for the Environment: \$10,447,873 over first four years – medium-high evidence certainty).

Wider government:

- Climate Change Commission: total cost over first four years (medium-high evidence certainty): \$42,227,048.

NB: The Department of Conservation, Ministry for Primary Industries, Ministry of Business, Innovation and Employment and Ministry of Education will also require additional resourcing, but detailed costings are not yet known. A number of other government agencies are also likely to require additional resources, depending on the nature of future decisions (eg, sector-specific budgets, adaptation reporting requirements, etc). For example, the Environmental Protection Authority and the Ministry of Culture and Heritage have cited additional costs of \$400,000 and \$250,000 per annum, respectively, with medium-high evidence certainty.

All affected parties:

- Uneven distributional impacts on lower-income households and regions/communities that are reliant on emissions-intensive, trade-exposed (EITE) activities: exact costs unknown and dependant on policy interventions – medium-high evidence certainty.

Total monetised costs:

- Total cost related to establishment and ongoing costs associated with the Commission and government response only: \$55,274,921 over first four years.

The modelled economy-wide impacts of the 2050 target outlined above are subject to certain assumptions and limitations and will depend on plans and policies to implement the target.

What are the likely risks and unintended impacts, how significant are they, and how will they be minimised or mitigated?

2050 Target

- Implementation risks will arise not as a result of setting the target in primary legislation, but rather from the policies put in place in pursuit of its achievement. These are presently unknown and will depend on the transition pathway. It is, therefore, more appropriate to carry out analysis as part of these policies' own regulatory impact assessments.
- The world has committed under the Paris Agreement to resourcing and financing the global transition to low emissions. However, there remains the unlikely risk of New Zealand incurring the significant costs of the transition unduly (and without any material impact on climate change) if the rest of the world does not act accordingly. This risk may be mitigated through concerted international engagement and cooperation in a range of bilateral, regional and multilateral fora, in which New Zealand may hold others to account by communicating its ambitious target and ongoing efforts to reduce emissions at home.
- There is also a risk of undue economic burden on New Zealand if the assumed future innovation, technological developments and productivity gains do not come to pass. This is mitigated in the Bill through a number of 'safety valves' and flexibility mechanisms that, due to changing information or unforeseen circumstances, allow for the necessary revision of the target and budgets, as well as purchasing international units. This also provides flexibility in the face of insufficient climate change action by the rest of the world.

Emissions Budgets

- A key implementation risk concerns a delay in setting the first three proposed emissions budgets via gazette notice, and having the necessary NZ ETS unit supply settings in place and communicated, by 31 December 2020. This delay may be mitigated through transitional provisions in the Bill that provide for:
 - a Provisional Emissions Allowance (PEA), developed by officials and agreed by Cabinet, to indicate the required NZ ETS unit supply settings in advance
 - plausible emissions reduction pathways to be developed by the Interim Climate Change Committee and handed over to the Commission for final recommendations once it is stood up
 - officials and the Interim Climate Change Committee to provide preliminary analysis on the first three emissions budgets – this analysis will be handed over to the Commission to make final recommendations to the Minister by mid-February 2020, after which the budgets will be tabled in Parliament.

Interaction with the NZ ETS

- There are key risks associated with the Commission's role advising on NZ ETS settings, including the additional cost, time and administrative burden and additional requirement for regard to be given to government policy, as well as this legislative mechanism departing from usual design principles. These risks are necessary to balance the importance of independent influence over NZ ETS settings with any significant macro-economic policy decisions remaining with the elected government.

Adaptation

- Assessments and prioritisation of actions at the regional, city, business and/or sector level may not align with the national priorities set by the Risk Assessment and the Plan. These risks may be mitigated by close consultation on the Risk Assessment and Plan with agencies, mana whenua and key stakeholders, particularly local authorities.
- There is a risk that adaptation measures in the Bill could draw focus away from mitigation measures (and vice versa) or create competing priorities. This will be minimised by the net benefit of a single, integrated and national-level framework and further mitigated by the Commission's mandated monitoring and evaluation role to ensure coordination.

Adaptation reporting power

- The adaptation reporting power presents risks of duplicating reporting requirements, compromising commercial confidentiality and not prioritising the materiality and significance of adaptation risks and action. These are mitigated by the Bill's regulation-making power specifically requiring information on these issues to be gathered in consultation and engagement with reporting authorities.

Commission

- There is a potential risk of duplication of effort among the Commission and wider government processes, for example in data collection, research, monitoring and tendering advice. This risk is somewhat mitigated by a clear delineation in the Bill of the roles and responsibilities of the Commission vis-à-vis the government, as well as open communication and collaboration.

Identify any significant incompatibility with the Government's 'Expectations for the design of regulatory systems'.

The options analysed are generally compatible with the Government's 'Expectations for the design of regulatory systems'.³

³ See <http://www.treasury.govt.nz/regulation/expectations>

Section C: Evidence certainty and quality assurance

Agency rating of evidence certainty

The Ministry and wider government have put significant resource and effort into developing a robust evidence base to underpin the Zero Carbon Bill proposals. This included: consulting scientific experts and literature; commissioning a range of sophisticated economic impact analyses and modelling; and undertaking an open and extensive public consultation process.

The scientific assessment of global climate change and its impacts, both internationally and domestically, is robust and credible, and has been subject to international peer review and quality assurance. This RIS benefits from the most up-to-date and objective scientific assessments, including by the Intergovernmental Panel on Climate Change (IPCC).

The actual and potential costs and benefits of climate change to New Zealand and the world are difficult to quantify. Economic data specifically on the costs of climate change impacts is not readily available in New Zealand, although some studies do exist. In these studies, various assumptions have been made, or proxy data extrapolated, to estimate the economic costs of extreme weather and natural events that may be exacerbated by climate change.

Economic modelling is not a perfect science and cannot predict the future. Forecasting the economic impacts of climate change policies, including long-term emissions reduction targets, is extremely difficult due to the uncertainty of future projections, as well as the potential for major policy and/or technological changes between now and 2050. Therefore, modelling in this area makes a range of assumptions about the economy to provide an idea of the plausible transition pathways for each option and their potential economic impacts. A range of qualitative economic studies also undertaken complement the modelled findings.

Much of the evidence related to New Zealand's policy and institutional framework is drawn from the work of the Productivity Commission and Climate Change Adaptation Technical Working Group (CCATWG). These works have their own limitations in terms of scope and analysis, but provide a comprehensive assessment of the existing mitigation and adaptation frameworks in New Zealand, as well as options to address gaps and shortcomings.

Furthermore, general public opinion and anecdotal evidence derived from public consultation on the Zero Carbon Bill (from 7 June-19 July 2018) has provided invaluable input into the qualitative and quantitative analysis contained in this RIS. Consultation included the public online release of a detailed discussion document and technical economic reports, nationwide roadshows and technical workshops, and targeted stakeholder engagement.

To be completed by quality assurers

Quality Assurance Reviewing Agency:
The Treasury and the Ministry for the Environment
Quality Assurance Assessment:

The Regulatory Quality Team at The Treasury and the Regulatory Impact Analysis Panel at the Ministry for the Environment have jointly reviewed the Regulatory Impact Statement “Zero Carbon Bill” (RIS) dated 19 October 2018. The joint review team considers that the RIS meets the quality assurance criteria for Regulatory Impact Assessments.

Reviewer Comments and Recommendations:

This assessment is based on: the RIS being complete; the proposal having been publicly consulted on; the RIS being as clear and concise as possible, given the complexity of the subject; and, the inclusion of modelled economic costs and benefits.

The RIS clearly explains the separate elements of the proposed institutional architecture – the Climate Change Commission and its role, and the system of emissions budgets – and how they fit together with each other. The question of the nature and level of the proposed emissions reduction target is also well set out. The extent and nature of uncertainty, on both the upside and the downside, of the economic costs and benefits of differing levels of ambition, is clear. The downside risks that assumptions about achievable levels of afforestation and technological innovations will be met are, however, given less prominence than the upsides.

The modelled finding that the economic impact under all scenarios is expected to be substantial leaves the case for the options proposed dependent on convincing non-economic arguments.

The case is made that a clear institutional and policy framework around emissions reductions is required to guide investment decisions, although it is acknowledged that the arrangements discussed in the RIS are not in themselves sufficient for that purpose. Further policy measures will be needed to achieve the targets and it will be important for these to undergo similarly careful analysis and evaluation of their impacts.

The assumption is also made that a high level of ambition in New Zealand will bring reputational benefits and have a positive influence on other countries’ mitigation efforts; and that this in turn will mitigate climate change to the point that New Zealand will experience further benefits, in terms of avoided adaptation costs.

However, little evidence or argument is available to support that assumption. For example, it is emphasised that New Zealand’s challenge in meeting its climate change obligations is different from that of other countries. This must reduce the likelihood that those other countries will want or need to follow New Zealand’s example or to take advantage of any New Zealand technological innovations. This in turn weakens the logic that mitigation action by New Zealand will reduce the impacts of climate change experienced here. This creates significant uncertainty as to the benefits of the proposed action and it will be important to monitor progress.

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Impact Statement: Zero Carbon Bill

General information

The Ministry for the Environment (the Ministry) is solely responsible for the analysis and advice set out in this Regulatory Impact Statement (RIS).

Purpose

This analysis and advice has been produced for the purpose of informing:

- key (or in-principle) policy decisions to be taken by Cabinet.
- final decisions to proceed with a policy change to be taken by or on behalf of Cabinet.

Key Limitations or Constraints on Analysis

Cabinet agreed in its 100-Day Plan for Climate Change [CAB-17-MIN-0547.01 refers] to introduce the Zero Carbon Bill (the Bill), including setting a new 2050 target and establishing an independent Climate Change Commission (the Commission). Cabinet also approved public consultation based on proposals for the Bill in four policy areas (2050 Target, Commission, Emissions Budgets and Adaptation). This RIS considers these four policy areas and three additional policy considerations: the use of international units, interaction with the NZ ETS and an adaptation reporting power.

There are interdependencies between the Bill's proposals and the role of the Interim Climate Change Committee or the Commission ultimately providing advice on the role of agricultural emissions in the NZ ETS. This has limited the scope of decisions for the Bill, as has ongoing work to improve the NZ ETS (following its 2015/16 review) and to amend the CCRA to align with the Paris Agreement.

The previous government directed the Productivity Commission's inquiry into the transition to a low-emissions economy and the CCATWG stocktake and recommendation reports. These also have a bearing on ongoing climate change policy work and have framed the available options considered for the Bill.

In addition, the Paris Agreement imposes particular obligations on New Zealand, including those relating to mitigation and adaptation measures. As a result, no options were considered that were inconsistent with meeting New Zealand's obligations under the Paris Agreement (and other international treaties).

Within these broad parameters, this RIS examines possible options for the following policy areas:

- 2050 target
- Use of international units
- Emissions budgets
- Interaction with the NZ ETS

- Adaptation to climate change
- Adaptation reporting power
- Climate Change Commission.

Evidence of the problem

The scientific assessment of global climate change and its impacts, both internationally and domestically, is robust and credible and has been subject to international peer review and quality assurance.

Quality of data used for impact analysis

This RIS relies on a range of qualitative and quantitative data to assess the impacts of the proposed options, including preliminary (Stage 1) and revised (Stage 2) economic modelling and analyses, independent advice, international evidence and anecdotal evidence from public submissions.

Economic data on the costs of climate change impacts are not readily available in New Zealand, though some studies do exist. In the studies referenced, various assumptions have been made, or proxy data extrapolated, to estimate the costs to the New Zealand economy of extreme weather and other natural events that may be exacerbated by climate change.

Much of the evidence related to New Zealand's policy and institutional framework is drawn from the Productivity Commission's final report on the transition to a low-emissions economy, as well as the CCATWG's stocktake and recommendation reports. These reports also have their limitations in terms of scope and analysis, but provide valuable insights and perspectives on the climate change problem.

No single model can give a full picture of the costs and benefits of adopting a particular target for emissions reductions in 2050. Acknowledging this, officials commissioned and undertook a range of analysis to support advice on the target options. This work was led by the Ministry, with input from other agencies including the Ministry for Primary Industries, Ministry of Business, Innovation and Employment, Ministry of Foreign Affairs and Trade, Electricity Efficiency and Conservation Authority and the Treasury.

The economic assessment commissioned improves on that carried out in 2015 to inform decisions on New Zealand's first Nationally Determined Contribution (NDC) under the Paris Agreement. This pre-Zero Carbon Bill economic analysis was divided into two stages in order to fit with the policy development process. Stage 1 was undertaken to support the development of the material supporting public consultation. Stage 2 builds on and refines the results of Stage 1 and will inform final policy advice.

Assessing the economic impacts of emissions reduction targets out to 2050 is extremely complex. The Ministry has undertaken a thorough assessment of the economic impacts of the proposed target options in a constrained timeframe. Discussions with international counterparts indicate that by integrating the assessment of economic impacts of a low-emissions transition across energy, transport and also land use, New Zealand is at the forefront of this type of analysis.

Problem definition and objectives

2.1 What is the context within which action is proposed?

Human-induced climate change is a global problem requiring a global response. Without collective global action to reduce GHG emissions, global temperatures are projected to increase by 3-5°C during the 21st century.⁴ This would have significant and long-term adverse effects on the global economy, societies and ecosystems. To limit warming to within 2 degrees Celsius, global carbon dioxide emissions would need to be reduced to net zero before 2100.⁵

The United Nations Framework Convention on Climate Change (UNFCCC) is the international framework to address human-induced climate change. It was adopted in 1992 and has near-universal membership with 197 Parties. The Kyoto Protocol to the UNFCCC (the Protocol) was adopted in 1997 and placed legally binding emissions reduction targets on participating developed countries.

Paris Agreement

The 2015 Paris Agreement was the result of a call for a new universal legal agreement under which all countries agree to address climate change from 2020 onwards. It represents a global commitment to avoid dangerous climate change by aiming to:

- keep global average temperature rise to well below 2 degrees Celsius above pre-industrial levels, and pursuing efforts to limit the temperature increase to 1.5 degrees
- enhance countries' ability to adapt and reduce vulnerability to climate change impacts
- make finance flows consistent with low-emissions and climate-resilient development.

Parties also agreed to aim to reach peak global GHG emissions, as soon as possible, and to aim for net zero emissions in the second half of the century.

New Zealand signed and ratified the Paris Agreement in 2016, as it represented genuine collective action to address the global climate change problem, to which New Zealand's major trading partners and other like-minded countries had also committed themselves.⁶ New Zealand's first NDC under the Agreement is to reduce emissions to 30 percent below 2005 levels by 2030 (equivalent to 11 percent below 1990 levels).

The Paris Agreement creates obligations on New Zealand to prepare, communicate and maintain successive NDCs and implement domestic measures to meet its commitments, including planning for and taking action on adaptation. New Zealand is required to report on its implementation of these commitments periodically.

IPCC Special Report on Global Warming of 1.5°C (SR15)

⁴ Intergovernmental Panel on Climate Change (IPCC), 2013.

⁵ IPCC, 2014a.

⁶ The United States (a major contributor to global emissions) has since announced its intention to withdraw from the Paris Agreement, which under the Agreement is permitted no earlier than 4 November 2020.

Work since the Paris Agreement has identified pathways that limit global warming to the more ambitious 1.5°C goal, and these have been assessed in an IPCC Special Report completed in October 2018 (SR15).⁷ Global CO₂ emissions in these pathways reach net-zero around mid-century. Non-CO₂ emissions show deep reductions that are similar to those in pathways limiting warming to 2°C. Global agricultural methane emissions in 2050 are 24 – 47 per cent below 2010 levels. Global GHG emissions reach net zero around 2070.

The SR15 highlights a number of climate change impacts that could be avoided by limiting global warming to 1.5°C compared to 2°C, or more. For instance, by 2100, global sea level rise would be 10 cm lower with global warming of 1.5°C compared with 2°C. Coral reefs would decline by 70-90 percent with global warming of 1.5°C, whereas virtually all (> 99 percent) would be lost with 2°C. These issues are of particular concern to low-lying states in the Pacific and around the world.

The SR15 has led to renewed calls for urgent global action to meet the 1.5°C temperature goal, which would require rapid, unprecedented and far-reaching economic and social transitions.

Domestic context

While New Zealand is responsible for about 0.17 percent of annual global GHG emissions⁸, its climate is impacted by the accumulation of GHG emissions from all countries. New Zealand temperatures have already risen by about 0.9°C in the past 100 years,⁹ and over the past century the sea levels at New Zealand ports have risen between 14 and 22 centimetres. New Zealand cannot limit the impacts of climate change alone – any future warming will depend on the level of future global emissions. However, small emitters collectively account for about a third of global emissions and, together, can have a significant impact.

Climate change mitigation via emissions reduction poses a significant challenge for New Zealand. Despite an overwhelmingly renewable electricity system and a sizeable forestry sector by international standards, New Zealand has among the highest per capita GHG emissions in the world.¹⁰ The agricultural sector – a major part of New Zealand's largely export-based economy – makes up a very high proportion of exported production and nearly half of all GHG emissions. Rapid population growth, and an associated increase in land transport emissions, have contributed the fastest growth in emissions in recent years.¹¹ Over 25 percent of New Zealand's land surface is covered in native forest, which represents a huge carbon reservoir that is worth protecting.

At the same time, New Zealand must adapt to ongoing climate change impacts. Our environment and economy are strongly interlinked and highly vulnerable to these impacts, which include sea-level rise, ocean acidification and the increased frequency and severity of

⁷ IPCC, 2018.

⁸ IPCC, 2014a.

⁹ Ministry for the Environment & Stats NZ, 2017.

¹⁰ New Zealand Productivity Commission, 2018.

¹¹ Ibid.

flooding, wildfires and drought.¹² Many sectors are vulnerable, such as farming, fishing, forestry, aquaculture and tourism. These sectors are also large contributors to the fast-growing Māori economy and asset base. Native species and ecosystems are especially vulnerable, as the capacity for natural systems to adapt is much lower than for managed systems.

New Zealand is already beginning to experience significant costs and disruption from previously 'locked-in' climate change. More frequent and extreme weather events pose a significant risk to important infrastructure and assets, including invaluable heritage sites and areas of particular significance to Māori, such as marae, wāhi tapu and mahinga kai rohe. Climate change also presents a magnified security and economic threat in terms of increasing disaster risk management and migration pressures in the wider Pacific region.

The specific economic costs of climate change impacts are difficult to estimate, because New Zealand has few integrated regional and sectoral assessments of impacts, adaptation and socio-economic risk¹³, but a limited number of reports have attempted to quantify New Zealand's high exposure risk to climate change impacts:

- The Parliamentary Commissioner for the Environment (PCE) indicates the cost of replacing every building within half a metre of the average high-tide mark could be \$3 billion and within 1.5 metres, as much as \$19 to \$20 billion.
- In one study, flood costs attributable to climate change were around \$11 million per year, which are likely to be underestimates as at least \$279 million in weather-related losses were not considered in the analysis.
- A report, commissioned by The Treasury, has found that climate change-related floods and droughts have cost the New Zealand economy at least \$120 million for privately insured damages from floods and \$720 million for economic losses from droughts over the last 10 years. This is expected to be a conservative estimate.¹⁴
- The estimated economic impact of climate change on New Zealand and Australia, combined, is a one percent reduction in Gross Domestic Product (GDP) levels by 2060, maybe up to two percent.¹⁵

Recent research initiatives have begun to sketch out a better understanding of climate change impacts, including the Deep South National Science Challenge, the Climate Change Impacts and Implications programme (funded by the Ministry of Business, Innovation and Employment) and work undertaken by the National Institute of Water and Atmospheric Research (NIWA) to assess the scale of coastal risks. However, at this stage, New Zealand lacks a formal, national-level, operational understanding of the economic, social and environmental costs and benefits of climate change.¹⁶

2.2 What regulatory system, or systems, are already in place?

¹² Reisinger et al, 2014.

¹³ IPCC, 2007.

¹⁴ National Institute of Water and Atmospheric Research (NIWA) & New Zealand Climate Change Research Institute, 2018.

¹⁵ Ministry for the Environment, 2018a.

¹⁶ NIWA & New Zealand Climate Change Research Institute, 2018.

Climate Change Response Act 2002 (CCRA) and Regulations

To enable New Zealand to meet its international obligations under the UNFCCC and Protocol, and the need for an economy-wide response to climate change, New Zealand enacted the Climate Change Response Act 2002 (CCRA). This established a legal framework that includes provisions for:

- the Minister of Finance to manage New Zealand's holdings of units that represent New Zealand's target allocation for GHG emissions under the Protocol
- the Minister of Finance to trade those units on the international market
- a registry to record holdings and transfers of units
- a national inventory agency to record and report information relating to GHG emissions in accordance with international requirements.

The New Zealand Greenhouse Gas Inventory was established as the official annual estimate of all human-generated GHG emissions and removals that have occurred in New Zealand since 1990, as required for reporting under the UNFCCC and Protocol.

In addition, there are seven regulations and four orders under the CCRA covering a broad scope of technical regulations. These include general exemptions, a fishing allocation plan, eligible industrial activities, removal activities, stationary energy and industrial processes, synthetic GHG levies, the New Zealand Refining Company Limited, unique emissions factors, the Unit Register, waste, forestry and fossil fuels.

New Zealand Emissions Trading Scheme (NZ ETS)

The New Zealand Emissions Trading Scheme (NZ ETS) was officially established in 2008, and is the Government's principal policy response to climate change. Its objective is to support and encourage global efforts to reduce GHG emissions by:

- assisting New Zealand to meet its international obligations
- reducing New Zealand's net emissions below business as usual levels.

The NZ ETS puts a price on GHG emissions to create a financial incentive for businesses to invest in technologies and practices that reduce emissions and encourage forest planting. The NZ ETS requires all sectors of New Zealand's economy to report on their emissions and, with the exception of biological emissions from agriculture, to purchase and surrender emissions units to the Government for those emissions.

2015/16 NZ ETS Review

Over 2015/16, the Government completed a comprehensive, two-stage review of the NZ ETS, focusing on operational and technical improvements, transitional measures introduced to moderate the impacts of the NZ ETS and the future evolution of the scheme.

The Government is in the process of consulting on proposals to improve the operation of the NZ ETS, including the outcomes of the NZ ETS Review and proposed amendments to bring the CCRA more firmly in line with New Zealand's obligations under the Paris Agreement.

Resource Management Act 1991 (RMA) and Regulations

The Resource Management Act 1991 (RMA) is New Zealand's framework for sustainable and integrated environmental management. The RMA is based on the principle of sustainable management, which involves considering the effects of activities on the environment now and in future when making resource management decisions (eg, plan making, consenting).

The RMA is relevant for some aspects of climate change policy, for example:

- Under Section 6, the management of significant risks from natural hazards shall be recognised and provided for as matters of national significance.
- Section 7 of the RMA requires that particular regard shall be given to matters related to climate change. These matters include the efficiency of the end use of energy, the effects of climate change, and the benefits to be derived from the use and development of renewable energy.

Other key players and initiatives

Many actors have taken direction from central government on the role they have to play in the climate change response.

New Zealand business and industry organisations have developed their own targets, plans, and strategies for reducing emissions and building climate resilience. Adaptation guidance has also been adopted by local authorities to help prepare their communities for climate change impacts and ensure risk management is integrated in planning and consenting procedures, particularly with respect to coastal hazards.

The Government has also signalled that it will continue to invest and engage in other non-regulatory areas that will assist the transition to a low-emissions economy. These include:

- working with local government and communities to develop a land transport policy statement that supports investment in low-emissions transport, including solutions that support mode shift in urban areas and contribute to liveable cities
- working alongside foresters and landscape restoration projects to plant one billion trees over 10 years (between 2018 and 2027), which will have a range of environmental, economic, fiscal and social benefits
- establishing a Green Investment Fund to stimulate investment in low-emissions industries
- continuing to develop practical solutions in the agriculture sector, where New Zealand is already a world leader, such as animal breeding and vaccines to reduce methane.

2.3 What is the policy problem or opportunity?

Despite existing efforts, and an established climate change mitigation framework driven by growing international commitments under the UNFCCC, Protocol and Paris Agreement, New Zealand's gross emissions have increased significantly since 1990 (by 19.6 percent in 2016). New Zealand is also lacking a nationwide approach to drive effective and coordinated action on climate change adaptation.

While separate issues, the underlying problem behind insufficient action on both climate change mitigation and adaptation is the same. The current framework falls short of providing a stable and credible policy environment to enable long-term planning, decision-making and investment by the private sector and civil society. A clearly signalled direction of policy travel

is needed via primary legislation, alongside credible mechanisms that call for steady action and accountability over the long term by a range of actors, including central and local government, industry, businesses and households.

With the signing and entry into force of the Paris Agreement, the global context in which the gazetted 2050 target was set has also changed significantly. The world agreed on the need to chart a transition pathway to lower emissions and strengthen climate resilience. This presents a significant challenge to continue delivering prosperity to New Zealanders in an emissions-constrained future. It also presents an opportunity for New Zealand to 'upgrade' to a greener, more competitive and productive economy that can improve overall wellbeing.

The Productivity Commission notes that New Zealand has had a legal and policy framework in place to combat climate change for some time, but that this has not generated action to reduce emissions.¹⁷ The upwards emissions trend is attributed to an inconsistency among various government policy settings and the uncertainty of the future, notwithstanding the fact of New Zealand's international targets.

Both the current and former Parliamentary Commissioner for the Environment (PCE) and the Productivity Commission have recommended a legislated and quantified emissions reduction target and the establishment of an independent expert body to advise government on climate change policy matters.

Cabinet agreed to introduce the Bill as an opportunity to tackle climate change action on both fronts – mitigation and adaptation – within a single, durable framework. This decision reflected the need to address the incompatibility of long-term climate change with New Zealand's short-term political cycles. Many countries have sought to address this through changes to institutional arrangements that better place them to meet the intergenerational challenge of climate change.

There are inherent risks in planning for an uncertain future. However, a recent study from Westpac NZ (2018) found that taking early and planned action on climate change could be less economically challenging, compared with taking delayed then abrupt action later. Modelling undertaken by Concept Consulting Group, Motu Economic and Public Policy Research and Vivid Economics (CMV, 2018) also indicates that greater technological change and early action to raise emissions prices may help to constrain long-term costs.

Therefore, it is important to influence decision-makers sooner rather than later to make sound long-term investments and avoid locking in higher emissions for decades to come.

2.4 Are there any constraints on the scope for decision-making?

Relevant Cabinet decisions

The range of options was defined within the parameters of introducing a Zero Carbon Act (the Act) and establishing an independent Climate Change Commission. These parameters were outlined in the Coalition Agreement between the New Zealand Labour Party and New Zealand First Party, and the Confidence and Supply Agreement between the New Zealand Labour Party and the Green Party of Aotearoa New Zealand.

Within these parameters, in December 2017, Cabinet agreed to the 100-Day Plan for Climate Change [CAB-17-MIN-0547.01 refers], which included the establishment of an **Interim**

¹⁷ New Zealand Productivity Commission, 2018.

Climate Change Committee to consider the priority matters of agriculture and renewable electricity generation. It will provide its analysis to the independent Commission, once established, to make recommendations to the Government on:

- a. how surrender obligations could best be arranged if agricultural methane and nitrous oxide emissions enter into the New Zealand Emissions Trading Scheme (NZ ETS)
- b. planning for a transition to 100 percent renewable electricity by 2035.

The Interim Climate Change Committee's terms of reference create interdependencies and sequencing issues with regard to what decisions are within scope of the Zero Carbon Bill (the Bill) and what the Commission will be required to consider upon its establishment. For example, policy decisions regarding agriculture in the NZ ETS and a transition to 100 percent renewable electricity generation lie outside the scope of the Bill until the appropriate evidence and analysis is delivered to government in the form of recommendations.¹⁸

This is also true for the implementation of key NZ ETS changes throughout 2018 and 2019. These are constrained by:

- in-principle decisions and other findings from the 2015/16 NZ ETS Review
- proposed amendments to align the Climate Change Response Act 2002 (CCRA) with the Paris Agreement.

Cabinet-agreed All-of-Government Framework for Climate Change

The range of options considered here was also assessed within the parameters of the **All-of-Government Framework** (the Framework) for climate change policy, which was agreed to by Cabinet in May 2018 [CAB-18-MIN-0218 refers]. This Framework includes a commitment that New Zealand will have achieved the following outcomes:

- by the end of 2019, put in place the necessary enduring institutional architecture to enable a just transition to a net zero emissions economy, and
- by 2020:
 - demonstrate its commitment to leadership on climate change, and promote global action to achieve the Paris Agreement's temperature goal
 - be on track to meeting its first emissions budget under the proposed Zero Carbon Act.

The Framework is further underpinned by three pillars agreed by Cabinet to guide key policy decisions:

Leadership at home and internationally (promoting global action):

- putting in place a world-leading and enduring climate change policy and legal framework

¹⁸ Subject to Cabinet agreement on 5 November 2018, an amendment to the terms of reference will provide for these recommendations to be made by the Interim Climate Change Committee rather than the Commission.

- holding ourselves and others to account for acting consistently with the Paris Agreement
- making investments that allow New Zealand to lead innovation in areas of comparative advantage
- influencing the global response and ensuring global action is in line with the interests of NZ Inc.
- supporting the Pacific and building the region's capacity for mitigation and adaptation.

A productive, sustainable and climate-resilient economy (ensuring the optimal transition pathway):

- taking into account the costs, benefits, opportunities and trade-offs of policies aimed at meeting the target and adapting to future climate change impacts
- recognising the different policy pathways and distributional impacts of meeting the target and putting in place support policies to mitigate any downside risks
- using the right tools and evidence to design the optimal transition pathways that maximise the benefits (and co-benefits) and minimise the costs of the transition.

A just and inclusive society (ensuring a careful transition):

- managing the speed and pathways for the transition to low emissions and climate resilience
- supporting regions and communities affected by transition policies and to adapt to ongoing climate change impacts
- recognising the rights and needs of future generations, as well as those of iwi/Māori under Te Tiriti o Waitangi.

As shown in **Appendix 1**, these three pillars form the All-of-Government Framework for Climate Change Policy. They provide the objectives necessary to guide government understanding of trade-offs and to drive well-balanced climate change decisions and actions.

Evidence of the problem

The problem definition assessment is based on internationally peer-reviewed and quality-assured analysis and data from the Intergovernmental Panel on Climate Change (IPCC), Organisation of Economic Cooperation and Development (OECD), the New Zealand Greenhouse Gas Inventory and the Ministry's environmental reporting series. It has also been heavily informed by the Productivity Commission's final report on the transition to a low-emissions economy, as well as the CCATWG stocktake and recommendation reports.

The assessments in each of the various policy areas also draw on international evidence. For example, many other jurisdictions have already set ambitious long-term emissions reduction or neutrality goals, including the United Kingdom (UK), EU, Canada, Norway, Portugal and Sweden. The Ministry also looked at experiences with adaptation legislation in nine countries: Australia, Canada, Chile, Denmark, Japan, the Netherlands, Norway, Sweden

and the UK. The assessment of options for the Commission also draws heavily on the experience of the UK Climate Change Committee.

Anecdotal and other general evidence was obtained through a six-week period of public consultation on the Zero Carbon Bill proposals from 7 June to 19 July 2018. This included a range of online engagement tools, public meetings and technical workshops. Consultation generated a significant response of 15,009 submissions in total, comprising 12,444 long submissions, 2,161 short submissions and 404 consultation forms. Of the 12,444 long submissions received, just under 3,000 (24 percent) were unique (ie, non-form submissions that did not follow a specified template). The remaining were pro-forma submissions that individuals completed based on template submissions from Greenpeace, Generation Zero and other organisations.

Much of the assessment of New Zealand's policy and institutional framework is drawn from the Productivity Commission's final report on the transition to a low-emissions economy, as well as the CCATWG's stocktake and recommendation reports. While these reports have limitations in terms of scope and analysis, they provide valuable insights and perspectives on climate change adaptation in the New Zealand context.

In particular, the CCATWG reports considered the following background information in order to develop the options New Zealand has to adapt effectively to climate change:

- New Zealand's social, cultural, environmental and economic context, eg:
 - relationship with tangata whenua
 - society, economy, natural environment and geography
- an economy-wide approach to adaptation
- actions other countries are taking to adapt to climate change.

While economic data on the costs of climate change impacts are not readily available in New Zealand, some studies do exist. In the studies referenced, various assumptions have been made, or proxy data extrapolated, to estimate the costs to the New Zealand economy of extreme weather and other natural events that may be exacerbated by climate change.

The economic analysis includes modelling which is indicative: modelling impacts out to 2050 is uncertain

A wide suite of economic studies has been carried out to support the impact analysis of targets. The economic analysis is a jigsaw of projected impacts. In other words, no single study or model provides perfect insight into how the economy and communities will respond to the proposed targets.

The analysis has assessed the economic challenges associated with achieving each target option, as well as the opportunities through stronger rates of innovation and wider co-benefits across health and other environmental outcomes.

The studies were carried out by a range of sources, including independent external experts and government economists. The table below sets out what we assessed as part of stage one of the economic assessment, how the work was done, who it was authored by, and what it gave us.

Table 1: Overview of 2050 target economic impact analysis and modelling undertaken

WHAT DID THE ECONOMIC ANALYSIS COVER?	HOW DID WE ASSESS THE ECONOMIC IMPACT?	WHO AUTHORED THE WORK?	WHAT RESULTS DID IT GIVE US?
Emissions prices	Bottom-up modelling, and whole-of-economy modelling	NZIER, and Concept, Motu and Vivid Economics (CMV) ¹⁹	Emissions prices required to achieve each target option
Economic growth and macro-economic impacts	Whole-of-economy modelling	NZIER	Impacts on macro-economic indicators, including GDP
Competitiveness challenges	Economic analysis of emissions intensive, trade exposed sectors	Sense Partners	Qualitative and empirical assessment of competitiveness impacts
Innovation opportunities	Economic analysis and review of international literature	Ministry, Sense Partners	Qualitative and empirical assessment of competitiveness impacts
Wider co-benefits	Economic analysis and review of international literature	Ministry	Qualitative and empirical assessment of the wider co-benefits of transitioning to a low-carbon economy
Avoiding damages caused by climate change	Short review of literature on economic impacts	No report	The potential for the baseline (and all impact analyses) to shift if we take into account the impact of potential damage by a changing climate

All modelling has limitations. The method of estimating emissions prices and effects on growth by both key models²⁰ could well overstate the economic challenges of the transition, because:

- The baseline growth rate is a business-as-usual scenario that assumes New Zealand's economic growth would continue as projected if we take no further action on climate change and the rest of the world does. The cost to the New Zealand economy of no further action on climate change (by New Zealand and the rest of the world) is estimated by the OECD as a reduction in Australia and New Zealand's combined GDP growth rate of 1–2 percent per annum by 2060.
- It also excludes consideration of the economic costs that a changing climate could have (eg, damage to infrastructure or agricultural output). Recent analysis published in the *Nature* journal suggests overall positive impacts to transitioning, including that limiting global warming to 1.5 degrees Celsius (rather than 2 degrees) by mid-century could have

¹⁹ CMV's work was jointly commissioned by the Ministry and Productivity Commission.

²⁰ The two key models to assess the impact of targets on emissions prices were built by Concept Motu and Vivid (CMV) and NZIER. The NZIER model also assesses the impact on macroeconomic metrics.

a significantly beneficial impact globally: an increase in global GDP of 1.5-2 percent and avoided damages from climate change globally of approximately \$11-\$16 trillion.²¹

- The economic modelling also excludes the upsides of stronger climate change policy, including potentially significant innovation effects and co-benefits.

Modelling out to 2050 would stretch any of this kind of model to its limits and so the results must be read with care; the models are not predictions or forecasts. Modelling cannot perfectly predict significant changes in technology availability and future changes to the economy. What will actually happen will depend on the actions of individual businesses and households and future policy choices by governments.

The results of this analysis should be read as indicative at best and are most useful for relative comparison of potential effects across target options, rather than as precise predictions of the economic impacts of each potential target.

Cultural impact analysis

In addition to social, environmental and economic impacts for all New Zealanders, climate change and the Government's response will have specific cultural implications for iwi/Māori.

It has been very difficult to project how the proposed policy interventions may specifically affect iwi/Māori. This difficulty is due to the fact that the extent of these impacts will depend largely on policies that are yet to be developed and are not considered in this advice (such as those ultimately recommended by the Commission). A discrete cultural impact analysis of the policy options has, therefore, not been possible.

However, when assessing the viability of policies – including support policies and transitional arrangements – specific impacts on iwi/Māori will need to be considered and taken into account, including cultural implications.

Criteria used to assess options

This RIS uses the three pillars as overarching objectives to assess each of the options considered in the various policy areas. However, these objectives are broad and apply to each of the policy areas in different ways. To accommodate this, additional sub-criteria within the overall objectives are used to assess the options for some of the policy areas.

In addition, the Paris Agreement imposes particular obligations on New Zealand with respect to mitigation and adaptation measures, amongst other things. Therefore, no options were considered that were not broadly consistent with meeting New Zealand's obligations under the Paris Agreement (and other international treaties).

Within these broad parameters, this RIS examines possible options in the following areas:

- 2050 target
- Emissions budgets
- Interaction with the NZ ETS

²¹ Burke et al, 2018.

- Adaptation to climate change
- Adaptation reporting power
- Commission.

2.5 What has consultation revealed?

Submitters to the Zero Carbon Bill consultation showed great awareness of the science behind climate change, and the effects this has already had (and will continue to have) on New Zealand's environment, economy and present and future generations. They were particularly mindful of the most vulnerable to climate change risks, including Māori communities.

Submitters identified the need for urgent and ambitious action and the shared responsibilities of all New Zealanders: businesses, communities and government agencies alike. They would like to see the Government and the independent Climate Change Commission play a key role in providing long-term certainty to enable this to happen.

New Zealand's green image was often referred to, with concern that we have not yet done our part to live up to this image. Many thought it was time for New Zealand to lead by example and find opportunities to make real change, including in challenging sectors such as agriculture and forestry.

“We are the *kaitiaki* of Aotearoa. It would be ethically and fiscally irresponsible not to do everything in our power to reduce the impacts of human-driven climate change. Aotearoa is developed enough and mobile enough to be world leading in this global movement, thus we should take this opportunity to show the world that it is not only possible, but that it can be profitable.” (Individual, 12713)

“As a young New Zealander, I think it is absolutely critical that we engage in sustainable planning for the sake of our country's future. The Zero Carbon Bill would introduce direction, certainty and accountability to New Zealand's climate change strategy, and drive a fair and cost-effective transition towards a thriving and resilient zero-carbon future.” (Individual, 12783)

Submitters were passionate about the implications the Bill would have for New Zealand. As such, they regarded the Bill as an important piece of legislation and strongly encouraged further consultation throughout the design and implementation processes of the Bill.

Submitters were overwhelmingly in favour of an ambitious 2050 GHG emissions reduction target to be set in legislation now, due to the urgency of the issue and the need for a long-term direction and certainty to enable everyone to plan for change and take action.

Submitters emphasised the importance of science and engagement with all affected parties in informing this decision.

By contrast, approximately only 48 people (0.004 percent of submitters) expressed opinions denying that climate change is happening, or caused by humans, or that New Zealand should or could do anything about it.

In addition, a recent poll commissioned by IAG Insurers²², in which one thousand New Zealanders took part, found widespread belief in the increased risks and impacts of human-

²² <http://www.iag.co.nz/News/Pages/Kiwis-pessimistic-that-we-will-meet-the-challenge-of-climate-change.aspx>

induced climate change, but limited confidence in New Zealand's current approach. 72 percent of New Zealanders thought that climate change is an important issue to solve, and 60 percent have become more concerned in recent years. However, only 10 percent placed climate change in their top three issues of concern.

For example, only 43 percent thought New Zealand's current response is on the right track, only 33 percent thought the Government response to date has been good and only 21 percent approved of the international response so far. There was a strong call for action, but varying opinions on the level of ambition and response required from New Zealand (eg, meeting or exceeding international commitments, acting even if other countries do not).

2050 Target

ADDENDUM

Note: This addendum was added to the RIS on 7 December 2018.

The Cabinet paper lodged on 7 December 2018 contains a proposal for a Emissions Reduction Target for 2050, being:

- net zero all other greenhouse gases (except biogenic methane) by 2050
- biogenic methane to reduce by 35 per cent below 2016 levels by 2050.

Under this proposed target, the biogenic methane level is set in legislation, but is subject to review by the Commission in 2025. In its review the Commission would also consider whether it is necessary to achieve 'net zero' emissions of biogenic methane by 2050.

How this proposed target fits with the other target options in the RIS

All other greenhouse gases (except biogenic methane) to net zero with a 35 per cent reduction on 2016 levels for biogenic methane was not specified in any of the target options modelled. However, the economic impacts of this target are approximated by comparing the impacts estimated for the options that were modelled.

This proposed target is broadly consistent with Option 3 in the RIS, but it has some differences. It:

- distinguishes 'biogenic methane' from 'all other GHGs', which is consistent with the distinction made for Option 5, and
- sets a gross emission reduction level for biogenic methane, which is consistent with feedback from public consultation to specify the emissions reductions required.

The *Impact Analysis* in the RIS assesses Option 3 in general rather than exact terms, and notes this is because it depends on the level at which reductions are set.

Both Option 2 and Option 3 in the RIS do not specify an amount of biogenic methane reduction. However, officials consider that the modelled results for Option 2 are a more reliable guide for the economic impacts for this target. The assumptions used in Option 3 mean the costs assessed for Option 3 are likely to be higher than the costs for this target.

Economic impact of this target

NZIER modelled Option 2 with two possible biogenic methane reductions levels (a 25 and 50 per cent reduction). Linearly interpolating between these levels implies a modelled GDP growth rate reduction of 0.11 per cent compared to the status quo of meeting the current target. Note that the results are sensitive to the modelling assumptions used.

Table 1: Economic impact of target options relative to the status quo

Target option	Innovation assumption	Forestry sequestration (MtCO ₂ e)	RELATIVE TO THE STATUS QUO:		
			Annual average GDP growth impact 2020-50 (per cent)	Annual average GDP impact 2020-50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018-50 (\$ billion)
Option 2 (50% reduction for SLGs)	Moderate	22.6	-0.18	-\$11.7	-\$94.8
Option 2 (25% reduction for SLGs)	Moderate	18.9	-0.07	-\$4.7	-\$38.9

Refer also to the diagram below containing relevant additional information.

2050 greenhouse gas emissions reduction targets: modelled indicative impacts

This brief describes for Ministers the modelled economic and social impacts of key policy choices for a new 2050 greenhouse gas emissions reduction target. It is intended to inform discussions between Climate Change Ministers and Chief Executives. The results presented give a scale of the potential impacts of a given target option. How the impacts are felt across society and the economy will depend on the policies used to make the transition.

Economic modelling helps illustrate the scale of the potential cost impacts of the range of target options. Impacts below do not consider the costs necessary to meet our current 2030 NDC. Potential upsides (shown on pg 2) are not included in the figures below.

	Impacts – 2020 to 2025			Policy preconditions	Impacts – 2020 to 2050		
	Whole of economy	Industries, primary sector & forestry	Households		Industries, primary sector & forestry	Regions	Households
New Zealand's emissions and sinks balance by 2050 None: Both options were modelled as net zero all-emission. The impacts reported do not consider any additional impact of constraints caused by gross domestic targets for biogenic methane and for other gases under option 2. This could result in option 2 having a greater economic impact than option 1.	Annual average GDP growth rate of 1.77 to 1.84% per annum Annual average GDP of \$311 b (2020 to 2030) Indicative cost of mitigation \$43 /tCO ₂ e** Fiscal impacts of policy not costed	Increased carbon prices will affect industries in the NZ ETS, including growth of the forestry sector Indicative additional cost per dairy farm of \$4,200 per annum (assuming ag in the NZ ETS with 95% allocation) Increase of \$223 per year (2.8%) in the average household energy bill (petrol, electricity and gas) Increase of \$78 per year (2.8%) in the annual energy bill for low income households (first quintile)	Indicatively: • Household incomes could grow by 10% between 2020 and 2025 • Increases of 5 cents per litre of petrol • 1 cent per kWh of electricity • Increase of \$123 per year (2.8%) in the average household energy bill (petrol, electricity and gas) • Increase of \$78 per year (2.8%) in the annual energy bill for low income households (first quintile)	For the impacts reported here (to 2050), governments will need to ensure: • Large scale-up take of an efficient and low-emission transport system, including shift to electric vehicles • Significant afforestation • Innovation in agriculture, including methane inhibitors utilised in most farms • Increased renewable electricity generation • Transition to electrification of industrial processes and to lower emission fuel sources	Higher emissions prices encourage sheep and beef farmers to convert to forestry (some conversions already underway at current prices) Indicatively 2 million Ha converted from sheep and beef to forestry*** This would double current plantation pine estate, and reduce sheep and beef land by approximately 25%, remaining sheep and beef land is assumed to be more productive than currently A larger forestry sector could lead to higher demand for wood processing and services Change in the dairy sector is less significant, as long as the sector continues to innovate	Sheep and beef makes a significant contribution to the regional economy in Manawatu-Wairarapa, Otago and Canterbury, so these regions could be affected Other localised effects as larger emitters transition	Household incomes could grow by 81 to 86% between 2020 and 2050 Expect minimal impacts on expenditure by 2050 electricity will be primarily renewable and transport will be electric Petrol price in 2050 increases by 40 to 67 cents per litre (assuming full emissions price passed through)
Gross reduction of biogenic methane emissions of 25%, net zero emissions of all other gases by 2050	Annual average GDP growth rate of 1.84% per annum Annual average GDP of \$312 b Indicative cost of mitigation \$32 /tCO ₂ e** Fiscal impacts of policy not costed	Indicative additional cost per dairy farm of \$2,500 per annum ETS with 95% allocation Increased carbon prices will affect industries in the NZ ETS	Indicatively: • Household incomes could grow by 11% between 2020 and 2025 • Increase of 2 cents per litre of petrol • Increase of 0.3 cents per kWh of electricity • Increase of \$48 per year (1.1%) in the average household energy bill (petrol, electricity and gas) • Increase of \$30 per year (1.1%) in the annual energy bill for low income households (first quintile)		Indicatively 1 million Ha converted from sheep and beef to forestry This would increase current plantation pine estate Change in the dairy sector is less significant, as long as the sector continues to innovate	Sheep and beef makes a significant contribution to the regional economy in Manawatu-Wairarapa, Otago and Canterbury, so these regions could be affected Other localised effects as larger emitters transition	Household incomes could grow by 84% between 2020 and 2050 Impact on electricity costs unknown Petrol price in 2050 increases by 20 to 40 cents per litre (assuming full emissions price passed through)
Current domestic target: 50% reduction on 1990 levels by 2050	Annual average GDP growth rate of 1.91% per annum Annual average GDP of \$313 b		• Household incomes could grow by 11% between 2020 and 2025		Indicatively 0.8 million Ha converted from sheep and beef to forestry	Localised effects as larger emitters transition	Household incomes could grow by 87% between 2020 and 2050

**This represents the average cost of reducing emissions across the economy. It is not an NZU price in the NZETS.

***Modelling does not consider water quality constraints

Sources: Modelling based on Concepts, Maori, Whānau (CMV) modelling for NZE & Productivity Commission, GDP impacts from NZE modelling, household impacts (NZU consolidation) based on CMV modelling

Problem/opportunity definition

The current legal and policy framework for climate change action falls short of ensuring New Zealand's economy is sufficiently incentivised to transition to lower emissions at a scale that enables continued prosperity to New Zealanders in an emissions-constrained future global economy. It fails to provide a stable and credible policy environment to enable long-term planning, decision-making and investment by the private sector and civil society.

In line with the All-of-Government Framework's 2020 outcomes and three pillars, setting a new 2050 target would:

- provide an enduring, long-term signal to businesses, consumers and New Zealanders
- align with the emission reduction objectives of the Paris Agreement
- articulate the direction of travel for New Zealand's successive NDCs
- reinforce New Zealand's position as a global leader on climate change.

A domestic target that is legislated and quantified would clearly signal the pace of New Zealand's transition to a low-emissions, climate-resilient economy. It also provides the direction of policy travel needed for climate change mitigation in the near to long term. A legislated 2050 target, compared with the current gazetted target, would have more prominence, discourage changes of ambition in response to short-term considerations and provide greater regulatory certainty about the direction for transition.

We are unable to specify further how the new target will influence the exact transition pathway taken as this will be determined by the policies designed to drive and support transition to meet the new target. Government departments are progressing policies towards lowering emissions in some sectors (eg, transport) while other sectors' transitional policies are less developed. Considering distributional effects across regions and society will be critical when developing the transitional policies.

On the basis of these considerations, in December 2017, Cabinet agreed to introduce a 2050 emissions reduction target by way of the Bill [CAB-17-MIN-0547.01 refers]. This decision has informed the available options in this policy area.

Options identification

Matters to consider

This section considers two matters relevant to setting a 2050 emissions reduction target:

- 2050 target options: defining the target
- use of international units: considering whether international units may be allowed to contribute towards meeting a new target.

What options are available to address the problem?

Any target we set should be informed by the best available climate change science, including the different attributes of short-lived and long-lived GHGs.

Short-lived gases like biogenic methane (CH₄) which is New Zealand's dominant GHG, decay relatively rapidly in the atmosphere. It lasts for decades rather than centuries. This means global temperatures can be stabilised (at a given temperature level) without necessarily reducing emissions of these gases to zero. Reducing short-lived gases further below the stabilisation level, such that global temperatures remain constant, may also reduce climate impacts.

To stabilise temperatures, long-lived gases like carbon dioxide (CO₂) and nitrous oxide (N₂O) either need to reduce entirely to zero or be balanced out (to net zero) by an equal amount of removals, for example by planting new forests. In New Zealand, biogenic methane comprises 93 percent of short-lived gas emissions. In the context of setting a target that differentiates between short-lived and long-lived gases, 'short-lived' gases refers to biogenic methane only. Note, the Kigali Amendment aims for the phase-down of hydrofluorocarbons (**HFCs**) by cutting their production and consumption. The amendment will enter into force on 1 January 2019.

Taking this into account, three 2050 target options were proposed for public consultation on the Bill, with one of the options more appropriately considered as two distinct options²³:

1. net zero carbon dioxide by 2050
2. net zero long-lived gases and stabilised short-lived gases by 2050 (*fungible – non-methane offsets can be counted towards achievement of stabilisation level*)
3. net zero long-lived gases and stabilised short-lived gases by 2050 (*non-fungible – absolute cap on biogenic methane*)
4. net zero GHG emissions across all gases by 2050.

In addition, two further options were identified following consultation:

5. net zero emissions in the second half of the century with separate pathways for long-lived and short-lived gases: biogenic methane to [x] percent below 2016 levels by 2050 and all other GHGs to net zero by 2050.
6. a domestic-only target explicitly recognising different pathways for different gas types (similar to Option 5), nested within an overall conditional target of net zero GHGs in 2050 that can be met through the use of international units.

The key differences between targets are: coverage of gases (and whether they are considered to be fungible²⁴); level of ambition; and whether use of international units to count towards achievement of the target is made explicit.

²³ Submissions in support of Option 2 (net zero long-lived gases and stabilised short-lived gases by 2050) promoted two fundamentally different approaches to achieving stabilisation – an absolute cap on methane (*non-fungible*) or the ability to use non-methane offsets to reach the desired level (*fungible*) – see footnote 24 below.

²⁴ Fungibility refers to whether or not sequestration of long-lived gases (eg carbon dioxide) are permitted to offset emissions of short-lived gases (eg biogenic methane). Target options that do not allow fungibility place an absolute cap on emissions of short-lived gases, whereas target options that permit fungibility allow emissions of short-lived gases to exceed the specified stabilisation level, if there is equivalent amounts of sequestration and abatement of long-lived gases.

The target options are mutually exclusive. However, all target options seek to achieve at least net zero carbon dioxide by 2050 (Option 1). All targets would be set in legislation, rather than by gazette notice.

The key difference between the options is how different gases are to be treated in the target:

Regardless of the form and level at which the Government sets the target, the degree of access to international units will create trade-offs in incentives. Allowing international units, and having access to international markets, would:

- reduce the size of the challenge of the required domestic transition, but also
- reduce the strength and clarity of the legislation's signal incentivising change necessary for New Zealand's domestic transition to a low-emissions economy.

2050 target policy intervention options

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Description	Net zero carbon dioxide by 2050	Net zero long-lived gases and stabilised short-lived gases (fungible) by 2050	Net zero long-lived gases and stabilised short-lived gases (non-fungible) by 2050	Net zero GHGs by 2050	Net zero GHGs in the second half of the century with separate pathways for long-lived and short-lived gases: biogenic methane to [x] percent below 2016 levels by 2050 and all other GHGs to net zero by 2050	Domestic emissions target with separate pathways for long-lived and short-lived gases (Option 5), nested within an overall conditional target of net zero emissions by 2050 (which can be partly met through international units)
Key features	<ul style="list-style-type: none"> The target would be to reduce CO₂ emissions (only) to net zero by 2050. 	<ul style="list-style-type: none"> The target would be to achieve net zero emissions of long-lived gases by 2050, while stabilising emissions of short-lived gases. Under this option, long-lived and short-lived gases are fungible – emissions reductions from one gas (eg, CO₂ sequestration from forestry) can be used to help reach the stabilisation level of another (eg, biogenic CH₄). 	<ul style="list-style-type: none"> The target would be to achieve net zero emissions of long-lived gases by 2050, while stabilising emissions of short-lived gases. Under this option, the CH₄ stabilisation level requires an absolute cap on CH₄ – offsets from forestry may not be used to help reach the methane stabilisation level. The CH₄ stabilisation level could be set out in the Zero Carbon Bill; alternatively, it could be set by the government at a later stage on the basis of a recommendation by the Commission. 	<ul style="list-style-type: none"> The target would be to achieve net zero GHG emissions by 2050. Under this target option, all GHG emissions are fungible. 	<ul style="list-style-type: none"> The target would be to achieve net zero GHG emissions by between 2050 and 2099. In 2050, long-lived gas emissions would reach net zero, with short-lived gases to achieve a net [x] percent reduction in biogenic methane. Under this target option, all GHG emissions are fungible. The CH₄ reduction level could be set out in the Zero Carbon Bill; alternatively, it could be set by the government at a later stage on the basis of a recommendation by the Commission. 	<ul style="list-style-type: none"> Under this option, two targets are set in legislation: <ul style="list-style-type: none"> the first is a domestic emissions reduction-only target the second is a conditional target of net zero emissions by 2050, which can partly be met using international units. Emissions remaining after achievement of the domestic target would be offset by international units.

What criteria, in addition to monetary costs and benefits, have been used to assess the likely impacts of the options under consideration?

The target options were assessed against the following sub-criteria within the three overarching objectives. Each sub-criterion has been given equal weighting of importance. The key considerations that underpin these criteria are further specified in **Appendix 2**.

Leadership at home and internationally (promotes global action):

- i. represents bold domestic action and ambition, particularly in areas where New Zealand leads or can take the lead
- ii. is informed by science
- iii. aligns with New Zealand's international commitments.

A productive, sustainable and climate-resilient economy (ensures the optimal transition pathway):

- iv. maximises the economic, social and environmental benefits including:
 - a. economic benefits:
 - innovation effects and productivity
 - increasing competitiveness
 - further positive economic externalities
 - b. social, health and environmental co-benefits
- v. minimises perverse incentives and economic distortions, including:
 - a. adverse impact on competitiveness or further economic costs
 - b. social and environmental costs.

A just and inclusive society (ensures a careful transition):

- vi. enables planning ahead
- vii. protects those who may face challenging effects.

How has consultation affected these options?

There was a clear majority (100 percent form submissions; 67 percent non-form; 91 percent overall in favour of the government setting a 2050 target in legislation now.

The majority of submitters (99.9 percent form submissions; 58 percent non-form; 90.6 percent overall) indicated a preference for the net zero emissions target (Option 4 in this RIS). The main arguments in favour of this included higher ambition, a science-based approach, and maximising the benefits of strong climate policy.

Some submitters (0.01 percent form submissions; 22 percent non-form; 4.8 percent overall) expressed a preference for net zero long-lived gases and stabilised short-lived gases (Options 2 and 3). The main arguments in favour of this were the explicit recognition of the different impacts of long-lived and short-lived gases and the perceived negative economic and social impacts of a net zero emissions target.

Few submitters (<0.01 percent form submissions; 10 percent non-form; 2.3 percent overall) chose net zero carbon target (Option 1). The main arguments for this option were the lower cost of CO₂ reductions, recognition of the difference between carbon dioxide and methane (with its limited abatement opportunities) minimising the risk of emissions leakage.

Potential for emissions leakage and competitiveness challenges

New Zealand is considered to be an emissions-efficient producer of meat and dairy products by international standards. The potential for emissions leakage – understood as economic activity migrating from New Zealand to other jurisdictions in which it is more emissions-intensive – was raised by submitters. These submitters identified a potential perverse outcome of increasing overall global emissions as a result.

Numerous submissions also expressed concerns that strong climate change action could bring competitiveness challenges, especially for emissions-intensive and trade-exposed (EITE) firms. These challenges reflect differences in the costs businesses face compared to their overseas competitors.

Potential leakage and competitiveness challenges were recognised in the economic modelling and analyses undertaken, particularly by Sense Partners (2018), and are discussed further below in the section on **Economic impact analysis of 2050 target options**. Target options that differentiate between different gases will go some way to alleviate these concerns. Different policy mechanisms are also available (eg, free allocation to EITE participants in the NZ ETS).

Alternative metrics

Some submissions called for the adoption of a new metric (GWP*) to replace the hundred-year global warming potential metric (GWP₁₀₀) metric that is currently used by all countries to report their emissions under the UNFCCC, and that is used to compare the impact of different GHGs relative to the impact of carbon dioxide over a period of one hundred years. As with all metrics used to compare the impacts of different greenhouse gases, it is imperfect.

GWP₁₀₀ is considered by some to over-represent the impact of short-lived gases and under-represent the impact of long-lived gases on overall global warming. Adoption of a different metric could materially change the potential impacts of various target options (for example by changing the estimation of impacts of different sectors), and is also likely to have implications for consistency with how we report our emissions internationally.

Further consideration of the appropriate metric for New Zealand's 2050 target could be contemplated (for example, by the Climate Commission). However, this analysis has been carried out on the basis of the evidence base available. New Zealand inventory data (on the basis of which the NZIER model was built) is reported using GWP₁₀₀.

What other options have been ruled out of scope, or not considered, and why?

No non-regulatory options were considered. This is because one of the key purposes of the Zero Carbon Bill is to set a new 2050 emissions reduction target in primary legislation, to which Cabinet has already agreed.

The option of separate emissions reductions required for the agricultural sector or land sectors compared to all other sectors of the New Zealand economy was not considered.

This is because the vast majority of the scientific literature on the treatment of GHGs to limit global temperature increase to two degrees (the bottom-line emission reduction objective of the Paris Agreement) suggests that all long-lived gases, such as nitrous oxide, need to be reduced to net zero as soon as possible, with all GHGs to net zero by the end of the century; this option would likely not support this target.

While the conversation regarding metrics is an important one, it could significantly alter the economic impact of target options and/or the prioritisation of action in respect of specific GHGs. Therefore, alternative metrics have not been considered in this analysis. If there is an appetite to open up the question of metrics, we consider this decision could be based on more in-depth work to be carried out by the Commission.

What relevant experience from other countries has been considered?

Many other countries have already set ambitious long-term emissions reduction goals.

Table 2 presents a number of long-term targets that have been set by other countries. This comparison helps provide context for setting New Zealand's emissions reduction target.

Table 2: 2050 target international comparisons

The proportion of biogenic methane emissions in each country is presented for context. All countries will face challenges in particular sectors in reducing emissions to reach all-of-economy emissions reduction targets. Jurisdictions are listed in alphabetical order.

Jurisdiction	Emissions reduction commitment	Gases covered	Access to international units	Target status (legislated, goal in long-term strategy, Nationally Determined Contribution (NDC), etc)	Comment	Biogenic methane (% of total emissions) for latest inventory year ²⁵
Australia	No 2050 target	N/A	N/A	N/A	Australia only has a 2030 target – to reduce emissions by 26-28 per cent on 2005 levels by 2030.	10%
Canada	Target to reduce GHGs by 80% in 2050 from 2005 levels.	All gases (unspecified)	Yes	Strategy The Clean Air Act legislates a target of 45-65% reduction from 2003 levels by 2050.	Canada has a strategy specifically addressing short-lived gases, including CH ₄ , but this focuses on emissions from oil and gas sources (ie, non-biogenic). CH ₄ and other volatile gas reduction is legislated (by 40-45% below 2012 levels by 2025 from oil and gas industry).	4%
China	No 2050 commitment	N/A	N/A	N/A	China's NDC includes the target to peak CO ₂ emissions by 2030 at the latest, lower the carbon intensity of GDP by 60-65% below 2005 levels by 2030, increase the share of non-fossil energy carriers of the total primary energy supply to around 20% by that time, and increase its forest stock volume by 4.5 billion cubic metres compared to 2005 levels.	4%
Denmark	Objective for Denmark to be a low-emissions society (target not specified), independent of fossil fuels, by 2050.	N/A	N/A	N/A	The Danish Government's contribution to the EU's target of 80-95% reduction by 2050 (see below) entails Denmark being able to produce renewable energy sufficient to cover total Danish energy consumption including transport. Danish reduction obligations under EU target have not yet been negotiated.	11%
Ethiopia	Ethiopia has pledged to become carbon-neutral by 2050. This is supported by an interim target of 64% below business-as-usual emissions levels by 2030.	Carbon dioxide (CO ₂), methane (CH ₄) and nitrous oxide (N ₂ O).	Yes – Ethiopia intends to sell carbon credits during the target period to achieve its Green Economy Strategy and supports development of effective accounting rules for environmental integrity of market mechanisms.	Target communicated in NDC and long-term strategy .	A strategy is currently being developed for reaching carbon neutrality (no further defined), at the same time as attaining Middle-Income Country Status and improving resilience. Sectors included are agriculture (livestock and soil), forestry, transport, electric power, industry (including mining) and buildings (including waste and green cities). One key area of focus is improving efficiency in the livestock value chain.	48%
European Union	Target to reduce greenhouse gas emissions by 80-95% compared to 1990 levels by 2050.	All gases (unspecified) The 2050 Roadmap covers the power sector, residential and tertiary, industry, transport, non-	Yes – emissions should be cut by 80% through domestic reduction measures alone, but use of international credits ensures achievement of	Described in the EU's long-term strategy, the 2050 Low-Carbon Economy Roadmap	The EU Roadmap outlines the strategy for getting to 80% reduction by 2050. EU officials advise that this roadmap is being renewed and ambition will probably be lifted to net zero emissions or something else aspirational, such as "1.5°C compatibility".	6%

²⁵ Data on agricultural methane emissions sourced from the United Nations Framework Convention on Climate Change (UNFCCC) greenhouse gas inventory (<https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/ghg-data-unfccc>), with the exceptions of the State of California (https://www.arb.ca.gov/app/ghg/2000_2016/ghg_sector_data.php) and State of Victoria (<http://ageis.climatechange.gov.au/SGGI.aspx>).

Jurisdiction	Emissions reduction commitment	Gases covered	Access to international units	Target status (legislated, goal in long-term strategy, Nationally Determined Contribution (NDC), etc)	Comment	Biogenic methane (% of total emissions) for latest inventory year ²⁵
		CO ₂ agriculture and other non-CO ₂ sectors	overall emission reductions above 80%. ²⁶			
Finland	Target to reduce greenhouse gas emissions by at least 80% by 2050 compared to 1990 levels.	Greenhouse gases defined as CO ₂ , CH ₄ , N ₂ O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF ₆), nitrogen trifluoride (NF ₃) and other gaseous components of the atmosphere, both natural and anthropogenic, which absorb and transmit infrared radiation	Yes – Finland is an EU ETS participant and its medium-term plan recognises measures to achieve the 2030 (and 2050) target will primarily comprise national emission reduction measures, but flexibility will also be important	2050 target is legislated in the Climate Change Act 2015 and reflected in Medium-Term Plan	Finland's Medium-term Plan includes a mitigation action plan for human-induced greenhouse gas emissions in agriculture, transport and waste management. The National Energy and Climate Strategy specifies key objectives and policy outlines to 2030 concerning both the emissions trading and non-emissions trading sectors. Finland has also approved the EU target to reduce emissions by at least 20% by 2020 from 1990 levels, in addition to its own individual targets: <ul style="list-style-type: none"> to reduce emissions by 16% in non-emissions trading sectors (eg, construction, building heating, housing, agriculture, transport, waste management and industrial F-gases). to increase the use of renewable energy to 38% of final energy consumption. Besides these, operators covered by the EU ETS are to reduce CO ₂ emissions by 21% of 2005 levels by 2020.	4%
France	Target to reduce greenhouse gas emissions by 75% by 2050 compared to 1990, but relevant plan aims for carbon neutrality by 2050.	All gases (unspecified)	Yes – France is an EU ETS participant	Target legislated in the Energy Transition Act, and the National Low-Carbon strategy outlines sector-specific emissions reduction targets (covering construction, transport, agriculture, industry and waste)	A 2050 Climate Plan was published in 2017, which would see France becoming man-made greenhouse gas neutral by 2050, supported by a ban on domestic fossil fuel production and the sale of petrol and diesel-fuelled cars by 2040. As in the UK, France adopted a series of carbon budgets (first three span 2015-2018, 2019-2023 and 2024-2028).	8%
Germany	Target to reduce greenhouse gas emissions by 80-95% by 2050 compared to 1990 levels. Aspirational goal for greenhouse gas neutrality by 2050.	All gases (energy, buildings, transport, industry, agriculture, land use and forestry sectors)	No information	Target in long-term strategy , the Climate Action Plan 2050	A large proportion of Germany's energy is generated from fossil fuels. Meeting its targets will be supported by the "Energiewende" (energy transformation), which covers all greenhouse-gas emitting sectors of the economy. Germany has also developed a "Climate Action Plan 2050" which aims to set the long-term direction of travel, as well addressing a projected shortfall on its 2020 emissions reduction target.	4%
Iceland	Carbon neutrality by no later than 2040, with an interim target of 40% below 1990 levels by 2030.	All gases (unspecified)	Yes – Iceland is an EU ETS participant	Recently announced Government goal (not legislated or in formal plan/document)	A Climate Change Committee has been established and a new Climate Change Action Plan is being developed which will, inter alia, revise Iceland's carbon tax. Emissions reductions have so far been achieved primarily from transport and shipping, as well as afforestation.	10%
Ireland	Target to reduce CO ₂	All gases (unspecified)	Yes – Ireland is an EU	Target in long-term	Ireland's Climate Action and Low Carbon Development Act 2015 provides the	32%

²⁶ EU ETS participants can use international credits (from either the Kyoto Protocol's Clean Development Mechanism (CDM) or Joint Implementation (JI))²⁶ towards fulfilling part of their obligations until 2020, subject to qualitative and quantitative restrictions. The Paris Agreement established a new market mechanism to replace the CDM and JI after 2020.

Jurisdiction	Emissions reduction commitment	Gases covered	Access to international units	Target status (legislated, goal in long-term strategy, Nationally Determined Contribution (NDC), etc)	Comment	Biogenic methane (% of total emissions) for latest inventory year ²⁵
	emissions by at least 80% compared to 1990 levels by 2050 across electricity generation, built environment and transport sectors. Goal of carbon neutrality in the agriculture and land-use sector, including forestry.		ETS participant	strategy , the National Policy Position on Climate Action and Low-Carbon Development	statutory basis for the national transition objective to achieve a low-carbon, climate-resilient and environmentally sustainable economy by the end of the year 2050. The Climate Action and Low Carbon Development Act 2015 further established processes for Ireland to achieve its long-term objective of a “ <i>transition to a low carbon, climate resilient and environmentally sustainable economy</i> ” by 2050, including establishing an independent committee to annually review Ireland’s climate change action. Ireland’s 2017 National Mitigation Plan notes that Ireland expects to make use of provisions to bank excess allowances to future years and to trade allowances with other EU Member States in meeting its compliance requirements under the Effort Sharing Decisions for 2020 and 2030. This policy may not continue.	
Japan	Target to reduce greenhouse gas emissions by 80% by 2050 compared to 1990 levels	All gases (unspecified)		2050 goal in long-term strategy , the Basic Environmental Plan (BEP – unclear if a formal/official commitment Tokyo ETS targets: • by 2020: 25% reduction from 2000 GHG levels • by 2030: 30% reduction from 2000 GHG levels. •	BEP notes to achieve the 80% reduction goal, global warming measures including innovative energy efficiency and maximum use of renewable energy will be important. 2050 goal set in Kyoto Protocol context given responsibility as ‘industrialised’ country.	2%
Marshall Islands	Net zero emissions by 2050	CO ₂ , CH ₄ , N ₂ O	Long-term strategy recommends government consider how to have a more coordinated and efficient approach to applying for overseas aid	Goal in long-term strategy , Marshall Islands Climate Strategy	The Marshall Islands Climate Strategy was released on 25 September 2018. It includes a goal of 100% renewable energy by 2050 and a commitment to produce a National Adaptation Plan by end of 2019. The Strategy will be reviewed and updated every 5 years; updates will include recommended NDC targets.	Not estimated
Netherlands	Currently consulting on a goal of 95% reduction of emissions compared to 1990 levels by 2050	All gases (unspecified)	Yes - the Netherlands is an EU ETS participant	Draft Climate Law would legislate the 2050 target	The Netherlands will develop a new energy and climate plan for 2040 and is also developing its long-term, low-emissions development strategy. These documents are currently under public consultation and are proposing a 95% reduction target for 2050 – the world’s most ambitious, if passed. The Netherlands also has a particular focus on leading the world in ‘circular agriculture’; this initiative builds on joint discussions among companies and organisations in the agricultural sector to reduce emissions by at least 3.5 MtCO ₂ -e by 2030.	8%
Norway	Climate neutrality goal by 2030 (emissions reductions and offsetting)	All gases (unspecified)	Yes – to contribute to emissions reduction in other countries, particularly developing	2030 neutrality goal approved by Parliamentary motion	Alongside the financial budget, the Norwegian government must deliver an annual climate budget to parliament outlining how the proposed national budget is going to affect Norwegian greenhouse gas emissions.	5%

Jurisdiction	Emissions reduction commitment	Gases covered	Access to international units	Target status (legislated, goal in long-term strategy, Nationally Determined Contribution (NDC), etc)	Comment	Biogenic methane (% of total emissions) for latest inventory year ²⁵
	2050 target: 80-95% reduction compared to 1990 (domestic only)		countries (note this info is from 2007)	Legislated 2050 Target in Climate Change Act 2017	Norway has said that climate neutrality can be achieved through the EU emissions trading market, international cooperation on emissions reductions, emissions trading and project-based cooperation.	
South Korea	No 2050 commitment	N/A	N/A	N/A	South Korea's 2030 NDC target is 37% reduction compared to BAU emissions (18% below 2010) by 2030 – this is more than double 1990 levels.	2%
State of California	Goal to achieve carbon neutrality as soon as possible, and no later than 2045, and achieve and maintain net negative emissions thereafter	All gases (unspecified)	Unclear/not specified – current cap-and-trade system includes general requirements for linking to other trading programs (linked with Québec, Canada – Ontario recently departed)	Draft SB100 Bill would legislate the 2050 goal	California's draft SB100 Bill would set three targets: <ul style="list-style-type: none"> • 50% renewables by 2026 • 60% renewables by 2030 • 100% zero-carbon energy by 2045 These targets are in addition to California's targets to reduce emissions to 40% below 1990 levels by 2030, and 80% below 1990 levels by 2050.	5%
State of Victoria	Long-term target of net zero greenhouse gas emissions by 2050	'Greenhouse gases' defined as: (a) CO ₂ , CH ₄ , N ₂ O or SF ₆ ; or (b) HFCs or PFCs specified in regulations made under the National Greenhouse and Energy Reporting Act 2007 of the Commonwealth	N/A	2050 target legislated in Victoria's Climate Change Act 2017	In addition to setting a 2050 target, the Act also: <ul style="list-style-type: none"> • requires five-year interim targets • introduces a new set of policy objectives and an updated set of guiding principles • requires the government to develop a Climate Change Strategy every five years • requires Adaptation Action Plans for key systems • establishes a pledging model to reduce emissions from government's own operations and from across the economy (from 2020) • establishes a system of periodic reporting. 	9%
Sweden	Net zero emissions by 2045 and negative emissions thereafter	All gases (unspecified)	Yes – domestic emissions will be at least 85% lower than 1990	To be legislated in new Climate Act	The net zero emissions target envisages reducing domestic emissions by at least 85 percent by 2045 and offsetting the remaining emissions by planting trees or by sustainable investments abroad. The Government must present a climate report every year in its Budget Bill.	9%
United Kingdom	Target to reduce greenhouse gas emissions by at least 80% by 2050 compared to 1990.	All gases (CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ (and any other GHGs the Secretary of State may designate))	Yes – the UK will remain an EU ETS participant until at least 2020 Fifth Carbon Budget includes recommendation that budget be met without use of international units	Legislated in Climate Change Act	This target is legislated in the Climate Change Act 2008, which also mandates a process for setting five year carbon budgets. The UK has announced a review of the long term target. The Act treats GHGs in the same way. There are different applicable baseline years (either 1990 or 1995) for different gases.	5%
United States of America	No 2050 commitment. However, the US NDC notes its economy-wide 2025 target (26%-28% below 2005 levels) is consistent with a	All gases in US 2014 Inventory (CO ₂ , CH ₄ , N ₂ O, perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulfur hexafluoride (SF ₆) and	N/A	No formal 2050 commitment; NDC notes straight-line, economy-wide emissions reduction pathway to 2050 only.	The US Government has announced its intention to withdraw from the Paris Agreement. Under the terms of the Agreement, which mandates a three-year notice period, the US NDC legally remains in place at least until the end of 2019, although the US intends to withdraw it at that time unless it has found suitable terms for re-engagement. The Trump Administration has already ceased implementation.	4%

Jurisdiction	Emissions reduction commitment	Gases covered	Access to international units	Target status (legislated, goal in long-term strategy, Nationally Determined Contribution (NDC), etc)	Comment	Biogenic methane (% of total emissions) for latest inventory year ²⁵
	straight-line emissions reduction pathway from 2020 to economy-wide emission reductions of 80% or more by 2050.	nitrogen trifluoride (NF ₃).				

Impact Analysis

Criteria:	Option 1: Net zero carbon dioxide by 2050	Option 2: Net zero long-lived gases (LLGs) and stabilised short-lived gases (SLGs) by 2050 (Fungible)	Option 3: Net zero LLGs and stabilised SLGs by 2050 (Non-Fungible)	Option 4: Net zero GHG emissions by 2050	Option 5 - Net zero GHG emissions in second half of century, with net zero LLGs by 2050 and [x] reduction in SLGs by 2050	Option 6: Domestic-only target with separate pathways for LLGs and SLGs (Option 5), nested within conditional overall target of net zero GHG emissions by 2050 using intl units
Represents bold domestic action and ambition, particularly in areas where New Zealand leads or can take the lead	- Limits action and leadership to CO ₂ only.	++ Represents bold domestic action and ambition (depending on the stabilisation level). Demonstrates leadership with respect to tackling biogenic methane.	+++ Implied absolute cap on methane means increased domestic action and ambition (depending on the stabilisation level) compared to Option 2. Demonstrates leadership with respect to tackling biogenic methane.	+++ Represents bold domestic action and ambition for all GHGs.	+++ Represents bold domestic action and ambition (depending on the stabilisation level). Demonstrates leadership with respect to tackling biogenic methane.	+++ Represents bold domestic action and ambition (depending on the stabilisation level). Timeframe to achieve net zero is longer than Option 4. Domestic action supplemented by international units to reach net zero emissions in 2050. Demonstrates leadership with respect to tackling biogenic methane. Conditional net zero

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						target provides less certainty than an unconditional one.
Is informed by science	<p>-</p> <p>Acknowledges the need to reduce one long-lived gas (CO₂) to net zero as soon as possible; ignores the need to reduce other LLGs such as nitrous oxide or SLGs to net zero by end of century.</p>	<p>+</p> <p>Acknowledges different pathways are appropriate for LLGs (net zero as soon as possible) and SLGs (net zero not required). However, depending on the method, allowing fungibility is less consistent with the science than a non-fungible approach and is arguably less consistent with taking a split-gas approach.</p>	<p>+++</p> <p>Acknowledges different pathways are appropriate for LLGs (net zero as soon as possible) and SLGs (net zero not required). Non-fungibility is more consistent with taking a split-gas approach.</p>	<p>++</p> <p>Acknowledges that all GHGs need to be reduced to net zero globally. Does not acknowledge different pathways appropriate for LLGs and SLGs.</p>	<p>++</p> <p>Acknowledges different pathways are appropriate for LLGs (net zero as soon as possible) and SLGs (net zero not required). Fungibility of gases is entirely consistent with adopting an overarching 'all GHGs' framing.</p>	<p>++</p> <p>Acknowledges different pathways are appropriate for LLGs (net zero as soon as possible) and SLGs (net zero not required). Fungibility of gases is entirely consistent with adopting an overarching 'all GHGs' framing.</p>
Aligns with New Zealand's international commitments	<p>-</p> <p>Is not consistent with either a 2 or 1.5 degree pathway. Is not consistent with achieving a balance between emissions by sources and removals by sinks in the second half of the</p>	<p>+</p> <p>Depending on the stabilisation level, could be consistent with either a 2 or 1.5 degree pathway. Doesn't provide any clarity about achieving a balance between emissions by sources</p>	<p>+</p> <p>Depending on the stabilisation level, could be consistent with either a 2 or 1.5 degree pathway. Doesn't provide any clarity about achieving a balance between emissions by sources</p>	<p>+++</p> <p>Consistent with both a 2 and a 1.5 degree pathway. Provides clarity on New Zealand's contribution to achieving balance between emissions by sources and removals</p>	<p>++</p> <p>Consistent with a 2 degree pathway; depending on the stabilisation level, could also be consistent with 1.5 degree pathway. Provides clarity on New Zealand's</p>	<p>++</p> <p>Consistent with both a 2- and a 1.5-degree pathway (if conditions for the net zero target are met; depending on stabilisation level if not). Provides some clarity on New Zealand's contribution to achieving</p>

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	century.	and removals by sinks in the second half of the century.	and removals by sinks in the second half of the century.	by sinks in the second half of the century	contribution to achieving a balance between emissions by sources and removals by sinks in the second half of the century.	balance between emissions by sources and removals by sinks in the second half of the century (the conditionality reduces this clarity).
Maximises the economic, social and environmental benefits, including: a. economic benefits: <ul style="list-style-type: none"> • innovation effects and productivity • increasing competitiveness • further positive economic externalities b. social, health and environmental co-benefits	<p>--</p> <p>Decarbonising NZ's economy will drive some innovation and productivity improvements, and competitiveness. But, it results in fewer co-benefits from action on other GHGs.</p> <p>Constrains social, health, and environmental co-benefits to action on CO₂ only.</p>	<p>+++</p> <p>Incentivises some innovation and productivity improvements and competitiveness across all GHGs.</p> <p>Social, health, and environmental co-benefits will apply across the economy.</p>	<p>++</p> <p>Incentivises innovation and productivity improvements across the economy, particularly in biogenic CH₄-emitting sectors.</p> <p>May result in poorer social outcomes; and improved health and environmental benefits.</p>	<p>+++</p> <p>Reducing all GHGs incentivises innovation and productivity improvements and competitiveness. Will result in the opportunity to achieve greatest co-benefits.</p> <p>Provides enough flexibility between gases to be able to balance co-benefits.</p>	<p>+++</p> <p>Reducing all GHGs incentivises innovation and productivity improvements and competitiveness. Will result in the opportunity to achieve greatest co-benefits.</p> <p>Provides enough flexibility between gases to be able to balance co-benefits.</p>	<p>++</p> <p>Reducing long-lived GHGs to net zero and stabilising short-lived GHGs will incentivise some innovation and productivity improvements and competitiveness across all GHGs.</p> <p>Social, health, and environmental co-benefits will apply across the economy.</p>
Minimises perverse incentives and economic	<p>---</p> <p>Distorts the economy by focusing on one</p>	<p>-</p> <p>May incentivise preferential treatment</p>	<p>---</p> <p>Same as option 2, however the lack of</p>	<p>--</p> <p>Minimises perverse incentives and</p>	<p>-</p> <p>Will create fewer economic distortions</p>	<p>--</p> <p>Will create fewer economic distortions</p>

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<p>distortions, including:</p> <p>c. adverse impact on competitiveness or further economic costs</p> <p>d. Social and environmental costs</p>	<p>GHG, could result in preferential treatment of other sectors which sends inconsistent signals around climate change action. Limits ability to transition to a climate-resilient economy in the short-term.</p>	<p>of sectors, leading to economic distortions. Moderate ability to transition to a climate-resilient economy in the short term. Costs relative to other target options will depend on methane stabilisation level.</p>	<p>fungibility is likely to result in significantly greater economic impacts for a given target, as it reduces flexibility in achieving the target at lowest cost.</p> <p>Costs relative to other target options will depend on methane stabilisation level.</p>	<p>economic distortions as this target is an economy wide target. Likely to have the most significant economic impacts to 2050, but impacts are greatly reduced with higher forestry sequestration.</p> <p>May have significant competitiveness impacts.</p> <p>To some extent may be offset by social and environmental benefits.</p>	<p>than options 1-3; will have less significant economic impacts and competitiveness risks than option 4.</p> <p>Essentially the same overall economic impacts through to 2050 as option 2, although the clearer signal provided by the long-term trajectory to net zero may influence this.</p>	<p>than options 1-3; may have less significant economic impacts and competitiveness risks than option 4 depending on relative costs of domestic abatement and sequestration compared with international units.</p> <p>Requirement to purchase units to reach net zero all GHGs will impose additional cost on the economy relative to option 5.</p>
<p>Enables planning ahead</p>	<p>-</p> <p>Enables planning ahead for carbon-dependent sectors, simple to understand and drives focus for the economy and transition towards decarbonisation. Leaves the question of other GHGs unanswered which may result in</p>	<p>+</p> <p>Less simple to understand; but provides a clear pathway to 2050 and beyond.</p>	<p>+</p> <p>Less simple to understand; but provides a clear pathway to 2050 and beyond.</p>	<p>++</p> <p>Enables planning ahead for all sectors of the NZ economy, simple to understand (on the same basis as all of our past targets) and drives focus for the economy and transition for all GHGs.</p>	<p>+</p> <p>Least simple to understand; maintains some ambiguity as to the pathway for reaching net zero emissions.</p> <p>Covers (and sends signal to reduce) all GHGs.</p>	<p>0</p> <p>Equally difficult to understand and communicate as option 5; maintains some ambiguity as to the pathway for reaching a net zero emission economy.</p> <p>Covers (and sends signal to reduce) all GHGs.</p>

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	regulatory uncertainty.					
Protects those who may face challenging effects	<p>0</p> <p>May be significantly more expensive than the status quo.</p> <p>Enshrines (through the target) protection for non-CO₂ emitting sectors, some of whom may face challenging effects.</p> <p>Delaying or diluting the signal for non-CO₂ signals to transition may result in greater costs in the longer term.</p>	<p>0</p> <p>Likely to be more expensive than the status quo through to 2050.</p> <p>Confers a greater degree of protection from the costs of transitioning for CH₄ emitting sectors.</p> <p>Delaying or diluting the signal for non-CO₂ signals to transition may result in greater costs in the longer term.</p>	<p>0</p> <p>Likely to be significantly more expensive than the status quo through to 2050.</p> <p>An absolute cap on methane is likely to exacerbate the challenges of transitioning for CH₄-emitting sectors – particularly if few abatement options are available.</p>	<p>0</p> <p>Likely to be the most expensive compared with the status quo through to 2050.</p> <p>Does not confer any particular protection to any sector or group; leaves flexibility for downstream policy decisions to mitigate any challenging effects.</p> <p>In the long term, the transition to a net zero emission economy may make us the most resilient compared to the other options.</p>	<p>0</p> <p>Likely to be more expensive than the status quo through to 2050.</p> <p>In the long term the greater strength of signal to transition to a low emission economy may enhance the resilience of New Zealand's economy.</p> <p>Provides a moderate and temporary level of protection to CH₄-emitting sectors.</p>	<p>0</p> <p>Likely to be more expensive than the status quo through to 2050.</p> <p>Confers a greater degree of protection from the costs of transitioning for CH₄ emitting sectors.</p> <p>Delaying or diluting the signal for non-CO₂ signals to transition may result in greater costs in the longer term.</p>
Overall assessment	<p>-</p> <p>Worse than the status quo in relation to most criteria.</p>	<p>++</p> <p>Considerably better than the status quo in relation to most criteria.</p>	<p>+</p> <p>Better than the status quo in relation to some criteria.</p>	<p>++</p> <p>Considerably better than the status quo in relation to most criteria.</p>	<p>+++</p> <p>Significantly better than the status quo in relation to most criteria.</p>	<p>++</p> <p>Considerably better than the status quo in relation to most criteria.</p>

Key:

- +++** significantly better than preserving the status quo
- ++** considerably better than preserving the status quo
- +** better than preserving the status quo

- 0** about the same as preserving the status quo
- worse than preserving the status quo
- considerably worse than doing the status quo
- significantly worse than preserving the status quo

Economic impact analysis of all 2050 target options

A wide suite of qualitative, empirical and quantitative modelling studies informs the assessment of the potential economic impacts of the target options considered. These studies consider both the upsides and challenges of a transition, as presented in **Table 3**.

Table 3: The suite of economic studies and mapping to targets

<i>Economic studies</i>	<i>Relevant to option</i>
The Sense Partners and Ministry qualitative studies consider wider impacts on competitiveness, innovation and wider co-benefits	All target options
The Concept, Motu and Vivid (CMV) ²⁷ and New Zealand Institute of Economic Research (NZIER) modelling studies tell us about emissions prices that could be necessary to achieve net zero emissions or a stabilised methane target equivalent to 25 MtCO ₂ -e remaining at 2050	Options 2 and 4
The NZIER modelling tells us about the potential macroeconomic impacts and allows comparison of the impact of targets to a 'do-nothing further on climate change' baseline or to the 'status quo' current domestic target of a 50% reduction on 1990 emissions by 2050	Options 1 to 4

Appendix 3 of this RIS provides more detail on the suite of qualitative and empirical economic analyses undertaken relevant to all target options and the quantitative modelling that allows relative comparisons to be drawn across Options 1–4. The economic reports underpinning public consultation on the Zero Carbon Bill, released during the consultation period, are also available online. Given the later stage at which Options 5 and 6 were developed, however, these are not specifically included in NZIER's economic modelling.

This RIS chapter first explains economic impacts relevant to all targets, then provides an overview of the relative difference in impacts of Options 1–4.

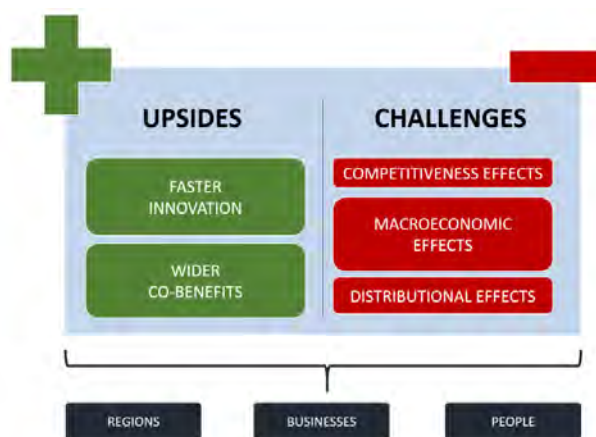
Key findings – across upsides and challenges

Analysis shows the strongest 2050 targets are challenging but achievable with innovation

The economic analysis tells us that all the targets considered in this RIS, including the most ambitious 2050 target considered — net zero emissions (all gases, domestically) — are challenging but achievable if specific innovations arise.

The transition will need progress to lower emissions across the energy, transport and agricultural sectors...

Meeting any ambitious emissions reduction target will require:



²⁷ Commissioned by the Productivity Commission and the Ministry.

- high levels of innovation across the economy
- decarbonisation of agriculture, transport, process heat and electricity generation.

... and substantial land use change into forestry

As emissions prices rise, it will make economic sense to switch from other land uses into forestry. Both CMV and NZIER's modelling shows that New Zealand will see high rates of afforestation to achieve potential 2050 targets.

Achieving this amount of sequestration from forestry could require around 1.3–2.8 million hectares of additional afforestation.²⁸ The annual rates of planting required to achieve these levels may be challenging.

Costs of inaction: doing nothing could also damage the economy

The potential costs of inaction were not modelled by CMV or NZIER. However, recent modelling analysis published in the *Nature* journal suggests that limiting global warming from climate change to 1.5°C (instead of 2°C) by mid-century could have a significantly beneficial impact globally: an increase in global GDP of 1.5 to 2 per cent and avoided damages from climate change globally of approximately \$11 trillion to \$16 trillion.²⁹ Other recent research by the Global Commission on the Economy and Climate estimates a US\$26 trillion direct benefit from taking bold climate action compared with business as usual, and weather- and climate-related hazards accounted for US\$320 billion in losses in 2017 alone.³⁰

The full costs from climate change on New Zealand (and its economy specifically) are difficult to estimate. In many areas, there is little economic evidence available as to the impacts from climate change including on migration, water resources, conflict, energy supply, labour productivity and tourism. Despite the limited economic evidence on the impact of climate damage on New Zealand, some studies do exist:

- Research by Victoria University and NIWA conservatively estimates that over 2007–2017, climate change-related floods and droughts have cost New Zealand at least \$120 million from privately-insured damages from floods and \$720 million for economic losses from droughts. The research states that costs that may be attributed to climate change

²⁸ Page 7 of Productivity Commission, September 2018. Low emissions economy: Final report. https://www.productivity.govt.nz/sites/default/files/Productivity%20Commission_Low-emissions%20economy_Final%20Report_FINAL.pdf.

Note that the high end of the range is from a scenario in which one-third of the afforestation was assumed to be permanent native forest. Other scenarios assumed all afforestation was exotic plantation forest.

²⁹ The avoided damages are calculated using a three per cent discount rate, and mid-century refers to the period between years 2046 to 2065. The authors report the discounted avoided damages in US dollars as between US\$7.7 trillion to US\$11.1 trillion. Burke M, Davis WM, Diffenbaugh NS. 2018. Large potential reduction in economic damages under UN mitigation targets. *Nature*, 557: 549–553.

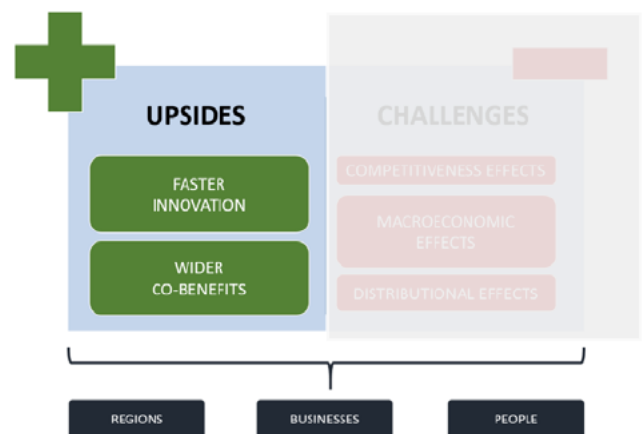
³⁰ The New Climate Economy, 2018. The authors of this work note that the last 19 years included 18 of the warmest years on record, and globally there were poorer food and water security risks and increased frequency and severity of natural hazards.

are expected to increase due to the ongoing emergence of stronger climate change impacts and development in vulnerable locations.³¹

- The OECD has estimated the economic impact of climate change on New Zealand and Australia (combined) as a one per cent reduction in GDP levels by 2060, maybe up to two per cent.³²
- The IPCC identified key climate risks to New Zealand as the increased frequency and intensity of flood damage, damage from wildfires, and risks to coastal infrastructure and low-lying ecosystems from continuing sea level rise.³³
- In addition to sea-level rise and flooding events, projected changes to the frequency and intensity of storms will increase the reach of storm surges and king tides and the extent of rising groundwater.³⁴ The Parliamentary Commissioner for the Environment (PCE) indicates the cost of replacing every building within half a metre³⁵ of the average high tide mark³⁶ could be \$3 billion and within 1.5 metres as much as \$19 to \$20 billion.³⁷

Stronger action to reduce emissions can create substantial upsides

Ministry research³⁸ has identified that there are potentially substantial ‘co-benefits’ available from a domestic transition to a low-emissions economy. Domestic and international evidence indicates that climate action stimulates faster innovation rates in low-emissions technologies³⁹ that are of high economic value. Businesses in emitting sectors, particularly sectors in which New Zealand research and development is world-leading, may thrive, and increased innovation will soften any competitiveness impacts from strong climate action. The nature and magnitude of these co-benefits will depend on the transition pathway.



³¹ NIWA & New Zealand Climate Change Research Institute, 2018.

³² OECD, 2015.

³³ IPCC, 2014. *Climate Change 2014: Impacts, Adaptation and Vulnerability. Part A: Global and Sectoral Aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge & New York: Cambridge University Press.

³⁴ White et al, 2016.

³⁵ The mid-range projected sea-level rise over the next 50 years is about 30 cm and could vary between 20 and 50 cm. Note in the past 100 years seas have risen around 14–22 cm in New Zealand ports.

³⁶ Defined as the Mean High Water Springs.

³⁷ Parliamentary Commissioner for the Environment, 2015.

³⁸ Ministry for the Environment, 2018c.

³⁹ Dechezlepretre et al (2016) find evidence that innovation closely correlates with stronger climate action.

We can also expect wider co-benefits from taking stronger climate action besides reducing emissions. These include reduced congestion, health benefits, cleaner air, cleaner water, and improved biodiversity. These benefits were not modelled and are far more difficult to quantify than economic costs, yet the Ministry has collated a number of studies (from both New Zealand and overseas) that calculate the substantial co-benefits from stronger climate change action:⁴⁰

- **Health benefits from better home insulation:** at the same time as increasing energy efficiency and reducing demand for electricity generation from fossil fuels, better home insulation can improve temperatures and reduce dampness and mould, thereby reducing risk factors of asthma, other respiratory problems and cardiovascular disease, particularly for at-risk groups (eg, children and the elderly). The benefit-cost ratio of insulating houses in New Zealand is estimated at 4:1.
- **Reduced air pollution, congestion and maintenance costs and safety benefits:** the increased use of public transport improves fuel efficiency and reduces traffic congestion, which costs households and businesses in Auckland alone an estimated \$0.9 billion to \$1.3 billion every year in lost time and economic activity. The benefits of switching freight from road to rail have been valued at about \$200 million per year for reduced congestion, \$80 million in maintenance spend and \$60 million in safety improvements. The total emissions reduction benefit is around \$6 million. Globally, a recent International Monetary Fund (IMF) study states that traffic congestion worldwide could cost over US\$350 billion per year from lost productivity and health impacts.⁴¹
- **Improved health and reduced congestion from active transport:** increased active transport (ie, walking and cycling) is shown to increase the level of exercise overall and reduce people's risk of developing Type 2 diabetes, heart disease, some forms of cancer and mental health problems. The net benefits of cycling infrastructure investment are also considerable, estimated at over \$15 billion, with a benefit-cost ratio of 24:1.
- **Improved water quality and biodiversity outcomes:** land-use change to forestry could reduce nitrogen leaching and soil erosion into waterways, as well as protecting the habitats of near-extinct and threatened indigenous species. Co-benefits are difficult to generalise at a national level and vary greatly depending on when, where and what kind of trees are planted. However, one study has estimated the added ecosystem-service value in one Bay of Plenty catchment (per-hectare, per-year) at \$6,092 for exotic forestry plantation, \$6,677 for indigenous forestry, and up to \$37,636 for wetlands and mangroves.⁴² This value covers a range of co-benefits such as water quality, recreation, biodiversity, pollination and erosion control.

Which co-benefits arise will depend on the measures taken to reduce emissions. For example, measures that encourage public transport use will have different co-benefits than those that improve home insulation. The IPCC (2014) has noted co-benefits can be as large as, or even larger than, the benefits of emissions reduction.

⁴⁰ Ministry for the Environment, 2018a.

⁴¹ Coady, D et al, 2015.

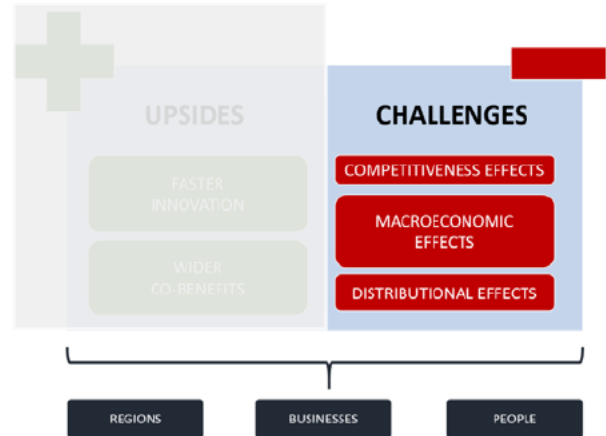
⁴² Yao & Velarde, 2014. Note the ecosystem-service value in this study for indigenous forestry and wetlands and mangroves does not factor in their potential carbon sequestration and adaptation benefits.

To meet any of the new targets evaluated, we can expect ongoing economic growth but at a slower rate

Modelling has been carried out, and must be read with care

The modelling exercises are limited by known omissions, which are that:

- the modelling of impacts:
 - includes only specific innovation upsides
 - excludes potential social and behavioural change
 - excludes wider potential co-benefits.
- The 'do-nothing' baseline excludes consideration of:
 - the impact of a changing climate on New Zealand's economy
 - the economic impact of New Zealand remaining a high-emissions economy whilst trading partners transition towards lower emissions.



These omissions and other limitations mean the modelling is likely to overstate the challenge of the transition.

A peer review of NZIER's work was undertaken by an expert in the method of modelling used, and concluded that, while the modelling framework is appropriate and the "analysis is appropriate under the time constraint for the study", the assumptions present in the modelling mean that on balance the cost estimates produced are "likely in the high end of the probable range".

The modelling tells us ongoing growth is consistent with meeting targets, just at a slower rate

As detailed in the section on **2050 target options identification**, the design of target options considered differs by gases covered, the emissions reduction ambition, whether biogenic methane is 'fungible' or not, and whether international units can be used towards meeting the target. Split-gas targets in which biogenic methane is considered fungible can be expressed as equivalent to 'all gases' targets.

The modelling commissioned indicates the following key findings across all targets:

- All targets pose an economic cost to New Zealand compared to the current domestic target: growth remains positive, yet at a slower rate.

- The costs of meeting potential targets are very sensitive to the amount of afforestation assumed.⁴³ The targets could be met with much lower emissions prices and economic impacts if there is substantial afforestation.
- For all target options, sector-specific, regional and distributional impacts could arise. For example, NZIER's modelling finds that potential target options have the greatest impact on households in the two lowest-income quintiles.⁴⁴ A just transition will mean considering tools to mitigate unwanted impacts on regions, industries and lower-income households.
- A split-gas target allowing a reduced, stabilised level of biogenic methane emissions will incur a lower cost than a net zero, all gases target by 2050.

Allowing fungibility under a given split-gas target would be expected to lower the cost of meeting it, as it would allow abatement (or sequestration) to occur wherever this is at least cost to the economy. However, known limitations of the modelling's specific scenario designs did not allow direct assessment of the economic impact of fungibility, absent the effect of other assumptions.

Some industries may face competitiveness challenges

Analysis commissioned by the Ministry⁴⁵ explored the sectors of New Zealand's economy that could face challenges with competitors from other countries if New Zealand's climate change policies are relatively more stringent. In this scenario, relevant sectors may need policies to ease competitiveness challenges, such as continued free allocation of New Zealand Units (NZUs) under the NZ ETS.

Allowing international units may reduce the domestic cost of the transition

Given the significant uncertainty of how the future will play out, policy consideration is being given to the role international units could play in meeting targets as a 'safety valve', allowing flexibility if innovation and afforestation rates do not eventuate as modelled. NZIER's modelling indicates allowing the use of international units could lessen the overall economic impact of meeting a target if it reduces (or delays) the need for higher-cost domestic abatement or sequestration. However, this depends on the relative costs of available international units and domestic abatement and sequestration in the future, which the model cannot predict. Signalling the use of international units today risks diluting incentives for domestic transition, which could lead to higher costs and lower co-benefits over the long run.

Acting sooner could reduce the overall cost of the transition

⁴³ Increasing the amount of forestry sequestration assumed for the net zero emissions target by one-third (10 MtCO₂e) reduces the modelled economic impacts by an order of magnitude.

⁴⁴ NZIER, 2018. *Economic impact analysis of 2050 emissions targets: A dynamic Computable General Equilibrium analysis*. Report prepared for the Ministry for the Environment, Wellington. Figure 4 on page ix. Retrieved from <http://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/NZIER%20report%20-%20Economic%20impact%20analysis%20of%202050%20emissions%20targets%20-%20FINAL.pdf>

⁴⁵ Sense Partners, 2018. *Countervailing forces: Climate targets and implications for competitiveness, leakage and innovation*. <https://www.mfe.govt.nz/publications/climate-change/countervailing-forces-climate-targets-and-implications-competitiveness>.

CMV note in their work that stronger, near-term action could result in lower overall costs to New Zealand.⁴⁶ Strong policy action (through higher emissions prices) prior to 2030 leads to lower emissions price pathways between 2030 and 2050, regardless of whether innovations occur that disrupt or support existing industries.

Economic analysis of the difference in impact across the target options evaluated

Economic modelling has evaluated the specific target options 1 to 4

The economic modelling has been extended since consultation

CMV refined their modelling to add an uncertainty analysis: the modelling introduced a 'shock' in 2030 to explore what happens when factors do not turn out as expected and the implications for decision-making today. NZIER has also refined and extended its modelling.

Some of the macroeconomic impacts estimated by NZIER in Stage 2 differ from those reported at Stage 1 (which were included in the Bill's consultation stage). For example, Stage 1's modelling reported that to meet net zero emissions at 2050 is consistent with a 1.9 percent annual average growth rate (calculated from 2018-50); Stage 2 says 1.7 to 2.0 percent (calculated from 2020-2050 and depending on sequestration assumptions). Both Stage 1 and 2 estimate a 2.1 percent annual average growth rate if the current domestic target is met.

The change in modelling results are due to four key improvements made to the modelling: the abatement required at 2050 to meet net zero emissions has been recalculated; the baseline was updated to match most recent projections; and innovation assumptions and forestry projections have changed. The core changes between NZIER's Stage 1 and Stage 2 modelling are:

- **an increase in the abatement assumed necessary to achieve net zero emissions at 2050** and updates to the 'do-nothing baseline' to reflect latest Ministry emissions projections
- **changes to innovation assumptions:** Stage 2 refines the 'wide innovation across all sectors' assumption, and adds a 'moderate innovation across all sectors' assumption set. This refines Stage 1's approach which tested the sensitivity of innovation in agriculture separately from in energy and transport.
- **changes to modelling of forestry sequestration:** In Stage 1, forestry sequestration was an exogenous assumption (with different levels assumed for different targets). For Stage 2, an attempt was made to bring sequestration inside the model so forestry grows as carbon prices rise. This proved infeasible within the time available, and forestry sequestration remains exogenous. The model was also adjusted in Stage 2 so that land is reallocated to forestry from other competing land uses (horticulture and livestock

⁴⁶ Vivid Economics, 2018b. *Modelling the transition to a lower net emissions New Zealand: Uncertainty analysis*. Prepared in conjunction with Concept Consulting and Motu Economics and Public Policy Research for the NZ Productivity Commission and Ministry for the Environment.

agriculture) based on relative land prices (Stage 1 assumed that additional forests were planted on scrub-land).⁴⁷

Note that Stage 2's innovation and forestry sequestration assumptions are covered in detail in Appendix 3 (page 175 refers).

Different models give different results, and this type of modelling is highly uncertain

The CMV and NZIER models use very different approaches.⁴⁸ The NZIER model is expected to give higher estimated impacts by design. For consistency, inputs and assumptions in the two modelling exercises were aligned, where feasible.

The method of estimating emissions prices and effects on growth by both CMV and NZIER excludes the potentially significant upsides of the transition, meaning these modelled impacts could well be an overstatement. For example, as noted above, baseline economic activity assumed is a business-as-usual scenario that excludes consideration of the cost of damage that a changing climate could have on New Zealand's economy (eg, to infrastructure or agricultural output). The modelled baseline also excludes consideration of economic impacts New Zealand could face if taking weaker action to reduce emissions than comparable countries.

The modelling reported in this RIS should be read as *indicative*. Attempting to simulate an economic transition over three decades — likely to involve major shifts in technology, markets and behaviour — is an enormous challenge for any model. Interpretations — in particular on the NZIER modelling results — should focus on the relative differences between scenarios, rather than on the absolute cost estimates produced.

The modelling undertaken by CMV on behalf of the Ministry and the Productivity Commission indicated that a transition to net zero emissions by 2050 is feasible at lower emissions prices than were modelled by NZIER. While the CMV model does not estimate impacts on growth rates and GDP, we can reasonably assume lower emissions prices would give rise to a lower overall economic impact.

Indicative impact findings allow comparisons across Options 1–4

For full NZIER modelling results, see **Appendix 3**. In the results tables below, targets are presented in order of declining impact on economic growth. 'Growth rate' here refers to the annual average growth rate over the period 2020–50. 'GDP' refers to the annual average GDP level over the same period. 'NPV cost' refers to the sum of GDP impacts over the same period, in terms of 2018 net present value (NPV).⁴⁹

Modelled impacts are highly sensitive to assumed sequestration levels: more sequestration can dramatically reduce the impact

⁴⁷ Note that NZIER's modelling assumed all sequestration comes from exotic plantation forests.

⁴⁸ The CMV model allows good detail on mitigation options within emitting sectors, and tells us emissions prices required to meet the targets, but does not simulate macroeconomic impacts. The NZIER model is 'blunter', with less sectoral detail, but tells us about impacts across the whole economy and considers flow-on effects across sectors.

⁴⁹ Assuming a 6% per annum discount rate.

Table 5, below, compares results for NZIER's main net zero emissions scenario with its 'higher forestry sequestration' sensitivity run. The results demonstrate a high degree of sensitivity: here increasing the amount of sequestration assumed by one-third (10 MtCO₂e) reduces the modelled economic impacts by an order of magnitude. Under the main net zero emissions scenario, the annual average GDP growth rate is modelled to fall by 0.35 percentage points compared with the status quo, while in the higher forestry scenario this impact is reduced to 0.03 percentage points.

This suggests that forestry sequestration may be a vital factor in limiting the economic costs of the transition – particularly for more ambitious targets. Readers should note that the macroeconomic impacts of all target options relative to the status quo are highly sensitive to the level of forestry sequestration assumed.

Table 4: Economic impact of a net zero emissions target relative to the status quo under different sequestration assumptions

Target option	Forestry sequestration in 2050 (MtCO ₂ e) ⁵⁰	Average 2020–50 emissions price (\$/tCO ₂ e)	Relative to the status quo:		
			Annual average GDP growth impact 2020–50 (percentage points)	Annual average GDP impact 2020–50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018–50 (\$ billion)
Option 4 (net zero emissions, 30Mt sequestration)	30	1,056	-0.35	-\$18.4	-\$148.1
Option 4 (net zero emissions, 40Mt sequestration)	40	406	-0.03	-\$0.9	-\$10.9

The higher the target ambition, the higher the economic impact

Table 5, below, shows as the ambition of the target increases, so does the target's economic impact. If comparing the impact of meeting our current domestic target:

- to meet a target of zero net emissions (all gases) by 2050 (Option 4) the modelled growth rate slows by 0.35 percentage points
- to reach a fungible, split-gas target (Option 2) the modelled growth rate slows by 0.07–0.18 percentage points, depending on the SLG stabilisation level.

Table 5: Economic impact of fungible target options relative to the status quo

⁵⁰ Forestry sequestration will need to be slightly higher than that stated in this table due to an omission of residual emissions from household transport (ie emissions from fuel use in household-owned motor vehicles) which is computed outside the model. Offsetting these residual emissions would require an additional 2–3 MtCO₂e of forestry sequestration. For example, the Option 4 (with 30 MtCO₂e sequestration) would require 32 MtCO₂e sequestration (rather than 30 MtCO₂e) to meet the net zero emissions target with the stated economic impact.

Target option	Emissions remaining in 2050 (MtCO ₂ e) ⁵¹	RELATIVE TO THE STATUS QUO:		
		Annual average GDP growth impact 2020-50 (percentage points)	Annual average GDP impact 2020-50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018-50 (\$ billion)
Option 4 (net zero emissions)	0.0	-0.35	-\$18.4	-\$148.1
Option 2 (fungible split-gas target, 50% stabilisation level for SLGs)	16.4	-0.18	-\$11.7	-\$94.8
Option 2 (fungible split-gas target, 75% stabilisation level for SLGs)	24.6	-0.07	-\$4.7	-\$38.9

The impact of a given split gas target is expected to be lower if it allows for fungibility

If fungibility is not permitted, the sectors that emit SLGs (mainly livestock agriculture) are constrained so that emissions are stabilised at the specified level, eg, 50 percent or 75 percent of 2016 levels. In the model, this reduces the economic output of these and other related sectors (eg, dairy product manufacturing and meat processing) and reduces exports.

Allowing fungibility would be expected to lower the cost of meeting a given split gas target, as it would allow abatement or sequestration to occur wherever this is at least cost to the economy.

NZIER modelled a set of scenarios that allowed fungibility and a set that did not. These scenarios reduced net emissions of LLGs to zero by 2050 and stabilised SLG emissions at levels of 50 percent and 75 percent of 2016 levels. Collectively, these scenarios inform on the economic impacts of Options 2 and 3, as presented in **Table 6**.

However, the peer review of NZIER's study notes that the scenario designs **do not allow direct assessment of the impact of fungibility**, because they also used different input assumptions on sequestration and innovation. Isolating the impact of fungibility was very difficult due to model limitations.⁵² The results should hence be read with care.

Table 6: Economic impact of fungible and non-fungible split-gas target options relative to the status quo

⁵¹ Forestry sequestration will need to be slightly higher than that stated in this table due to an omission of residual emissions from household transport (ie emissions from fuel use in household-owned motor vehicles) which is computed outside the model. Offsetting these residual emissions would require an additional 2–3 MtCO₂e of forestry sequestration. For example, the Option 4 (with 30 MtCO₂e sequestration) would require 32 MtCO₂e sequestration (rather than 30 MtCO₂e) to meet the net zero emissions target with the stated economic impact.

⁵² The sequestration assumptions were set at different levels on the basis that the non-fungible target option does not allow sequestration to offset SLGs – however, it is difficult to determine what levels would be appropriate. The logic behind differing innovation assumptions for these scenarios was that achieving the non-fungible targets (option 3) would require a high level of innovation, particularly through a methane vaccine for livestock agriculture, whereas a fungible target (option 2) may give less incentive for this as it allows forestry to offset biogenic methane emissions.

Target option	Innovation assumption	Forestry sequestration (MtCO ₂ e)	RELATIVE TO THE STATUS QUO:		
			Annual average GDP growth impact 2020-50 (percentage points)	Annual average GDP impact 2020-50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018-50 (\$ billion)
Option 3 (non-fungible split-gas target, 50% stabilisation level for SLGs)	Wide	16.0	-0.33	-\$12.2	-\$75.6
Option 3 (non-fungible split-gas target, 75% stabilisation level for SLGs)	Wide	16.0	-0.31	-\$9.9	-\$52.7
Option 2 (fungible split-gas target, 50% stabilisation level for SLGs)	Moderate	22.6	-0.18	-\$11.7	-\$94.8
Option 2 (fungible split-gas target, 75% stabilisation level for SLGs)	Moderate	18.9	-0.07	-\$4.7	-\$38.9

Allowing the purchase of international units reduces the target's economic impact

Allowing the purchase of high-integrity international units could reduce the economic impact of achieving a net zero emissions target (Option 4). NZIER modelled a scenario where a net zero emissions target is met domestically and one where the target is met 80 percent domestically, with the remaining 20 percent of emissions offset through the purchase of international units. Results are presented below in **Table 7**.

Table 7: Economic impact of Option 4 net zero emissions scenarios relative to the status quo

Target option	Average 2020–50 emissions price (\$/tCO ₂ e)	RELATIVE TO THE STATUS QUO:		
		Annual average GDP growth impact 2020-50 (percentage points)	Annual average GDP impact 2020-50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018-50 (\$ billion)
Option 4 (Net zero emissions, domestic only)	1,056	-0.35	-\$18.4	-\$148.1
Option 4 (Net zero emissions, 80% domestic, 20% international units, \$150/tCO ₂ e) ⁵³	567	-0.11	-\$5.7	-\$48.4

⁵³ Note that the macroeconomic impacts stated for this scenario represent the economic costs of meeting an 80 percent reduction target in 2050. These impacts do not consider the costs of purchasing international units to account for the remaining 20 percent of emissions. There was not sufficient time to model this in a CGE framework. The purchase of international units would pose a cost to New Zealand of \$67.1 million per year over 2020-2050. These figures, therefore, underestimate the macroeconomic impact of this scenario.

If a net zero emissions target is met entirely domestically, then compared to the status quo, GDP growth is modelled to slow by 0.35 percentage points. If 20 percent of a net zero emissions target is met through the purchase of international units, then growth could slow by less: 0.11 percentage points.⁵⁴

Readers should note scenarios that allow for the purchase of international units are complex to model. In particular, in the scenario where 80 percent of the abatement must be met domestically, NZIER could not model offsetting the remaining 20 percent of emissions through a CGE framework. NZIER estimates that offsetting these emissions through purchasing international units at \$150/tCO₂e would cost \$67.1 million per year over the period 2020-2050. Therefore, the macroeconomic impacts in the table above underestimate the economic impact this target poses.

Further, the international unit scenario gives a higher economic impact than the higher forestry sequestration scenario presented earlier. This suggests that if more sequestration is feasible, this would be more economically beneficial than purchasing international units. However, the scenarios were not designed to allow a direct comparison.

While the availability of international units will likely reduce the economic impact of meeting the target, this could dilute the signal for transition set by the target. This could limit the extent to which the domestic economy transitions and would risk New Zealand not realising the potential co-benefits of a domestic transition. Readers should also note that there is huge uncertainty in the emissions price in the future — as a result, it would be risky to rely on international units to meet potential emissions targets.

The impacts of Option 5 and 6 have not been quantified

Although the economic impact of Option 5 has not been specifically modelled by NZIER, we know that the impact will be broadly equivalent to Option 2 up to 2050 (although the signal from the longer-term trajectory may mean they are not exactly the same). After 2050, Option 5 requires that SLG emissions continue to be reduced (through abatement, sequestration or international units) to reach net zero in the second half of the century. Modelling out to 2050 is already stretching the dynamic CGE model to its limits. Therefore, it has not been set to model the impacts of Option 5.

Option 6 has not been modelled.

Key findings of overall economic analysis and links to future emissions budgets

The key message from the economic analysis is one of uncertainty and a wide range of possible impacts. It may be technically feasible to meet the proposed target options (including the most stringent), but it depends on significant innovation and afforestation, starting early with strong price signals, a strong signal for domestic transition, accessing least-cost abatement across all sectors and cross-cutting levers in the economy. It also relies on the social and political will to push ahead.

⁵⁴ See 53 above. GDP impacts of this scenario are underestimated by at least \$67.1 million per year (the direct cost of purchasing units to offset the remaining 20 percent of emissions).

As Murray Sherwin, Chair of the Productivity Commission described: “it is achievable but a stretch.” This also needs to be coupled with what we know of the challenge of meeting the 2030 NDC. We anticipate that domestic abatement options are likely to fall short of that level of ambition. This implies the need to be clear about a transition pathway envisaged when the NDC target was set: one that starts more gradually but ramps up and whether international purchasing is needed to ‘top up’ domestic action.

The 2050 target options now under discussion involve differences of ambition within the ambit of a large range of uncertainty. What this argues for in a policy sense is:

- A strong domestic signal to drive change and innovation is critical, otherwise New Zealand will not be able to remain on track for its domestic transition.
- Some form of flexibility in budget-setting, and ultimately the chosen target option, may be necessary to be adaptive under uncertainty and to manage under- or over-achievement if innovation occurs at a different rate than anticipated. This needs to flow through in policy design from target to emissions budgets, Commission criteria and powers and flexibility mechanisms as an overall package.
- A balanced approach is essential — if the ability to revise the domestic portion of the target is built in, this would need to have tight parameters around it. These include requiring the government to consider the advice or recommendation of the Commission, and bounded criteria on when target revision may occur, such as on the basis of unforeseen circumstances — eg, technological change.

2050 target options: overall assessment

What is the preferred approach?

Economic modelling and analysis show that a transition to a low-emissions economy will be challenging yet technically achievable for New Zealand if specific innovations and economic changes occur. Achieving a low-emissions economy by 2050 will likely require significant afforestation and land use change, high levels of innovation across the economy, clear and consistent signals and early policy measures supporting cost-effective abatement across the economy.

The future is inherently uncertain. To mitigate the risks of this uncertainty, it will be critical to implement policies that incentivise wide innovation and to provide for safety valves and flexibility of implementation, regardless of which target option is adopted. Some of the anticipated ambition surrounding innovation, technology and land use change and energy efficiency could be considered optimistic.

Given these findings and the uncertainties associated with any projected economic impact analysis, and the potential cost to the economy if modelled innovation and afforestation do not eventuate, consideration must be given to certain ‘safety valves’ and flexibility measures, eg:

- allowing the use of international units

- the ability to revise the domestic target (either down or up)
- allowing budgets to be set bottom-up, based on what the economy can bear
- flexibility in the level of methane stabilisation (ie, set at a lower level)
- ongoing use of tools such as industrial allocation for trade-exposed activities
- potential measures to guard against periods of very high emission prices.

In light of these considerations, and the overarching 2050 target sub-criteria, an overall assessment of each of the six 2050 target options is summarised below.

Options 1, 2 and 3: not preferred

Options 1 and 3 were least preferred: Option 1 presents the fewest benefits compared to the status quo; Option 3, by imposing an absolute cap on biogenic methane, would pose unacceptable and unnecessary constraints on the New Zealand economy in the absence of viable abatement options.

Option 2 has also been discounted, as it does not provide clarity of New Zealand's contribution to achieving a balance between emissions by sources and removals by sinks in the second half of the century. In addition, the scientific and economic merits of arguing for a separate treatment of gases (absent of an overarching all-GHGs framing) while also allowing fungibility are unclear.

Three other options were considered viable:

Option 4: viable, but not preferred

Option 4 succeeds on the criteria of bold ambition and sending a clear signal both to the domestic economy and to the international community. A target set at this level would represent considerable international leadership and put New Zealand front and centre among the countries making every possible effort to keep the world on a trajectory that is consistent with holding the global average temperature to 1.5 degrees Celsius above pre-industrial levels. This option was also preferred by a clear majority of submissions (99.9 percent form submissions; 58 percent non-form; 90.6 percent overall).

However, it does not explicitly acknowledge the scientific basis for different pathways for different gases. The level of ambition also carries with it the risk of the most significant economic impacts, which could exacerbate the risks of uneven distributional impacts and require greater measures in support of a just transition. While these risks could, to an extent, be mitigated by the use of international units, this would come to the detriment of a clearly signalled transition to a low-emissions economy domestically. Alternatively, the timeframe for achievement of GHG neutrality could be extended to beyond 2050.

For these reasons, Option 4 is not preferred as currently framed.

Option 6: viable, but not preferred

Option 6 seeks to balance the requirement to transition New Zealand's economy with the aspiration to demonstrate global leadership. It does this by nesting a domestic-only target (with different pathways for long-lived and short-lived gases) within an overarching conditional target to reach net zero emissions in 2050 that can partially be met by international units.

This option creates a strong domestic signal for transition, but adds purchase of international units to the economic cost of the transition (assuming \$150 per tonne, and also assuming a net zero emissions target which is met 80 percent domestically, this would equate to a cost of \$67.1 million per year over the period 2020–50).

Option 6 is, therefore, not preferred.

Option 5: Recommended

Option 5 aims for net zero GHG emissions in the second half of the century and specifies separate pathways for different gases by 2050: to reduce emissions of long-lived gases to net zero and short-lived gases by [x] percent below 2016 levels.

This option combines the best elements of Options 2 and 3, and 4. It aligns with IPCC scenarios that provide a likely chance of keeping the increase in global average temperatures below 2 degrees above pre-industrial levels. These scenarios are characterised by reaching GHG neutrality in the second half of the century. It is also consistent with a rationale that identifies different pathways for different gases — with long-lived gases to net zero by 2050 and a longer timeframe for reduction of biogenic methane. This implies that methane does not need to be, and should not be, reduced to zero on an absolute basis, but that in order to reach overall GHG neutrality, New Zealand's remaining emissions of biogenic methane will need to be balanced by an equivalent level of negative emissions of all other GHGs. Option 5 is, therefore, entirely consistent with allowing full fungibility of gases (offsetting the climate impact of remaining methane with equivalent decarbonisation) and does not present the same inconsistencies as Option 2.

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In these respects, Option 5 strikes the best balance between the assessment sub-criteria. **Therefore, Option 5 is the recommended option.**

Economic modelling and analysis shows that a transition to a low-emissions economy will be challenging yet technically achievable for New Zealand if specific innovations and economic changes occur. While we recommend Option 5, we also consider it prudent to accommodate a degree of flexibility to mitigate the risk that one or more of these assumed innovations or changes does not occur.

We, therefore, also recommend a 2035 review of the target by the Commission (see also **Section 7.2** of this RIS) to assess the extent to which anticipated and assumed abatement technologies have been delivered and adopted. If these advances in technology have not progressed to the level anticipated, the Commission could then recommend changing the target; allowing the use of international units to meet it; or a combination of both.

Use of international units

Problem/opportunity definition

Allowing for the use of international units may be desirable as, in theory, it would substitute a certain portion of domestic action to meet the target at a lower cost, while abating equivalent amounts of GHGs from the atmosphere. Therefore, international units allow countries to:

- set deeper targets
- achieve targets earlier than might otherwise be possible
- reduce the economic impact of achieving a target.

The use of international units can also be a way to help manage the inherent uncertainties of committing to an emissions reduction target at such a distance point in the future, allowing the economy to adapt and flex as circumstances change.

Arguably, however, emitters will be less inclined to bear the cost of reducing actual emissions if these can be offset more cheaply through trading of international units. This can result in a delayed transition, risking greater economic cost over the long term.

There is widespread (officials and the public in consultation) concern that the experience with fraudulent units in the Kyoto Protocol period not be repeated New Zealand is leading in work internationally to ensure that it is able to identify, and have access to, units with environmental integrity.

Limiting the use of international units to meet the 2050 target does not preclude the ability for New Zealand to count international units towards achievement of its successive NDCs, if required, which has previously been agreed by Cabinet [CAB-18-MIN-0248 refers]. Prioritising domestic action to meet the 2050 target may reduce New Zealand's reliance on international units to meet progressively more ambitious NDCs over time.

What options are available to address the problem?

The three options considered were as follows:

	Option 1	Option 2	Option 3
Description	No international units	Allow use of international units, at discretion of Government.	Only allow the use of international units if deemed necessary, and up to a level mandated, by the Commission. The maximum allowable amount could also be limited by legislation.
Key features	The selected 2050 target can only be	International units can be purchased and	International units can be purchased and used to

	reached through domestic abatement measures	used (at whatever levels deemed necessary by the government) to reach the selected 2050 target	reach the selected 2050 target. However, they can only be used if deemed necessary by the Commission (eg as part of the 2035 review).
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What criteria, in addition to monetary costs and benefits, have been used to assess the likely impacts of the options under consideration?

The target options were assessed against the three overarching objectives of the Framework:

- leadership at home and internationally (promotes global action)
- a productive, sustainable and climate-resilient economy (ensures the optimal transition pathway)
- a just and inclusive society (ensures a careful transition).

How has consultation affected these options?

Public consultation on the Bill asked whether international units should be eligible towards achievement of the target. A clear majority was in favour of counting domestic action only towards achievement of the target.

Impact analysis: Use of international units

Criteria:	Option 1 No international units 2050 target solely through domestic abatement	Option 2 Allow the use of international units, at discretion of Government	Option 3 Only allow the use of international units if deemed necessary, and up to a level mandated, by the Commission.
Leadership at home and internationally	<p>++</p> <p>Demonstrates strong leadership at home by placing primary reliance on domestic abatement, helping to reduce New Zealand's emissions out to 2050</p> <p>Complements international commitments, making the split and level of domestic ambition clear</p>	<p>+</p> <p>Takes leadership, but sends a weaker signal domestically compared with Option 1</p> <p>Could support abatement efforts elsewhere through the purchase of international units</p>	<p>++</p> <p>Demonstrates strong domestic leadership and place primary reliance on domestic abatement, helping to reduce New Zealand's emissions out to 2050</p> <p>If allowed, could support abatement efforts elsewhere through the purchase of international units</p>
A productive, sustainable and climate-resilient economy	<p>+</p> <p>Sends a strong signal to industry and improves policy predictability by providing certainty around the level of abatement required (ie, cannot soften the requirements by purchasing international units)</p> <p>Greater economic costs compared to those potentially available through international unit, which could have a greater impact on economic</p>	<p>+</p> <p>Provides less certainty around actual level of domestic abatement required due to the flexibility afforded by the potential use of international units</p> <p>Would encourage innovation, diversification and the uptake of new technologies, but not to the same extent as Option 1 because of a weaker domestic signal. Less</p>	<p>++</p> <p>Sends a strong signal to industry</p> <p>Provides some certainty by clearly setting expectation of domestic action</p> <p>Balances ambition with pragmatism and ensures that the effort from 2035 to 2050 will be calibrated based on feasibility</p>

	productivity than the other two options	policy predictability	
A just and inclusive society	<p>+</p> <p>Creates and maintains transparency around the level of domestic abatement required for each emissions budget</p> <p>Will help to drive early action by focusing on domestic abatement, rather than relying on the use of international units</p> <p>Greater economic costs could result in adverse effects on certain parts of society</p>	<p>+</p> <p>Less transparency owing to uncertainty around the level of domestic abatement required, and until the Commission advises a cap on international units, the level to which these can be relied on</p>	<p>++</p> <p>Creates and maintains transparency around the level of domestic abatement required to meet the 2050 target under each emissions budget</p> <p>Provides for potential use of international units to soften the impacts on individual social sectors where necessary</p>
Overall assessment	+	+	++

Key:

- ++ much better than the status quo
- + better than the status quo
- 0 about the same as preserving the status quo
- worse than the status quo
- much worse than doing the status quo

What is the preferred approach?

There are benefits to clearly incentivising strong, bold domestic action. However, the flexibility allowed by the use of international units is also important to meet the selected 2050 target successfully without disproportionately affecting different social sectors.

Option 1 provides the clearest transition signal to the domestic economy and is, on balance, preferred over the status quo for its demonstration of leadership. However, the lack of flexibility creates risks to the economy and the imperative of a just transition. Option 1 is, therefore, not recommended.

Option 2 provides a greater deal of flexibility to deal with an uncertain future and a degree of policy predictability; however, this comes at the cost of a lack of clarity around the domestic signal. It is preferred over Option 1, but is not recommended.

For this reason, the recommended option is Option 3 — to allow the purchase of international units if deemed necessary, and up to a level mandated, by the Commission. This provides an adequate degree of flexibility to manage the uncertainty of making long-term projections, while also sending a clear signal on the need for domestic action. Allowing the Commission to provide advice on the use of international units following a 2035 review allows this decision to be made on the basis of better information than is currently available. On balance, we find this option is to be preferred over the status quo and Options 1 and 2.

Emissions Budgets

Problem/opportunity definition

Emissions budgets can be understood as interim targets or ‘stepping stones’ to New Zealand’s 2050 emissions reduction target. At present, New Zealand’s legal and policy framework does not specify or provide for a budgeting system to calculate and manage emissions reduction efforts beyond meeting the 2030 target.

A system of emissions budgets will help to manage the transition to a low-emissions and climate-resilient New Zealand and avoid any abrupt changes in policy out to 2050. They would serve as a valuable tool for tracking progress and determining whether New Zealand is on track to meet domestic and international emission reduction targets. In doing so, they will also create accountability across successive governments.

Emissions budgets could be used to signal a short-term pathway to the longer-term emissions reduction target so will operate as a market signal, providing businesses (particularly NZ ETS participants) and households with greater predictability and subsequently driving investment in low-emissions technology and innovation.

Options identification

What options are available to address the problem?

It is proposed that the Commission have a key role in recommending the level of emissions budgets and advising on plans and policies to meet them. The Commission will also monitor New Zealand’s progress towards meeting the budgets and, ultimately, the 2050 target.

Key elements of emissions budgets include:

- the length of emissions budgets and how far in advance they are set
- the ability to revise budgets
- banking and borrowing
- the role of the Commission with respect to emissions budgets, including its monitoring function.

Options for each of these matters are outlined below.

What criteria, in addition to monetary costs and benefits, have been used to assess the likely impacts of the options under consideration?

The following sub-criteria within the three overarching objectives were used to evaluate the best option in each case:

Leadership at home and internationally (promotes global action):

- i. contributes to the establishment of enduring institutions that will help to reduce New Zealand's emissions out to 2050 and hold Governments to account
- ii. complementarity with New Zealand's international emission reduction obligations.

A productive, sustainable and climate-resilient economy (ensures the optimal transition pathway):

- iii. improves policy predictability and investment confidence in low-emissions technologies in order to drive behaviour change, innovation and diversification, while remaining responsive to future technological, economic and social changes.

A just and inclusive society (ensures a careful transition):

- iv. considers the optimal speed and pathways for transition, including its social, economic, cultural and environmental impacts
- v. takes early action where this prevents greater costs in the long run
- vi. creates and maintains transparency around how New Zealand will transition to its 2050 emissions reduction target.

What other options have been ruled out of scope, or not considered, and why?

Cabinet agreed to introduce an emissions budgeting system in the Bill [CAB-17-MIN-0547.01 refers]. Therefore, the option of not having emissions budgets was not considered.

How has consultation affected these options?

Length of emissions budgets

The discussion document, *Our Climate, Your Say*, asked whether submitters agreed with the Government's proposal that three emissions budgets of five years each (ie, covering the next 15 years) are in place at any given time.

8,394 submitters responded to this question. Of these, 2,867 (34 percent) agreed with the proposal to set three five year budgets at any given time and 334 (4 percent) disagreed. The other 5,191 (62 percent) had a different opinion or were unsure.

Looking only at the unique submissions that provided an answer to this question, the level of agreement with the proposal was much higher. In all, 1,983 unique submissions (83 percent) were in favour of the three five year emissions budgets, 335 (14 percent) were against and 85 (4 percent) were unsure or held a different opinion.

Please note that only 9 percent of the form submissions received included a position on this question.

Overall, submitters considered that the proposal would provide businesses with a sufficient level of certainty. There was also general support for de-coupling emissions budgets from

the electoral cycle, and aligning budgets with other timeframes (eg, ETS obligations and Nationally Determined Contributions under the Paris Agreement).

Ability to revise budgets

The discussion document asked whether the Government should be able to alter the last emissions budget (ie, furthest into the future).

A total of 3,369 long submissions were received on this question. 47 percent considered that the third emissions budget in the sequence should not be able to be changed. 25 percent agreed that the third emissions budget should be able to be changed but only when the subsequent budget is set. 22 percent agreed that each incoming government should have the option to review the third budget in the sequence, and 6 percent were either unsure or had a different opinion.

When the unique submissions are considered in isolation, however, there is stronger support for the government being able to revise the third budget in the sequence. More specifically, 28 percent of submitters believed that each incoming government should have the ability to revise the third budget and 35 percent believed that the third budget could be revised, but only when the subsequent budget has been set. 30 percent of unique submissions disagreed with any suggestion that the third budget could be revised.

A strong concern from a broad range of submitters across sectors was that providing incoming governments with the ability to amend the third budget in the sequence could make the budgets susceptible to political influence, undermining the purpose of the budgets. Submissions also highlighted the need to limit strictly the circumstances in which the second and third emissions budgets can be revised, due in part to the need for certainty (particularly for businesses and investors). The submissions also flagged that the Commission should play a role in any proposed amendments to the level of emissions budgets, and that revisions are subject to a robust Parliamentary process.

The discussion document also asked whether government should have the ability to review and adjust the second emissions budget within a specified range under exceptional circumstances. A total of 3,336 responses were received on this question. While 47 percent agreed with the proposal, 49 percent disagreed and a further 4 percent offered other opinions.

Again, however, the unique submissions show stronger support for the government being able to revise the second emissions budget in exceptional circumstances. Over half of unique submissions agreed with this proposal (61 percent), compared with 33 percent who disagreed and 6 percent who were unsure or had another opinion.

While opinion was fairly evenly divided, there was a number of recurring themes in the comments received across both questions. There was general agreement, for instance, that the Commission – as an independent body – should have a role in advising on and reviewing emissions budgets set by the Government. There was also a strong sense that if emissions budgets are reviewed, amendments are subject to a Parliamentary process and that this process keeps the 2050 target in mind.

Role of the Commission

96 percent of all long submissions agreed that the Commission should have an advisory and monitoring function in relation to New Zealand's progress towards its goals. Emissions budgets are a critical part of this (refer to **Climate Change Commission** section).

The consultation document also asked whether the Zero Carbon Bill should require Governments to set out plans for achieving emissions budgets within a certain timeframe. 89 percent of unique submissions that responded to this question were in favour of this requirement. While this requirement relates specifically to plans and policies, we consider that it would be beneficial for a set timeframe to apply whenever the Government must respond to the Commission's advice and recommendations.

What relevant experience from other countries has been considered?

The system of carbon budgets introduced into the UK by the Climate Change Act 2008 has formed the basis of many of our recommendations. The system adopted in the UK is widely regarded as international best practice, and many of our preferred options are commensurate with the UK model. In some instances, however, the recommended options reflect lessons learned from the UK, particularly in terms of requiring the government to respond within a set timeframe.

Length of emissions budgets

The UK's carbon budgets each run for a period of five years. In July 2018, New Zealand's Environment Select Committee visited London to learn about the system put in place by the Climate Change Act 2008, including emissions budgets. The UK stakeholders all indicated a preference for carbon budgets of around five years, noting that this meant less sensitivity to annual fluctuations in emissions, and gave governments some flexibility in meeting the budget. Some of those present, including the Committee on Climate Change also noted that from a practical standpoint, periods of around five years were needed to enable the Committee to work through all the analysis required for each budget cycle. When prompted, the UK stakeholders commented that a six-year cycle with a three year review seemed sensible given New Zealand's election cycle.

Ability to revise emissions budgets

The UK model also allows carbon budgets to be revised provided the Secretary of State is satisfied that changes have occurred that affect the basis on which the budget was originally set. Under section 21 of the UK Climate Change Act 2008, a carbon budget may not be revoked after the date by which a carbon budget needed to be set. An exception exists where the Secretary of State considers that, since the budget was set, there have been significant changes affecting the basis on which the previous decision was made. Where the Secretary of State considers these changes have happened during the relevant budgetary period, the carbon budget may also be altered. A carbon budget cannot be altered following the conclusion of the budgetary period, however. It should also be noted that any alteration must be made via an order either revoking or amending an order setting the carbon budget, and must be subject to an affirmative resolution procedure.

Banking and borrowing

The UK model permits a level of banking and borrowing between carbon budgets. Under section 17 of the UK Climate Change Act 2008, any part of a budget surplus to be banked by adding it to the next budget; however, borrowing is limited to a maximum of one percent of the next budget. Prior to making a decision on whether banking or borrowing will be permitted for a certain budgetary period, there is also a requirement to consult other national authorities and obtain and take into account the advice of the Committee on Climate Change, which must be obtained before the Government exercises its ability to bank or borrow.

Role of the Commission

A common criticism of the UK Climate Change Act 2008 has been that it requires the Government to respond without specifying a timeframe. This lack of specificity led to delays in confirming the fourth carbon budget and resulted in significant frustration. The Committee on Climate Change has since reflected that setting a time limit of 6 months would be beneficial. We considered this when identifying an appropriate time for the Government to respond in a New Zealand context.

Emissions budgets policy intervention options

The following table sets out individual options that can be used in a number of different combinations. They are not mutually exclusive.

Policy intervention	Options		
	Option 1	Option 2	Option 3
Length of emissions budgets and look-ahead period	Five-year budgets. Three five-year budgets would need to be in place at any one time, meaning that emissions budgets would need to be set 10-15 years in advance.	Six-year budgets with a review at the three-year mark. Three six-year budgets would need to be in place at any one time, meaning that emissions budgets would need to be set 12-18 years in advance.	Four-year budgets. Three four-year budgets would need to be in place at any one time, meaning that emissions budgets would need to be set 8-12 years in advance.
Ability to revise budgets	Allow the government of the day to revise the third emissions budget in the sequence if one or more of the following criteria are met: <ul style="list-style-type: none"> scientific or technological developments relevant to climate change or emissions reduction (or lack thereof) methodological improvements in the way that emissions are measured and reported accelerating global warming, such that it is necessary to increase the ambition of emissions budgets or there is political consensus that this would be appropriate changes to international law or policy (eg, following a stocktake of countries' efforts under the Paris Agreement). 	Allow the government of the day to revise the second budget in the sequence in exceptional circumstances. Exceptional circumstances would not be specifically defined in the legislation, but rather determined by the responsible Minister.	Do not allow future emissions budgets to be revised.
Banking and borrowing	Allow banking and borrowing (within certain limits).	Allow banking, but no borrowing from future emissions budgets.	Consider emissions budgets to be "met" when actual emissions come within a pre-defined tolerance (eg, one percent).
Role of the Commission	Advisory and monitoring only. The Commission's monitoring function will involve: <ul style="list-style-type: none"> annual progress reports a full review following the close of a budget period. 	Advisory and monitoring, but with mechanisms to hold the Government to account. The Commission's monitoring function will involve: <ul style="list-style-type: none"> annual progress reports a full review following the close of a budget period. Governments will be held to account by being required to table a response to the Commission's advice and recommendations within a fixed timeframe (eg, 6 months).	Advisory, monitoring and decision-making roles, differentiated by function. The Commission's monitoring function will involve: <ul style="list-style-type: none"> annual progress reports a full review following the close of a budget period.

Impact analysis

LENGTH OF EMISSIONS BUDGETS

Decisions are required around the length of each emissions budget. In determining the optimal length of an emissions budget, it is necessary to strike the right balance between policy predictability and flexibility to respond to changing circumstances. It is also important to consider whether it is preferable to align emissions budgets with the electoral cycle or decouple them and, in doing so, de-politicise them, and to consider the international context (particularly NDCs set under the Paris Agreement).

Option 1: Five-year budgets (10-15 year look-ahead period)

Under this option, each emissions budget would run for a five-year term (eg, 2021-2025, 2026-2030, 2031-2035).

Five-year budgetary periods could be a good compromise between flexibility and certainty. They would be longer than our current electoral cycle (providing certainty) and balance the administrative costs with the flexibility required to tailor budgets. Five-yearly budgets would also allow annual fluctuations (eg, as a result of drought) to be taken into account and averaged out across the whole period.

Five-year budgets would also help to align with other policy instruments, including the NDC setting and revision cycle under the Paris Agreement, and the long-term planning undertaken by local government on a ten-yearly basis.

Look ahead period:

We propose that three emissions budgets are in place at any given time. In the case of five-year budgets, this means that shortly after the Zero Carbon Act is enacted, three emissions would need to be set (eg, covering the period 2021 to 2035). Subsequent budgets would need to be set between 10 and 15 years in advance.

Setting emissions budgets between 10 and 15 years in advance also allows some flexibility in terms of managing the Commission's workload and the Government's responsibilities. It also allows for some flexibility around the timeframes for the development of emissions budgets and the requisite Parliamentary processes to take place, while specifying the window in which new budgets must be advised on and set.

This option reflects the UK model. Under the Climate Change Act 2008, the first three carbon budgets needed to be put in place by 1 June 2009 (note: the Act entered into force on 26 November 2008). Subsequent budgets are required to be set at least twelve years in advance (section 4).

Option 2: Six-year budgets with a three year review (12-18 year look-ahead period)

Another option is that proposed by the Parliamentary Commissioner for the Environment (PCE). This involves a six-yearly budgets with an interim review and update of policy implementation after three years. The PCE considers that this could balance longevity with the need to maintain momentum and the pressure of scrutiny by the Commission.

This model could also align with New Zealand's electoral cycle, and would require each government to turn its mind to the question of emissions budgets at least once during its term in power. Please note that there are divergent views on the desirability of aligning emissions budgets with the electoral cycle. Some consider that it is important to decouple the process of setting emissions budgets from the electoral cycle and provide a more stable policy environment by instituting emissions budgets that span parliamentary terms.

In considering this option, it is also to recognise that the lag in Inventory data currently means that midway through an emissions budget, data would only be available for emissions in year one. This may reduce the perceived value of a mid-budget review.

Look-ahead period:

We propose that three emissions budgets are in place at any given time. In the case of six-year budgets, this means that shortly after the Act is enacted, three emissions would need to be set (eg, covering the period 2021 to 2038). This translates to a look-ahead period of between 12 and 18 years.

Setting emissions budgets 12-18 years in advance raises questions of uncertainty, as it is hard to predict the technological advances and circumstantial changes that will take place in the intervening period. The further into the future you look, the more uncertain it becomes. Setting emissions budgets for 15-20+ years' time could therefore bind future Governments, removing the flexibility needed to respond to changing circumstances, whether environmental, economic, or technological/scientific.

Option 3: Four-year budgets (8-12 year look-ahead period)

Under this option, each emissions budget would run for a four-year term (eg, 2021-2024, 2025-2028, 2029-2032).

This option acknowledges the reflection of the UK Committee on Climate Change that a five year carbon budget is too long, and recognises that a shorter budgetary period would be more likely to ensure that policies remain fit for purpose and are regularly updated if they are found to be falling short.

However, it is also important to consider what is involved in setting an emissions budget. We anticipate, for example, that the Commission will need at least a year to advise on the appropriate level for an emissions period and plausible pathways for meeting it. The government would be required to respond within twelve months. Noting that the Commission's proposed role in monitoring the success of emissions and advising on the plans and policies the government proposes in respect of upcoming emissions budgets, together with their responsibilities vis-à-vis adaptation and other matters, budgetary periods that are four years or less may not be workable in terms of the workload for both the Commission and the government.

Look-ahead period:

We propose that three emissions budgets are in place at any given time. In the case of four-year budgets, this means that shortly after the Act is enacted, three emissions would need to be set (eg, covering the period 2021 to 2032). This translates to a look-ahead period of between 8 and 12 years.

IN CONFIDENCE – NOT GOVERNMENT POLICY

When assessing the value of 4 year emissions budgets and a look ahead period of 8-12 years, it is important to consider whether this would provide a sufficiently stable policy environment for businesses and investors. This question becomes further problematic if Cabinet agrees that the second and third budgets in the sequence can be revised if certain criteria are met. While the criteria limit the circumstances under which revisions can occur, they would mean that a budget would only be set for four years. It is questionable whether this would provide the policy predictability needed to encourage innovation, investment and the uptake of new technology.

	Option 1: Five year budgets	Option 2: Six year budgets with reviews every three years	Option 3: Four year budgets
Leadership at home and internationally	<p style="text-align: center;">++</p> <p>De-couples emissions budgets from our electoral cycle, providing strong national leadership and sending a strong signal to businesses, investors and households.</p> <p>Aligns with NDC cycle, making it clear how domestic progress is aligning with our international obligations (eg, under the Paris Agreement), and how domestic ambition compares to our internationally communicated goals.</p>	<p style="text-align: center;">+</p> <p>Aligns with New Zealand's electoral cycle, potentially limiting the ability of budgets to bind successive governments and create enduring institutional architecture. Mid-year reviews do, however, require governments to turn their mind to emissions budgets at least once within their parliamentary term.</p> <p>Does not match NDC cycle.</p>	<p style="text-align: center;">+</p> <p>De-couples emissions budgets from our electoral cycle, providing strong national leadership and sending a strong signal to businesses, investors and households. Signal compromised by short-time period and shorter look-ahead period (owing to the need to have three emissions budgets in place at any one time)</p> <p>Does not match NDC cycle.</p>
A productive, sustainable and climate-resilient economy	<p style="text-align: center;">++</p> <p>Strikes a good balance between policy stability and flexibility to</p>	<p style="text-align: center;">++</p> <p>Strikes a good balance between policy stability and flexibility to respond to</p>	<p style="text-align: center;">+</p> <p>Four-year budgets considered too short to provide the stable policy environment</p>

	<p>respond to changing circumstances.</p> <p>Providing more certainty will help drive innovation and investment in low-emissions technologies.</p>	<p>changing circumstances.</p> <p>Providing more certainty will help drive innovation and investment in low-emissions technologies.</p>	<p>necessary to encourage innovation and investment in low-emissions technologies, particularly if the second and third budgets in the sequence can be revised.</p>
A just and inclusive society	<p>++</p> <p>Shorter cycle improves ability to adapt to changing circumstances, enabling ongoing consideration of the optimal speed and pathway for the transition</p>	<p>++</p> <p>Mid-year reviews create and maintain transparency around our progress and how we will meet emissions budgets and achieve 2050 targets.</p>	<p>++</p> <p>Shorter cycle improves ability to adapt to changing circumstances, enabling ongoing consideration of the optimal speed and pathway for the transition</p>
Overall assessment	<p>++</p>	<p>++</p>	<p>+</p>

Key:

- ++ much better than doing nothing/the status quo
- + better than doing nothing/the status quo
- 0 about the same as doing nothing/the status quo
- worse than doing nothing/the status quo
- much worse than doing nothing/the status quo

We recommend five-year budgets (Option 1) for the following reasons.

Five-year budgets would extend beyond our current parliamentary terms, depoliticising emissions budgets and helping create a stable policy environment. This will also provide businesses and investors with greater certainty, creating a climate that will encourage innovation, investment and the uptake of new technology.

Five-year budget cycles could also align with NDC setting/revision cycles, making it easier to compare the level of our domestic targets and international obligations. This would make the relationship between the two more transparent, particularly given the recommendation (see **2050 Target** section) that international units cannot be used to meet domestic targets (ie, the 2050 target and emissions budgets). There are also benefits in terms of monitoring and reporting, due to the fact that the same data would be relied on, which would result in more consistent reporting at both the domestic and international level.

Five-year emissions budgets allow enough time for the Commission and the government to deliver their statutory obligations vis-à-vis emissions budgets, adaptation and ETS settings. Shorter timeframes would not allow enough time for their business as usual tasks, let alone additional advice requested by the government on a more ad hoc basis.

While we recognise the UK stakeholders view that a six year cycle with a review at the three year mark seemed sensible given New Zealand's election cycle (July 2018), we recommend that five-years is still the preferred option. Due to the lag in data, a review at the three year mark would only relate to the first year of the emissions budget and would therefore be of limited value. We also note that the legislation does not preclude governments from reviewing of policies and plans to meet the emissions budgets at any point during a Parliamentary term. We would also like to emphasise our preference for decoupling emissions budgets from Parliamentary terms, as this will provide a more stable policy environment and greater predictability for businesses and industry.

THE ABILITY TO REVISE BUDGETS

Decisions are required to whether Governments should be able to revise emissions budgets and, if so, which emissions budgets can be amended and under what circumstances this can occur. These decisions will need to balance the need to provide a stable and predictable policy environment with the flexibility to respond to changing circumstances. Several options are outlined below.

Option 1: Allow the last emissions budget in the sequence to be revised if certain criteria are met

This option would allow the government of the day to revise the budget that is set farthest into the future, subject to certain criteria. The following table sets out suggested criteria and the rationale for including them.

Criteria	Rationale
Scientific or technological developments relevant to climate change or emissions reduction (or lack thereof)	<p>Scientific or technological developments could have a significant impact on New Zealand's ability to meet our emissions budgets. For example, if an effective methane vaccination is effectively introduced, a pre-existing emissions budget could be met without much effort. To maintain momentum and achieve as much domestic abatement as possible, this criteria would allow the ambition of an emissions budget could be increased.</p> <p>On the other hand, it is important to recognise that emissions budgets are likely to be informed by economic modelling that makes a number of assumptions, including around the nature and rate of scientific and technological advancements. If these do not occur at the anticipated rate, it may be that existing emissions budgets are unrealistic and that achieving them</p>

	<p>would put unreasonable pressure on the New Zealand economy. In such an event, it may be appropriate to decrease the level of ambition represented by an emissions budget.</p>
<p>Methodological improvements to the way that emissions are measured and reported</p>	<p>Methodological improvements to the way that emissions are measured and reported could have a significant impact on the ambition of emissions budgets and the effort needed to achieve them.</p> <p>For example, if the methodology used to measure biogenic methane emissions changed, the projections on which an emissions budget was originally based could be rendered inaccurate. This could mean that an emissions budget could be met without taking any steps to reduce emissions. To maintain momentum, drive abatement and remain true to the Bill's legislative intent, it would be appropriate to increase the ambition of the emissions budget in such an event.</p>
<p>Accelerating temperature rise globally, such that it is necessary to increase the ambition of emissions budgets, and/or there is political consensus that this is appropriate</p>	<p>This criteria would allow the third emissions budget to be revised in response to accelerating temperature rise globally. This would allow the ambition represented by the budget to be increased, irrespective of whether international partners have committed to taking additional steps to reduce their emissions.</p> <p>In addition, this criteria would permit the Minister to amend the third budget if we have over-achieved previous emissions budgets and there is political support for achieving a greater level of abatement than required under the existing emissions budget.</p> <p>More generally It would also allow budgets to be revised if there was widespread political support for transitioning to a low-emissions economy at a faster rate than suggested by the existing budgets.</p>
<p>Changes to international law or policy (eg, following a stocktake of countries' efforts under the Paris Agreement).</p>	<p>This criteria would allow the third emissions budget to be revised in response to changes in the international context, including situations where New Zealand's response to climate change is no longer proportionate to those of its global partners.</p>

This option would allow the ambition of the third emissions budget to be either increased or decreased, and would introduce limited flexibility in the system. While the UK model allows the second and third carbon budgets to be revised if there have been significant changes affecting the basis on which the carbon budget was originally set, specific criteria could provide greater certainty. Including specific criteria in the legislation may also prompt the government to consider criteria for revising budgets that may not have been immediately obvious or meet a “significant change” threshold, such as improved accounting and reporting methodologies.

If the Government seeks to revise the third emissions budget, they will need to clearly describe why it considers the criteria to have been met. Again, this explanation would need to be tabled in Parliament and made publicly available. Any revision would also be subject to advice and recommendations from the Commission.

Option 2: Allow the government of the day to revise the second emissions budget in the sequence in exceptional circumstances

This option would allow the government to review the second emissions budget in the sequence in the event of exceptional circumstances.

“Exceptional circumstances” would not be defined in the Act, but would instead be determined on a case-by-case basis by the responsible Minister. This would allow the Minister to determine whether an event (such as an earthquake or economic downturn) constitutes an exceptional circumstance for the purposes of the Act, and whether it warrants revising the level of an emissions budget. This would provide greater flexibility around the range of situations that it would encapsulate.

If the responsible Minister seeks to revise the second emissions budget, it will need to describe clearly why it considers the relevant event an exceptional circumstance. Again, this explanation would need to be approved by Cabinet and tabled in Parliament. Any revision would also be subject to advice and recommendations from the Commission. These requirements would provide transparency and accountability for any proposed revisions.

Option 3: No capacity to revise emissions budgets

This option would mean that, once set, emissions budgets are inflexible targets. This would provide businesses and investors with greater certainty, as emissions budgets would be fixed 10-15 years in advance.

While precluding any possibility of revision would send a strong signal and could therefore drive innovation, investment and the uptake of new technologies, it would also remove any flexibility to respond to changing circumstances, whether good or bad.

	Option 1: Allow the Government of the day to revise the last emissions budget in the sequence subject to certain criteria	Option 2: Allow the Government of the day to revise the second budget in the sequence in exceptional circumstances	Option 3: No capacity to revise budgets
Leadership at home and internationally	<p>+</p> <p>Will ensure emissions budgets are an enduring tool, because they remain flexible to changing circumstances.</p>	<p>+</p> <p>Will ensure emissions budgets are an enduring tool, because they remain flexible to changing circumstances.</p>	<p>++</p> <p>Budgets that cannot be revised sends a strong policy signal domestically and internationally.</p>
A productive, sustainable and climate-resilient economy	<p>++</p> <p>Strikes a good balance between predictability and flexibility, as places conditions on when budgets can be revised but allows us to remain responsive to changing context.</p> <p>Could encourage innovation and the uptake of new technologies, because there is the capacity to increase our level of ambition.</p>	<p>++</p> <p>Limiting the ability to revise the second budget to exceptional circumstances provides investor confidence that we will not blindly commit to meeting an emissions budget if circumstances mean we will be unable to meet that level of ambition. Means government can remain responsive to change.</p>	<p>+</p> <p>Doesn't provide flexibility to adapt to changing circumstances, including impacts on certain sectors of society or the economy.</p>
A just and inclusive society	<p>++</p> <p>Gives the government flexibility to re-evaluate social and economic costs of meeting the next emissions budget, and the optimal pathway in light of technological and scientific changes (taking into account</p>	<p>++</p> <p>Gives the government flexibility to re-evaluate social and economic costs of meeting the next emissions budget, and the optimal pathway (taking into account social, economic and</p>	<p>+</p> <p>Doesn't provide flexibility to adapt to changing circumstances, including impacts on certain sectors of society or the economy.</p>

	social, economic and environmental impacts). Retains ability to make the emissions budget more ambitious.	environmental impacts)	
Overall assessment	++	++	+

We recommend both Options 1 and 2. This would provide scope for the government of the day to revise the second and third emissions budgets in the sequence provided certain criteria are met (outlined above). The proposed approach is graduated, however, and would make it more difficult to revise the second budget in the sequence than the third, consequently providing greater certainty in the short-medium term.

This approach is considered to strike the right balance between certainty/predictability and flexibility. Constraining the circumstances under which emissions budgets can be revised and requiring any decisions to be informed by expert advice from the Commission adds rigour, but also mitigates any risks and offers a greater level of certainty. It also allows New Zealand to adapt to changing circumstances where a future emissions budget is unachievable due to a national emergency beyond New Zealand's control. Conversely, it allows the government to increase the ambition of future emissions budgets where scientific and technological advancements allow us to go harder and faster.

BANKING AND BORROWING

Decisions also need to be made around whether to allow borrowing from a future budget period and banking emissions reduction when an emissions budget has been exceeded. These concepts are closely related to compliance and accountability mechanisms, and could arguably be a smarter way of driving domestic abatement than allowing the use of international units.

The concepts of banking and borrowing arise due to the difficulty in exactly meeting an emissions budget. Issues such as economic growth, weather patterns (such as drought) that affect electricity generation and agriculture, and other real-world factors will cause actual emissions to vary from the intended trajectory.

Importantly, it is not necessary to exactly meet emissions budgets. As long as the emission reduction trajectory is aligned with the path of emissions budgets, any small discrepancies should be immaterial in the short-term.

We consider that there are several options for whether or not banking and borrowing should be allowed between budgetary periods. These options are outlined below.

Option 1: Allow banking and borrowing, within certain limits

This option would allow banking and borrowing across budgetary periods, but limit the extent to which this may occur by instituting a statutory cap of 1 percent. Under this option, any shortfall in abatement would still be reported (and could effectively be borrowed from the next

emissions budget), but any accountability mechanisms would not apply unless the budget was missed by more than the threshold.

On the other hand, if more emissions reductions were achieved than were required under one emissions budget, the excess abatement could be carried over to the next emissions budget and contribute towards meeting the required volume of abatement.

Allowing both banking and borrowing will provide a safety valve that is both transparent and controllable. The combination will provide a level of flexibility and mitigate the risk that the pressure to achieve emissions budgets will result in a transition that drives abatement harder and faster than the economy can bear and results in material costs. It also provides the government with a degree of administrative flexibility that will be particularly valuable where an unexpected event adversely affects New Zealand's ability to meet a budget.

In order to ensure that this maintains consistency with the 2050 target, the Commission would provide advice on acceptable levels of both banking and borrowing as part of its report on the success of the entire emissions budget. At this stage, it will become clear whether New Zealand has met, overachieved or underachieved an emissions budget.

Ultimately, however, the Minister would have the discretion to decide whether banking or borrowing should occur and the level to which this should take place. In making this decision, the Minister would be required to have regard to the advice and recommendations provided by the Commission. This decision would be required within two months of receiving the Commission's report.

This would allow for some flexibility and would avoid some of the measures that may be instituted if strict compliance with emissions budgets was required.

Option 2: Allow banking, but no borrowing from future emissions budgets

This option would allow emissions abatements over and above those required to meet one emissions budget to be "banked" – ie, carried over to the next emissions budget. However, it would preclude the ability to underachieve an emissions budgets and "borrow" from the next in order to meet it.

This approach would create some flexibility across budgetary periods, but does not push the burden for reducing emissions onto subsequent budgets, making them. This is another way of managing the transition, so that costs are spread over the period to 2050.

Excluding borrowing would send a stronger signal domestically and provide greater certainty for sectors needing to reduce their emissions. It could create economic risks, however. For example, precluding borrowing may mean that the government will intentionally try to over-achieve abatement. This could lead to the transition happening at speed, forcing it to deviate from the "optimal" abatement path and resulting to material economic costs.

Option 3: Consider budgets to be "met" when actual emissions come within a pre-defined tolerance (eg, 1 percent of the emissions budget)

This option could be a simpler means of achieving the same outcome as "banking and borrowing". Under this model, an emissions budget would be deemed to have been "met" when actual emissions come within a pre-defined tolerance (eg, 1 percent) of the emissions budget.

IN CONFIDENCE – NOT GOVERNMENT POLICY

In this way, the compliance regime is not enforced unless there is a material departure from the emissions budget. Essentially, this amounts to borrowing from a future budget. If New Zealand were to exceed the abatement required over an emissions budget, the “banking” would also happen by default.

This option would also provide some flexibility when assessing whether or not a certain emissions budget has been “met” because it would allow for situations in which the data is imprecise and subject to change. For example, initial data may suggest that a failure to meet a budget by 0.7 percent, but once reviewed, adjusted and reported the data may reveal that the budget has in fact been met.

	Option 1 Allow banking and borrowing within certain limits	Option 2 Allow banking, but not borrowing	Option 3 Consider budgets to be “met” when actual emissions come within a pre-defined tolerance
Leadership at home and internationally	<p style="text-align: center;">+</p> <p>Allowing banking and limited borrowing sends a strong domestic signal and allows some flexibility where unexpected events have impacted the ability to meet an emissions budget. In some situations, however, it could push the burden onto future budgetary periods.</p>	<p style="text-align: center;">++</p> <p>Leadership – sending a strong signal, but allowing banking that rewards over-achieving emissions budgets and benefits. Provides flexibility in the system overall</p> <p>Enduring architecture – allows some flexibility in system without adversely affecting future budgets and adding to their requirements</p>	<p style="text-align: center;">+</p> <p>Governments would have to account for this decision – take ownership of the pre-defined tolerance</p> <p>Enduring architecture – allows some flexibility in system without adversely affecting future budgets and adding to their requirements</p>
A productive, sustainable and climate-resilient economy	<p style="text-align: center;">++</p> <p>Introducing uncertainty and flexibility into the emissions budget system could reduce predictability. However, this is outweighed by the fact that a combination of banking and borrowing would</p>	<p style="text-align: center;">+</p> <p>Improves policy predictability and investment confidence. Burden cannot be pushed onto future emissions budgets, increasing their ambition</p>	<p style="text-align: center;">+</p> <p>Places some limits on policy predictability, because there would be greater give in the system</p>

	help to manage the transition and mitigate any economic impacts that it may have. It should also be recognised that emissions budgets must have a degree of flexibility, as they are highly uncertain and have large economic impacts.		
A just and inclusive society	<p>++</p> <p>Does not reduce costs in the long run – borrowing could make future emissions budgets more onerous. Equally, making poor economic choices to achieve abatement at higher costs will lock in future economic costs.</p> <p>Transparency provided by statutory limit on borrowing, and the fact that any decision on banking and borrowing is made by the Minister on the advice of the Commission.</p>	<p>++</p> <p>Will help ensure a smooth transition by allowing budgets that are overachieved</p>	<p>++</p> <p>Transparency because budgets would only be considered to be met if actual emissions can be within a pre-defined tolerance (eg, one percent).</p> <p>Smooths transition without having any impact on the level of future budgets</p>
Overall assessment	++	++	++

The recommended option is to allow both banking and borrowing across consecutive budget periods (Option 1). This provides a safety valve that is transparent and easily controlled, due to the Commission's advisory role. It would also complement other safety valves that will be built into the legislation, including the ability to revise emissions budgets in limited circumstances.

Banking introduces some flexibility into the system of emissions budgets and accordingly smooths the transition to the 2050 target. It does this by allowing emissions budgets that have been overachieved to benefit future budgetary periods.

Borrowing, on the other hand, allows an emissions budget to be “met” by transferring a volume of permitted emissions from the next budget period. To prevent the burden of meeting the next budget being increased to a level that is untenable, the volume of emissions that could be borrowed would be limited to 1 percent of the emissions budget. This cap would be set in legislation.

Allowing a combination of both banking and borrowing would smooth the course to New Zealand’s long-term emissions reduction target by making it easier for the government to adhere to the “optimal” abatement path. This would also enable the social, economic and environmental impacts of the transition to a low-emissions economy to be better managed.

Ultimately, it will be for the Minister to decide whether banking or borrowing may occur, and what the appropriate level would be. This decision will be informed by advice received from the Commission and subject to the statutory cap on borrowing.

THE ROLE OF THE COMMISSION

We propose that the Commission play a role in relation to emissions budgets, including providing advice on the level and composition of emissions budgets and monitoring progress. While there are a number of options for the Commission’s overarching role, its monitoring function will be consistent.

Monitoring function

The Commission will have a critical role in monitoring New Zealand’s progress. This will provide New Zealanders with access to information around the level of our emissions and whether we are on track to meeting our emissions budgets and, ultimately, our 2050 target.

Relying on the reconciled data comprising the New Zealand Greenhouse Gas Inventory, the Commission will be required to provide:

- annual progress reports
- emissions budget report that reviews the success of the entire budgetary period.

Data availability under the New Zealand Greenhouse Gas Inventory can be delayed by approximately two years due to the processes involved in its review and finalisation. For this reason, it is likely that the first annual report will be tabled in Parliament two and a half years after the end of the first year of the first emissions budget. The lag in data availability will also mean that the first review of an entire budgetary period will be tabled in 2027/2028.

To promote accountability and ensure that the system of emissions budgets instituted by the Zero Carbon Act is enduring, the government will be required to provide an explanation if an emissions budget is not met. This will need to be tabled in Parliament and made publicly available.

Option 1: Advisory only

If the Commission had a strictly advisory role in relation to budgets, it would provide expert advice to the government, but the government would not be obliged to respond to its recommendations.

Under this option, the Commission would advise on the most appropriate level and composition of emissions budgets, and provide independent expert advice on areas on the economy to focus on and achieve our emissions budgets. It would also monitor New Zealand's progress towards meeting these budgets and, ultimately, achieving our 2050 target.

Option 2: Advisory, with mechanisms built in to hold the Government to account

Under this option, the Commission would have advisory and monitoring functions on emissions budgets, supplemented by mechanisms designed to hold government to account.

This would see the Commission advise on the most appropriate level of emissions budgets, including plausible pathways for meeting them. These pathways will indicate the areas that could be focussed on to achieve emissions reductions (eg, transport, agriculture). The Commission would also monitor our progress towards achieving these budgets and, ultimately, our 2050 target.

Mechanisms to hold government to account

To support emissions budgets, we consider that the government should publicly respond to the advice and recommendations provided by the Commission. To ensure this is as transparent as possible, this response must be tabled in Parliament within a set timeframe and made publicly available.

We recommend that the government respond to the Commission's advice and/or recommendations within 12 months. Consultation on the Bill included the question of whether the Bill should require governments to set out plans within a certain timeframe to achieve the emissions budgets. The submissions overwhelmingly supported this proposition (91.5 percent of submissions received on this question). While the question related specifically to the requirement to produce plans and policies, we recommended this timeframe apply whenever the government is required to respond to advice and recommendations provided by the Commission.

The form of the government's response

Once an emissions budget has been set, the government will be required to put a plan in place to meet it. This plan will comprise various policies and strategies that will be subject to advice and recommendations from the Commission.

The primary purpose of these plans and policies will be to assist New Zealand's efforts to meet emissions budgets in a way that is as fair and just as possible. To this end, they will seek to drive abatement and manage the distributional impacts of the transition, particularly on vulnerable communities and iwi/hapū/Māori. These plans and policies will include, but not be limited to:

- plausible pathways for meeting the specific emissions budget and, ultimately, achieving the 2050 target

- sector-specific policies
- a strategy to support the transitional shift to lower-emissions, climate-resilient sectors and recognise and mitigate impacts on workers, regions, Māori interests and wider communities (including details on how this action could be funded)
- any other plans or policies that the responsible Minister considers appropriate.

(a) Plausible pathways for meeting the specific emissions budget and, ultimately, achieving the 2050 target

Building on the abatement opportunities identified by the Commission when advising on the level of emissions budgets, this plan will detail actions that will drive abatement over the period to 2050 (eg, government initiatives to support investment in low-emissions sectors and funding for research, or incentivise the uptake of low-emissions technology, etc). The development of this plan will require a holistic approach that would help New Zealand proactively adapt and identify actions that we can take to ease the transition and would be developed in consultation with communities and key stakeholders.

This plan will require the government to consider the overall trajectory from 2021 to 2050, signal the rate of change required to meet the overarching 2050 target and identify associated costs and benefits, risks, opportunities and associated means of mitigating these impacts. However, this plan will also provide specific policies designed to realise the potential of abatement opportunities identified for the specific budget period under consideration.

(b) Sector-specific policies

Sector-specific policies will identify abatement opportunities and drive emissions reductions within each major sector of the New Zealand economy (eg, agriculture, energy, transport). These strategies would be tailored to each sector and developed in consultation with both sector representatives and relevant government agencies to ensure that they are fit-for-purpose, realistic and capable of effective implementation. For example, the strategies that apply to the energy sector would be developed in consultation with energy companies (eg, Genesis, Transpower, Mercury, Contact), and agencies such as the Ministry of Business Innovation and Employment (MBIE) and the Energy Efficiency and Conservation Authority (EECA), and could include policies could be incentives to support low-emission alternatives, such as energy efficiency standards.

Sector-specific policies will send a strong signal to individual sectors of the economy and, in doing so, drive innovation, diversification and the uptake of new technology. Given agriculture is the most significant sector emitter, these policies also provide an opportunity for New Zealand to take particular leadership in this area.

The publication of these plans also provides a level of accountability for sectors to make the recommended changes. While these policies will be developed ahead of each budget period, they may be constantly updated to reflect the changing context.

(c) A strategy to support the transitional shift to lower-emissions and climate-resilient sectors and recognise and mitigate impacts on workers, regions, Māori interests and wider communities.

This strategy would look at the impacts of transitioning to a low-emissions and climate-resilient New Zealand with a view to managing these to ensure the transition is as fair and as just as possible. As opposed to the plausible pathways and sector-specific policies, which are respectively focussed on actions at the government and sector-level, this strategy would focus on the impact on New Zealanders overall.

This strategy will include specific sections aimed at addressing challenges faced by vulnerable communities and Māori interests. Given vulnerable communities are likely to be most affected by climate change and the transition to a low-emissions economy, it is essential that the government turns its mind to how these communities are supported through the transition. This is especially important given one of the cornerstones of the climate change agenda is to ensure a just transition. It is also critical to recognise the impact of the transition on Māori interests, including the risk that the transition could have a disproportionate impact on the Māori economy (ie, by limiting the economic opportunities available). This strategy will therefore be developed in consultation with iwi/hapū/Māori, and will involve opportunities for ongoing engagement and information sharing.

Please note that this strategy could also include details on how these actions could be funded.

Option 3: Advisory and decision-making roles, differentiated by function

This option is a combination of the advisory function set out above and the decision-making role below.

If this option was selected, the Commission would have the authority to make decisions on some matters. For example, the Commission may have the ability make decisions around the level and composition of an emissions budget, which it could then set as a legally binding interim target.

In other respects, however, the Commission would have a strictly advisory role. For example, it may be able to set emissions budgets, but would only be able to advise on the policies and plans the government should introduce to achieve those budgets.

The matters over which the Commission had decision-making powers would need to be strictly defined in legislation ahead of time.

	Option 1: Advisory and monitoring only	Option 2: Advisory and monitoring, but with mechanisms to hold the Government to account	Option 3: Advisory, monitoring and decision-making roles, differentiated by function
Leadership at home and internationally	<p>+</p> <p>Would contribute to enduring institutional architecture. Would not require the government to respond if it chose to</p>	<p>++</p> <p>Would contribute to enduring institutional architecture. Provides greater transparency, due to the requirement that the</p>	<p>+</p> <p>Accountability would not rest with the government where the Commission has decision-making powers. Could mean a lack of public</p>

	deviate from the Commission's advice and recommendations. Government would be responsible for any decisions made, but there would not be the same transparency around its decisions.	government respond to the Commission's advice and provide an explanation if it deviates from that advice. Would require the Government to hold itself to account.	accountability and could lead to a situation where the government defers all hard decisions to the Commission.
A productive, sustainable and climate-resilient economy	++ Would improve investor confidence because an independent body of experts would be informing government decisions, particularly as their work will involve considerable public consultation.	++ Would improve investor confidence because an independent body of experts would be informing government decisions, particularly as their work will involve considerable public consultation. Ongoing advice and monitoring by would mean that the budgets can remain responsive to future changes.	++ Would improve investor confidence because an independent body of experts would be informing government decisions, particularly as their work will involve considerable public consultation. Limited, however, by a potential lack of clarity around who the final decision would rest with. This would need to be very clear. Ongoing advice and monitoring by would mean that the budgets can remain responsive to future changes.
A just and inclusive society	++ Would provide transparency around the information informing decisions on the level and composition of emissions budgets, and how New Zealand is tracking towards its emissions budgets and overall target. Also makes the government accountable to the	++ This option provides the most transparency around the advice informing decisions on the level and composition of emissions budgets, and how New Zealand is tracking towards its emissions budgets and overall target. Also makes the government accountable to the	+ If the Commission had decision-making powers, this may limit the transparency around the decision-making process.

	public.	public.	
Overall assessment	++	++	+

We recommend that the Commission have an advisory and monitoring function in relation to emissions budgets, but with mechanisms to hold the government to account (Option 2).

We consider that this option best meets the criteria. The establishment of an independent expert body that provides independent advice on the level of emissions budgets (and the best ways to achieve them) will increase public confidence in the emissions budgets that are ultimately gazetted. This is enhanced by the fact that the Commission's advice will be tabled in Parliament and made publicly available. The information and analysis that informs emissions budgets will be completely transparent as a result.

As indicated above, the Commission will also have an ongoing monitoring role in relation to emissions budgets. Their reports will be publicly available and will ensure that New Zealanders remain informed about our progress towards emissions budgets and, ultimately, our 2050 target. The independence of the Commission will augment the credibility of these reports and keep successive governments accountable.

This option also requires the government to respond to the Commission's advice (see below for more detail around the form of the government response that will be required and the process for setting emissions budgets). In doing so, the government will need to assume responsibility and is made accountable for its decisions.

CONSIDERATION OF 2030 DOMESTIC TARGET IN THE CONTEXT OF A NEW 2050 TARGET AND EMISSIONS BUDGETS

As explained above in the **2050 Target** section, New Zealand has agreed under the Paris Agreement to an NDC of reducing emissions by 30 percent below 2005 levels (equivalent to 11 percent of 1990 levels) by 2030.

New Zealand cannot rely on afforestation to deliver the necessary offsets over the next twelve years to meet its NDC, or on major innovations being market-ready and adopted (such as a methane vaccine or widespread adoption of electric or autonomous vehicles). Based on what we know from high-level indications of abatement potential, New Zealand's transition pathway is highly likely to start more gradually – as opposed to continuing in a straight line from now to 2050 – and could accelerate in later decades if innovations come to fruition, likely bolstered if there are strong domestic signals that support transition.

Given the level of uncertainty on a cost-effective pathway for domestic emissions, this may argue for an adaptive approach to budget-setting that drives domestic abatement based on feasible opportunities available. The level of uncertainty on actual economic impacts also suggests an ability to review the target that we aim for domestically, within clear bounds and after independent advice, based on evolving information on technological and other developments.

How this relates to New Zealand's responsibilities to meet its NDC is that, whilst there are some ready abatement opportunities, these are expected on best estimates to be less than the abatement required to meet our NDC, leaving a gap between domestic budgets and our NDC in 2030.

What is the preferred approach?

The following table provides an overview of the package of recommended options for emissions budgets that best meet the assessment sub-criteria (highlighted in green).

Topic	Options		
	Option 1	Option 2	Option 3
Length of emissions budgets and look-ahead period	Five year budgets (10-15 year look-ahead period)	Six year budgets with a review at the three year mark (12-18 year look-ahead period)	Four year budgets (8-12 year look-ahead period)
Ability to revise budgets	Allow the government of the day to revise the third emissions budget in the sequence subject to certain criteria	Allow the government of the day to revise the second budget in the sequence in exceptional circumstances.	Do not allow future emissions budgets to be revised
Banking and borrowing	Allow banking and borrowing (within certain	Allow banking, but no borrowing from future	Consider emissions budgets to be "met" when actual emissions come

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	limits)	emissions budgets	within a pre-defined tolerance (eg, one percent)
Role of the Commission	Advisory and monitoring only.	Advisory and monitoring, but with mechanisms to hold the government to account	Advisory, monitoring and decision-making roles, differentiated by function

Interaction with the NZ ETS

Problem/opportunity definition

The NZ ETS was established in 2008 to support New Zealand to meet its international climate change targets and reduce net GHG emissions below business-as-usual levels. It does so by requiring companies to purchase allowances to emit GHGs, which puts a price on emissions and values removals. It is established under the Climate Change Response Act 2002 (CCRA). The NZ ETS will be a key tool for helping New Zealand to meet its targets.

How unit supply in the NZ ETS is managed over time is critical to provide the scheme with regulatory predictability and stability. The most recent review of the NZ ETS in 2015/16 found that existing arrangements leave significant uncertainty and that the NZ ETS did not have tools in place to allow it to be aligned with New Zealand's emissions reduction targets.

Related measures

A number of measures have been proposed to bring more stability to the NZ ETS. Stage two of the recent review⁵⁵ gained in-principle agreement to further potential improvements to the NZ ETS to put in place tools to allow the NZ ETS to be aligned to emissions reductions targets and to improve certainty and stability (unit volume and supply). These proposals are currently being consulted on⁵⁶ and would strengthen the response and operation of the NZ ETS to the signals provided by the target and emissions budget.

A potential role for the Climate Change Commission

Given the functions proposed for the Commission in New Zealand's broader climate policy framework, we consider here what role it might have in relation to the NZ ETS.

Options identification

The Commission could play a role in the NZ ETS in a number of ways. Its role could be:

1. advisory only at the policy level (high-level: this is the status quo that would be provided for by other proposals recommended in this RIS)
2. advisory also at the level of specific unit supply settings (Advisory)
3. advisory also at the level of specific unit supply settings, with mechanisms for recommendations to be given effect unless the government provides otherwise (Advisory-plus)
4. decision-making, in respect of the unit supply settings.

How has consultation affected these options?

The discussion document on the Zero Carbon Bill asked:

⁵⁵ NZ ETS Review 2015/16. Further information at <http://www.mfe.govt.nz/climate-change/new-zealand-emissions-trading-scheme/reviews-of-nz-ets/nz-ets-review-201516/outcomes>

⁵⁶Ministry for the Environment, 2018d.

What role do you think the Climate Change Commission could have in relation to the New Zealand Emissions Trading Scheme (NZ ETS)?

Pick one:

- *advising the Government on policy settings in the NZ ETS*
- *makes decisions itself, in respect of the number of units available in the NZ ETS*

The large majority of submitters on this question (84 percent in total, 100 percent of form submissions and 58 percent of non-form submissions) favoured an advisory role for the Commission in the NZ ETS. Submitters who favoured this option indicated a view that the Commission should not be involved in policy or regulatory decisions and that accountability for these should remain with the elected government. Some submissions from iwi indicated that it was important that decision-making in this case was held by the Crown as the Treaty partner, or that iwi could hold the Crown accountable for NZ ETS decisions.

Some submitters thought the Commission's role could be extended to making specific recommendations on NZ ETS unit supply and alignment with emission-reduction targets, although there was not general agreement on this.

A common view among submitters who favoured the decision-making option was a lack of support for the NZ ETS as an effective mechanism for reducing emissions, or a lack of confidence in the government's ability to operate it effectively.

Following public consultation and consideration of the other functions (existing and proposed) of the Commission and government, we consider that it is essential that accountability for decision-making in the NZ ETS remains with the elected government. We have considered what role the Commission could play in bringing further transparency and predictability to those decisions. The "Commission decision-making" option was considered out of scope of the further impact analysis.

Under all of the three options considered:

- The Commission recommends emissions budgets (with a mandated government response) 5-yearly
- The Commission advises on macro-level policy to meet set emissions budgets (including NZ ETS) 5-yearly
- The Commission reports on (annually) and reviews (5-yearly) government's progress toward budget and target.

Additional features of Options 2 and 3 are summarised in the table over the page.

Interaction with the NZ ETS policy intervention options

	High-level	Advisory	Advisory +
Commission recommends technical ETS settings annually	N	Y	Y
Presumption that Commission recommendations be given effect unless government provides otherwise and gives reasons	N	N	Y
Accountability for decision-making	Remains with elected government	Remains with elected government	Remains with elected government
Independent (apolitical) influence on ETS settings	<ul style="list-style-type: none"> Constrained by target and emissions budget Informed by (public) macro-level advice 	<ul style="list-style-type: none"> Constrained by target and emissions budget Informed by (public) macro-level advice Informed by specific recommendations 	<ul style="list-style-type: none"> Constrained by target and emissions budget Informed by (public) macro-level advice Presumption for specific recommendations to apply
Staffing	Commission baseline	Additional expertise in secretariat Function duplicated in government	Same as Advisory
Costs	Within proposed baseline	Greater (in the range of 300K/year)	Same as Advisory
Additional implications	N/A	<ul style="list-style-type: none"> Could risk draining expertise from existing institutions – but could also make larger pool of expertise available Adds an additional process (time) Need to make explicit provision for regard to government policy in respect of additional function (distinct from other functions of Commission) 	<ul style="list-style-type: none"> Same as Advisory Legislative mechanism needed for presumption (may depart from usual design principles) The ease with which the Government could respond could make the setup and operational costs of this approach less attractive

In order to provide recommendations under either the Advisory or Advisory-plus option, the Commission will need to take account of the government's other policies for the period, and what effect these will have on the level of abatement that can and should be achieved through the mechanism of the NZ ETS (in order to meet emissions budgets). The government would need to provide this information to the Commission prior to the recommendations in a transparent way.

It will likely be necessary for the Commission to consult broadly in preparing its recommendations.

Under the Advisory-plus option, the scope of recommendations to which the presumption applies should be constrained to those necessary to make regular adjustments to the NZ ETS – the package of 'unit supply' settings. The discussion document on the proposed improvements to the NZ ETS proposes a coordinated decision-making process for announcing these settings on a 5-year rolling basis. They could include setting the supply of New Zealand Units (NZUs) for auctioning, any use of international units and settings of a proposed cost-containment reserve (its volume and trigger price). Final decisions about that process are expected to be made in 2019.

Policy decisions about the Bill, including the role of the Commission in relation to the NZ ETS, will be considered in final policy decisions on the proposed coordinated decision-making process for the NZ ETS.

What criteria, in addition to monetary costs and benefits, have been used to assess the likely impacts of the options under consideration?

The options were assessed against the three overarching objectives of the Framework:

- Leadership at home and internationally (promoting global action):
- A productive, sustainable and climate-resilient economy (ensuring the optimal transition pathway):
- A just and inclusive society (ensuring a careful transition).

What other options have been ruled out of scope, or not considered, and why?

As noted above, options that removed accountability for decision-making from the elected government were not considered further.

Impact analysis

	Option 1: High-level	Option 2: Advisory	Option 3: Advisory+
Leadership at home and internationally	<p>0</p> <p>Targets and goals are strengthened and clarified, providing useful context for the operation of the NZ ETS.</p>	<p>+</p> <p>Potential improvements in holding NZ to account to meet international commitments due to decreased political influence on ETS</p> <p>Independent influence contributes to an enduring architecture by helping to build trust in the effectiveness of the NZ ETS</p>	<p>++</p> <p>Greater potential improvements in holding NZ to account to meet international commitments due to decreased political influence on ETS</p> <p>Independent influence contributes to an enduring architecture by helping to build trust in the effectiveness of the NZ ETS</p>
A productive, sustainable and climate-resilient economy	<p>0</p> <p>Expected improvements in predictability and trust in NZ ETS are likely to help it drive behaviour change</p>	<p>+</p> <p>May be more effective than option one in driving behaviour change, due to greater improvements in trust and predictability in NZ ETS</p>	<p>+</p> <p>May be more effective than options one and two in driving behaviour change, due to greater improvements in trust and predictability in NZ ETS</p>
A just and inclusive society	<p>0</p> <p>Independent advice helps inform decision-making about the settings of the NZ ETS. It is available at a high level only</p>	<p>+</p> <p>A source of specific independent advice helps to make sure that information about climate change is robust and accessible to aid decision-making on NZ ETS settings</p>	<p>+</p> <p>A source of specific independent advice helps to make sure that information about climate change is robust and accessible to aid decision-making on NZ ETS settings</p>
Overall assessment	<p>0</p> <p>Provides some independent influence on NZ ETS settings</p>	<p>+</p> <p>Provides more independent influence on NZ ETS settings</p>	<p>++</p> <p>Provides highest-level independent influence on NZ ETS settings</p>

Key:

IN CONFIDENCE – NOT GOVERNMENT POLICY

- ++** much better than doing nothing/the status quo
- +** better than doing nothing/the status quo
- 0** about the same as doing nothing/the status quo
- worse than doing nothing/the status quo
- much worse than doing nothing/the status quo

What is the preferred approach?

The preferred option is Advisory-plus (Option 3), which provides for the greatest level of independent influence on the settings of the NZ ETS.

While this option would impose additional costs and resourcing requirements, and implies a duplication of effort, it is considered to be the best approach to balance the importance of maintaining independent influence over the NZ ETS settings with ensuring policy decisions with significant macroeconomic implications remain with the elected government.

Adaptation

Problem/opportunity definition

There are barriers to effective adaptation action in New Zealand due to the absence of any requirement for coordination between agencies, or clear lines of responsibility, and misalignment in how climate change adaptation and resilience objectives are incorporated into legislation and policy. The current legal and policy framework lacks an integrated, nationwide approach to adaptation that has clear objectives and priorities for New Zealanders to understand the risks posed by climate change and take appropriate action.

There are also variable levels of understanding and acceptance of climate change by the public. Many sectors are generally well informed about potential climate change impacts but are not acting even when it is likely to be in their best interests (eg, infrastructure)⁵⁷, while in other cases information in its current form is not reaching key decision-makers.

Understanding the risks, and what action is being taken to adapt or mitigate, will help New Zealand to coordinate efforts, and funding, to adapt appropriately.

Options identification

The options for adaptation policy intervention that were considered are over the page and were assessed against each of the following objectives and sub-criteria (see Impact Analysis section):

Leadership at home and internationally (promotes global action):

- i. provides national leadership on climate change adaptation and helps New Zealand to fulfil its international obligations
- ii. creates enduring and flexible adaptation mechanisms that continue to add value over time
- iii. aligns with international best practice.

A productive, sustainable and climate-resilient economy (ensures the optimal transition pathway):

- iv. enables effective adaptation action to be taken by all actors
- v. drives better coordinated and efficient adaptation action.

A just and inclusive society (ensures a careful transition):

- vi. clarifies roles and responsibilities for climate change adaptation to increase accountability
- vii. provides or improves access to information that increases understanding across society of the risks and opportunities posed by climate change.

⁵⁷ Climate Change Adaptation Technical Working Group (CCATWG), 2017.

Adaptation policy intervention options

Primary legislation (Option 1)	National Policy Statement (RMA-specific) (Option 2)
<p>The three elements of this option include:</p> <ul style="list-style-type: none"> National Climate Change Risk Assessment (the Risk Assessment) National Adaptation Plan (the Plan) Regularly monitoring and reporting on the implementation of the Plan <p><i>Timing</i></p> <ul style="list-style-type: none"> The proposal is for a six-yearly cycle, with an option for some flexibility to produce the plan in a shorter timeframe, if this is necessary to manage workloads or efficient in terms of lining up with other processes such as mitigation plans and policies. <p><i>Responsibilities</i></p> <ul style="list-style-type: none"> The Commission will be responsible for preparing the Risk Assessment on an ongoing basis. The proposal is that the Ministry will undertake the first one, and then pass this role onto the Commission. The Minister will be responsible for preparing the Plan. This will involve close work with other agencies and stakeholders to ensure that existing plans and policies are taken into account and work is not duplicated. The Commission will have a responsibility to undertake the monitoring and evaluation of the effectiveness of the Plan in addressing the risks, and report on implementation progress. The Commission is independent from government and will have expertise on a variety of climate-related topics. <p>Although the Risk Assessment and the Plan will establish priorities nationally, it is anticipated that more detailed assessments of risks and prioritisation of actions will also need to be undertaken by regions, cities, businesses or sectors.</p>	<p>The elements of this option include:</p> <ul style="list-style-type: none"> National Climate Change Risk Assessment (the Risk Assessment) National Policy Statement on Climate Change Adaptation <p>Neither of those actions would be mandated in legislation. The actions could be enabled by decisions from the Minister for Climate Change and Minister for the Environment and the provision of sufficient budget to enable this work to be undertaken.</p> <p>Instead of producing a National Adaptation Plan, national direction could be developed under the Resource Management Act 1991 (RMA) in the form of a National Policy Statement (NPS). An NPS would set out nationally consistent policies and objectives, which councils would then be required to implement through planning documents and resource consent decisions.</p> <p><i>Note that Option 1 does not preclude Option 2: an NPS could still be developed to support the implementation of a broader National Adaptation Plan, if necessary.</i></p>

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How has consultation affected these options?

During consultation and engagement with the public and relevant central government agencies, generally high levels of support were noted for Option 1.

Of the submitters who responded to the discussion document's question on whether or not the Bill should cover adapting to climate change, 94 percent of all respondents agreed that it should, and 84 percent of non-form submitters also agreed. Respondents who agreed noted that a certain level of adaptation is inevitable and that there needs to be an equal focus on mitigation and adaptation, and that a joined-up approach would improve coordination and consistency. For those who did not agree, the main reasons were that they felt that mitigation should be the focus of the Bill and that this focus should not be diluted. These respondents felt that adaptation required its own legislation and/or could be dealt with elsewhere, perhaps using existing legislation.

89 percent of the submitters who responded agreed to the inclusion of the proposed adaptation functions in the Bill (the proposed functions included: the Risk Assessment, the Plan, and regular review of progress towards implementing the Plan). A number of respondents agreed with the proposed functions, but noted the importance of consulting with iwi/Māori as Treaty partners and key stakeholders (local government and communities in particular) when developing the Risk Assessment and the Plan. Respondents from local government expressed a strong desire to be closely involved in the development of both the risk assessment and the Plan. In response to this feedback, the proposal is to include a requirement to consult publicly on the development of the Plan prior to its approval.

A few non-form submitters commented on the desirability of developing an NPS under the RMA (rather than using the Bill) to enable local government to plan and provide for climate change adaptation more effectively. It is clear from regular engagement with local authorities that local government has been asking for an NPS to provide them with guidance on how to best manage the effects of climate change locally. This has informed the strengths and weaknesses considered for Option 2.

What relevant experience from other countries has been considered?

The Ministry has compared New Zealand's resource management and planning system to the systems of nine other nations.⁵⁸ This analysis indicates that New Zealand could benefit from providing more national direction on climate change adaptation within the RMA, but it also indicates that developing stand-alone climate change legislation is also likely to be beneficial, as adapting to climate change is an issue that is not likely to be sufficiently addressed through one regulatory tool alone.

In most countries studied, compared to New Zealand, there is greater integration of climate change considerations across legislation. For example, in the UK and Norway, climate change mitigation is more integrated in spatial planning legislation than it is in New Zealand's RMA. However, in terms of adaptation, it is also fairly common for climate change to be dealt with in distinct statutes outside broader resource management regimes. This occurs, for example, in Norway and the UK. These countries found it necessary to produce National Adaptation Plans and Frameworks, similar to what is proposed in Option 2.

As of 2015, 10 countries of 99 studied have framework legislation for climate change adaptation. Framework legislation has been defined as a law, or regulation with equivalent

⁵⁸ Australia, Canada, Chile, Denmark, Japan, the Netherlands, Norway, Sweden and the United Kingdom (UK).

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status, which serves as a comprehensive, unifying basis for climate change policy that addresses multiple aspects or areas of climate change mitigation or adaptation (or both) in a holistic, overarching manner.⁵⁹

Of the 99 countries studied, 58 countries had framework laws or policies to address both climate change mitigation and adaptation.⁶⁰ The UK's Climate Change Act 2008 (the UK Act) is one example. The UK Act puts in place a similar policy framework to promote adaptation action, consisting of the following three tools:

- UK Climate Change Risk Assessment – a five-yearly assessment of the major risks and opportunities from climate change
- National Adaptation Programme – the Government's strategy to address the main risks and opportunities as identified by the Risk Assessment. Also produced every five years. Progress is reported back to Parliament every two years
- UK Adaptation Reporting Power – which requires public service organisations to produce reports on what they are doing to adapt to climate change.

The 2017 progress report produced by the UK's Committee on Climate Change found that actions in the current National Adaptation Programme were largely being delivered and that meaningful progress was being made towards some objectives. However, the report also found that communities were becoming increasingly vulnerable to climate change. The Committee recommended that the National Adaptation Programme should set clear priorities for adaptation, include measurable objectives that can be monitored and evaluated, and focus on the core set of policies and implementation activities that will deliver the most benefit. The lessons from the UK experience have informed the development of this option.

Experience in the UK has found that mandatory adaptation reporting delivers a higher standard of reports, and although some organisations treated it as a compliance exercise, in general the information provided was sufficient to gain a better understanding of the adaptation action being taken.

Lessons have also been drawn from overseas examples in relation to the development of a New Zealand National Climate Change Risk Assessment. While noting that there are many different approaches to undertaking such an assessment, key lessons from the many European examples include:

- It is important to have an overarching assessment to enable comparisons across sectors and to determine policy priorities, to provide a framework for more narrowly-focussed or geographically-specific individual assessments
- It is important to link to national risk assessments for security and disaster risk reduction, eg, by using common assessment approaches, scenarios or metrics
- The importance of the assessment process, including stakeholder involvement or buy-in.⁶¹

Are the options mutually exclusive?

⁵⁹ Nachmany M et al, 2015.

⁶¹ European Environment Agency, 2018.

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The options are not mutually exclusive. It is entirely possible that Option 2 will be delivered alongside or after Option 1, if a National Policy Statement on Climate Change Adaptation is progressed by the Government in the interim.

It is also likely that the Government will continue to use and develop the tools described in the counterfactual, including the production of further guidance. In the RMA's National Direction Forward Agenda, one relevant programme of work is signalled: resilience in land-use planning (natural hazards and climate change adaptation). This work will provide guidance to improve resilience to natural hazard risks and the effects of climate change through resource management and land-use planning.

Impact analysis

	Option 1: Risk Assessment, Plan Implementation and Review – legislatively mandated and regularly refreshed	Option 2: Risk Assessment and an NPS-Climate Change Adaptation (NPS-CCA)
Provides national leadership on climate change adaptation and helps New Zealand to fulfil its international obligations	++ Clearer responsibility for central government to coordinate national response to climate change risks and refresh this response over time. Meets international obligations under Article 7 of the Paris Agreement to engage in adaptation planning processes.	+ Will provide some national leadership in the form of direction to local government and would contribute to meeting international obligations.
Creates enduring and flexible adaptation mechanisms that continue to add value over time	++ Core accountability mechanisms of assessment, plan and monitoring established. Flexibility as to what levers government can use to address risks through plan.	+ An NPS-CCA could be enduring, but would not necessarily be flexible enough to respond to changing risk profiles or emerging threats, as it can take many years to update an NPS and considerably longer for those changes to be addressed in local plans.
Aligns with international best practice	++ International best practice suggests that a broad review of the suite of existing policy settings is necessary to enable effective adaptation to occur.	0 An NPS is an RMA instrument and inherently cannot take a broad review of the suite of existing policy settings, it can only address adaptation through land-use planning and resource management. This does not align with international best practice.
Enables effective adaptation action to be taken by all actors	++ Plan will enable shared priorities for adaptation action to be set nationally. It has scope to allocate actions to a wide variety of actors.	+ Will enable some adaptation action but limited in scope because it can only direct action by local government who can go on to regulate individuals via land-use and resource management policies, objectives and rules.
Drives better coordinated and efficient adaptation action	++ Action will be centrally prioritised and Plans will be coordinated by central government. This will enable coordination of actions, reduce duplication of effort and improve efficiency of actions.	+ An NPS could help create more consistent planning policies and objectives that would lead to land use and resource management decisions around the country that support the national approach.
Clarifies roles and responsibilities for	++ Roles and responsibilities for climate	+ Will clarify roles and responsibilities

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climate change adaptation to increase accountability	adaptation on a multi-sectoral, economy-wide basis should be clarified through the Plan, developed in consultation with stakeholders.	of central and local government respectively with regard to particular risks
Provides or improves access to information that increases understanding across society of the risks posed by climate change	++ Regular preparation and publishing of Risk Assessment would improve access to information across society.	++ Regular preparation and publishing of Risk Assessment would improve access to information across society.
Overall assessment	++ Much better than status quo in relation to all sub-criteria.	+ Better than status quo in relation to all sub-criteria.

Key:

- ++ much better than doing nothing/the status quo
- + better than doing nothing/the status quo
- 0 about the same as doing nothing/the status quo
- worse than doing nothing/the status quo
- much worse than doing nothing/the status quo

What is the preferred approach?

This RIS recommends Option 1 to provide New Zealand with a clear, planned approach to climate change adaptation, based on the best available evidence, information and assessment of risks. Primary legislation will ensure these measures are regularly undertaken and given sufficient prioritisation, allocating responsibilities for national direction with central government and implementation with local authorities, utility providers and communities.

Situating adaptation measures in the Bill alongside those for mitigation is designed to address their shared intergenerational implications. It will provide an integrated and holistic approach to the problem, which is lacking in the current framework, and ensure that policies and long-term decision-making are appropriately contextualised and coordinated.

The proposed Risk Assessment will draw together existing information about climate change impacts to inform a national understanding of the risks and opportunities of climate change and provide the necessary foundation for investment prioritisation of future work. The Risk Assessment will be outlined flexibly enough to support with existing and proposed work on managing national risks, including work to prepare a National Risk Register and Report, while fulfilling its own purpose of supporting national action on climate change impacts to be prioritised and coordinated.

We consider the Commission is the appropriate body for preparing the Risk Assessments on an ongoing basis, as it is important that the Risk Assessment is credible, objective and free from a perception of government influence. Due to the time it will take to enact the legislation and set up the Commission, and the perceived urgent need for a first national climate Risk Assessment, the proposal is that the Ministry will undertake the first one and then pass this role onto the Commission. Other options for responsible bodies have been considered,

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including other central and local government agencies. However, at present the Commission is considered to be the best option in terms of its expertise and economy-wide focus.

The Plan aims to provide a strategic government response to the risks identified and prioritised in the Risk Assessment. Only central government has the necessary authority and levers to undertake this function. Therefore, it is appropriate that it is prepared by the responsible Minister. Articulating a common set of outcomes, goals and priorities for taking action to prepare for the effects of climate change in New Zealand will provide more certainty about roles and responsibilities of various actors, especially central and local government agencies.

The development of the Plan will necessarily involve close work with other agencies and stakeholders to ensure that existing plans and policies are taken into account and work is not duplicated. It will identify which parts of society, the natural and built environment and economy will be most vulnerable to those risks. In doing this, it will provide nationally consistent information that will be accessible and standardised to better support decision-makers (including iwi/Māori, communities, transport and infrastructure sectors, and central and local government).

There is a strong argument for a six-yearly cycle to line up with a number of other investment cycle timings, including local government planning timeframes and land transport investment planning, both of which happen on three-yearly timeframes. We consider anything shorter than five years would not give enough time for the plan to be developed and implemented.

Adaptation reporting power

Problem/opportunity definition

Understanding the risks, and what action is being taken to adapt or mitigate, will improve New Zealand's ability to coordinate efforts, and funding, to adapt to climate change impacts.

Currently, there is no formal requirement for New Zealand organisations or firms to report on the risks that climate change poses to their operations, either in terms of physical or financial impacts. Overall, there is no clear picture of what action is being taken as part of risk management processes by organisations. As a consequence, there is no comprehensive national understanding of what the most severe impacts will be for New Zealand over the medium/long term, or who is most vulnerable.

There is an opportunity for greater public benefits by ensuring that organisations prepare effectively for climate change and report publicly on their work. This would allow for people, communities, government and other stakeholders to be engaged on important issues or decisions. Risks may be identified, along with barriers to adaptation, and better, more timely information can inform investment decisions about how and when to adapt.

Options identification

What options are available to address the problem?

An option to address the problem is to include a reporting power in the Bill, so as to formalise a process of risk assessment and management in climate change adaptation. The power would apply to central government, local government and critical infrastructure ('lifeline utilities' as defined in the Civil Defence Emergency Management Act 2002), together known as Reporting Organisations.

The purpose of the reporting power function would be:

- to include those organisations responsible for providing services and infrastructure to the public and encourage a transparent process of risk assessment and management in climate change adaptation
- to inform the Risk Assessment and the Plan and assist with decision-making on priorities for action and investment at central, regional and local scales
- to ensure important information is publicly available in order that people and communities, as well as decision-makers, are aware of the risks and vulnerabilities arising from climate change on public infrastructure and services
- to help ensure that public services and infrastructure are resilient to climate change.

The expected outcomes of the reporting power function are:

- Reporting organisations will identify actions to reduce, manage and mitigate the risks, and reduce the long term costs arising from climate change.
- There is an overall behaviour change within organisations, whereby important planning or investment decisions are informed by climate change risk assessments.

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- New Zealand can improve its contribution to progress on adaptation globally as well as domestically, in accordance with the Paris Agreement. This includes through engaging in adaptation planning processes, periodically submitting an adaptation communication and sharing practice and lessons learned about adaptation for the purposes of international cooperation.

The alternative option is for adaptation reporting to be left to organisations on a voluntary, informal basis. This alternative differs from the status quo in that their adaptation reporting and proposed actions would be informed by the Risk Assessment and Plan and supplemented by central government publishing further guidance.

The two available options are further described over the page.

Adaptation reporting power policy intervention options

Option 1: Adaptation reporting mandated in the Bill	Option 2: Voluntary/informal reporting with additional published guidance
<p>Reporting Authorities will include central government, local government and critical infrastructure organisations.</p> <p>Information required will include current and future predicted impacts of climate change on the organisation, and identified proposals for adapting to climate change and reporting on progress against adaptation actions.</p> <p>The Act will provide that the power will be exercised by the government and that the government has the discretion to request information on a mandatory or voluntary basis.</p> <p>There will be a regulation-making power allowing for the necessary information to be prescribed in regulation, including as a minimum:</p> <ul style="list-style-type: none"> • a definition of ‘public infrastructure and services’ • specific information requirements • timeframes for the submission of reports, <p>In making the regulations, the Minister shall consider:</p> <ul style="list-style-type: none"> • the ability to tailor the reporting request in relation to the size and capability of the Reporting Organisation • the potential extent and significance of climate change impacts on the functions of the Reporting Organisation • the avoidance of unnecessary duplication with existing reporting frameworks. 	<p>This option leaves adaptation reporting to relevant organisations at the informal request of government or on a voluntary basis, with additional guidance prepared and published by central government.</p> <p>Under this option, the Risk Assessment and Plan would be the primary drivers for information on the risks of climate change to public services and infrastructure and proposals for adaptation.</p> <p>Published guidance could provide a template for uniformity and consistency in the information provided by organisations. This guidance would align with the information requirements for the Risk Assessment and Plan.</p>

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What criteria, in addition to monetary costs and benefits, have been used to assess the likely impacts of the options under consideration?

The sub-criteria used were the same as for the adaptation policy intervention options, ie:

Leadership at home and internationally (promotes global action):

- i. provides national leadership on climate change adaptation and helps New Zealand to fulfil its international obligations
- ii. creates enduring and flexible adaptation mechanisms that continue to add value over time
- iii. aligns with international best practice.

A productive, sustainable and climate-resilient economy (ensures the optimal transition pathway):

- iv. enables effective adaptation action to be taken by all actors
- v. drives better coordinated and efficient adaptation action.

A just and inclusive society (ensures a careful transition):

- vi. clarifies roles and responsibilities for climate change adaptation to increase accountability
- vii. provides or improves access to information that increases understanding across society of the risks and opportunities posed by climate change.

How has consultation affected these options?

Of the 12,432 substantive submissions received, 3086 provided a response to the question: “should we have an adaptation reporting power in the Zero Carbon Bill?”

Of the 2,125 non-form submissions, 1870 (88 percent) said yes, and 255 (12 percent) said no. Many of these submitters were unsure or did not consider that there was enough detail in the discussion document for them to form a view.

Of those who supported the reporting power, the support derived from: 1,563 individuals, 19 local government, 14 iwi/Maori, 92 from a combination of NGO, university, research institutes, schools and community groups and 164 business/industry. In general, there was a high level of support from the electricity industry. There was little response from the communications industry.

Of those who said no, key reasons included:

Business/industry submitters

- do not get distracted from mitigation
- too much of an administrative burden on private companies

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- align to existing reporting frameworks (eg, annual reporting) that businesses are already applying
- risk assessments for climate impacts are already being undertaken on larger public and public-privately funded infrastructure, but could be aligned or integrated better and improved through further support for skills development and education
- organisations' confidential information should remain as such and the information should be obtained through direct consultation and engagement with business/industry
- reporting should be on a voluntary basis.

Several also discussed the option of the Bill including requirements for climate-related financial disclosure based on the UK Bloomberg report, *Taskforce on Climate-related Financial Disclosure* (TCFD), either as mandatory reporting or voluntary guidance. It was not the intention of the proposal to consider this. There was also some confusion about what this would apply to with some support for it to include the reporting of emissions.

Other key issues that arose included the support for transparency and information sharing, the caution around duplicating reporting requirements, need for commercial confidence and that it would be appropriate to have a proportionality requirement. To determine the content of reporting requirements, agency feedback has made the following suggestions for further consultation to be required upon developing regulations:

- incorporating reporting into existing frameworks, eg, a state-owned enterprise could include planned mitigation in its Statement of Intent, 4-Year Plan or Statement of Performance Expectations (SPEs) and report on risks in its Annual Reports
- ensuring information is not limited to how the organisation will be impacted by climate change, but also how the infrastructure and services it provides, manages and operates, impacts on communities and customers
- outlining some proposed principles to guide how reporting is undertaken, such as in the UK's third round of reporting, which included "proportionate, risk-based and streamlined to minimise burdens or duplications."

What relevant experience from other countries has been considered?

Experience in the UK has found that mandatory adaptation reporting does not necessarily lead to a higher standard of reports. Their first round of reporting was deemed mandatory, and although they received good coverage from organisations, the information did not meet their expectations. Many organisations appeared to have simply responded as a bare-minimum compliance exercise. Despite this, the information they did receive helped gain a better understanding of the adaptation actions being taken.

The UK's use of a voluntary approach in the second round was seen to offer a more flexible and responsive reporting process, and reduce the risk of the 'box-ticking' approach to reporting. This could mean more useful results and voluntary uptake, insofar as organisations identify and own the actions that need to be taken in response to the threats and opportunities identified. It was also suggested the level of work would be proportionate to the organisation.

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Noting the statutory differences between the New Zealand and UK contexts, there is some merit in maintaining the ability to apply the adaptation reporting power as mandatory in New Zealand. There is little point in providing discretion to the Minister as to whether the request for information should be mandatory or voluntary. If the request is anticipated to be applied as voluntary, no power is required in the legislation. If, on the other hand, the ability to have the mandatory requirement available lends weight to a voluntary request, then it is of value to have the power available. However, if the power is provided in the legislation, it is likely that any request will go out citing the legislation – this is the situation that occurs with other requests, such as under the RMA or the CCRA.

Are the options mutually exclusive?

Options 1 and 2 are mutually exclusive – adaptation reporting is either mandated through the Bill or undertaken by organisations at the informal request of the government or on a voluntary basis.

What other options have been ruled out of scope, or not considered, and why?

Requiring all organisations, companies and firms to report on adaptation risks and efforts under the Bill was considered to be overly cumbersome and to impose a significant compliance burden. It also would not necessarily improve the level of required information. Therefore, this option has been ruled out of scope of the analysis.

Proposals for adapting to climate change and financial risk disclosure have also been excluded. Adding the requirement for financial risk disclosure would go some way towards satisfying those who support the TCFD. However, given the desired objectives and outcomes identified in this analysis, this financial information is not necessary and could risk duplication of efforts.

Impact analysis

	Option 1: Mandated adaptation reporting power in the Bill	Option 2: Voluntary/informal reporting supported by guidance
Provides national leadership on climate change adaptation and helps New Zealand to fulfil its international obligations	++ Better information will be available to support investment in adaptation planning and action	+ The existence of the Risk Assessment and Plan will drive the need for better information – even if not in the Bill, informal requests for information are likely to occur, which is an improvement over the status quo
Creates enduring and flexible adaptation mechanisms that continue to add value over time	++ The regular requesting, reviewing and publishing of information will add value for national and local adaptation	0 Without the reporting power in the Bill, it is possible that over time the requests are deprioritised by government
Aligns with international best practice	++ International best practice is moving towards full climate-related disclosures; this is a first step towards that for New Zealand	0 International best practice is moving towards full climate-related disclosures
Enables effective adaptation action to be taken by all actors	++ The reporting requirement will motivate those organisations who may not have properly assessed their climate risks to do so, and to take adaptation action to address those risks	+ Informal requests for information are likely to result in less information; however, this would still be an improvement on the status quo and enable more effective action to be taken than the current situation
Drives better coordinated and efficient adaptation action	+ Will support the Plan, which is likely to be the key driver for better action – by providing this information as an input to the Plan, we can coordinate and align actions between individual organisations to achieve co-benefits and efficiencies	0 The Plan will have less baseline information to start with
Clarifies roles and responsibilities for climate change adaptation to	++ Roles and responsibilities will be clarified through the Plan – by reporting their risks and self-	0 Roles and responsibilities will be clarified through the Plan; without certainty of information

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increase accountability	determined actions, key infrastructure and service providers will be incorporated into the Plan, which will help to increase accountability	being provided, it will take more time and effort to engage with individual organisations to come up with adaptation actions, and some organisations may be left out
Provides or improves access to information that increases understanding across society of the risks and opportunities posed by climate change	++ Primarily this is about providing public access to information to enable better decision-making, coordinate actions and achieve a more complete understanding of risks and adaptation actions across the country	+ Provided that this informal request process is funded, this will be an improvement on the status quo
Overall assessment	++	+

Key:

- ++ much better than doing nothing/the status quo
- + better than doing nothing/the status quo
- 0 about the same as doing nothing/the status quo
- worse than doing nothing/the status quo
- much worse than doing nothing/the status quo

What is the preferred approach?

Based on the impact analysis above, the recommended option is Option 1. There are likely to be benefits from the proposed approach.

Given the lack of readily available and adequate information, and that the Bill will also establish a framework for climate change risk identification and adaptation actions, it is useful to include a mechanism by which information can be gathered from those responsible for providing public services and infrastructure.

As opposed to the status quo described in the problem definition, and Option 2, the benefits of Option 1 are:

- Information would help the Government design supportive policies and to encourage adaptation.
- Reporting organisations, with a better understanding of potential risks, can identify actions to reduce, manage and mitigate the risks, and reduce the long term costs arising from climate change.
- By encouraging transparency on climate change adaptation risks, people and communities can access information and participate in decision-making processes or planning regarding the infrastructure and services that they rely on.

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- Building a comprehensive national understanding of the most severe impacts, and those who are most vulnerable in the Risk Assessment and Plan, will help communities build resilience and inform policy, planning and decision-making at all levels.

The information requirement in this option will address the information gap on climate change risk assessment and management plans for public infrastructure and services. Therefore, it is a first step towards satisfying the sub-criterion of understanding the impacts on people and communities.

The ability to exercise a mandatory adaptation reporting power could provide certainty that information will be gathered on an ongoing basis and give a clear picture of what action is being taken in risk management processes within organisations.

Additional considerations for the Option 1 approach:

There will be a need for a prescription of further detail about the reporting information and to provide reporting entities more certainty about this. The proposal is, therefore, that provision be made in the Bill for a regulation-making power that will allow for the necessary information to be prescribed in regulation.

This approach does require careful consideration of what guiding principles may be required in the legislation in order to ensure the regulations are designed well. For instance, the UK's reporting guiding principles are "proportionate, risk-based and streamlined to minimise burdens or duplications." Second, areas that require more policy analysis and consultation could be identified for inclusion in secondary legislation.

Other considerations include, but are not limited to:

- how the wider risk of non-compliance and/or inadequate reporting would be addressed
- assessment of the administrative and compliance costs on both the reporting organisations and central government
- functions to ensure consistency and coordination of reporting across organisations
- the type of support that organisations may require, given differing capabilities and methodologies.

There are also options as to where the power resides under the legislation. This RIS proposes that the Plan be the responsibility of central government. It is appropriate that the reporting power sit with the same body that has responsibility for the Plan, as much of this information is likely to be incorporated into it. Therefore, the preferred approach is that the power also sit with the responsible Minister.

Climate Change Commission

Problem/opportunity definition

A key focus of the Bill is establishing the enduring institutional architecture that will ensure continued, well-informed progress toward a low-emissions and climate-resilient future. New Zealanders need confidence that climate change policies will remain stable and that the pathway to the long-term target will stay broadly consistent. The Commission would be the best institution to show that New Zealand is on track and to help people hold governments to account.

Climate change is a long-term problem, yet decisions are needed now on how we address it. There is a strong case for insulating the policy-making process from short-term political pressures. Establishing the Commission would provide ongoing, independent expert advice to the Government on how we make the transition.

Other countries have already established independent institutions to provide advice to Government.⁶² Both the former and current Parliamentary Commissioners for the Environment and the Productivity Commission have recommended an institution like this should be established in New Zealand.

The core intended role of the Commission in New Zealand is to be the institution that provides independent expert advice and holds governments to account for progress towards emissions reduction and climate resilience.

Options identification

The form of the Commission should reflect the functions that will be required of it, and this section identifies how each of the options provide for the proposed functions (these functions are described in this RIS in relation to the 2050 target, emissions budgets and adaptation. A specific function is also proposed for the Commission in relation to the settings of the NZ ETS, and options for that function are assessed in the section on the **Interaction with the NZ ETS**.

Under the proposed overall approach, the Commission would be required to regularly:

- prepare a recommended emissions budget, with the government having the responsibility of setting budgets and giving reasons where it differs from the recommended budget
- monitor and report on government progress towards emissions budgets, with the government required to respond to that report within 12 months
- prepare the national climate change risk assessment, which the government would have regard to when preparing the Plan
- monitor and report on government progress in implementing the Plan and managing risks from climate change
- recommend specific unit supply settings for the NZ ETS, having regard to the factors specified in the Climate Change Response Act.

⁶² These include Australia, Denmark, Finland, Ireland, Sweden and the United Kingdom.

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The Commission also has a role if the government of the day should seek to revise a future budget or the 2050 target to:

- advise whether statutory thresholds for revision have been met
- advise on a revised budget or target.

Additionally, the Commission will have a broad power to prepare reports on any matter related to climate change, on the request of government or of its own volition.

All Commission reports would be tabled in Parliament and made public, to promote transparency and accountability.

The discussion document asked:

The Government has proposed that the Climate Change Commission advises on and monitors New Zealand's progress toward its goals. Do you agree with these proposed functions?

97 percent of long submissions on this question (11,453 of 11,884)⁶³ agreed with the proposed advisory and monitoring functions for the Commission.

Submitters who agreed with this option indicated a view that the Commission should be politically independent, and expressed that decisions should be made by democratically accountable decision-makers. There was broad support for the proposal that the Commission act in an advisory and monitoring capacity, with mechanisms to hold the government to account for its actions.

The proposed framework provides that accountability by requiring the government to:

- set emissions budgets, subject to Parliamentary resolution, having regard to the recommended emissions budget prepared by the Commission and giving reasons where the proposed budget differs from the budget recommended by the Commission
- prepare policies and plans to meet emissions budgets, having regard to the Commission's advice
- respond to the Commission's review (following each budget period) of government progress toward meeting its emissions budgets
- prepare and implement the National Adaptation Plan, having regard to the Risk Assessment prepared by the Commission
- respond to the recommendations of the Commission for the unit supply settings of the NZ ETS, giving effect to those recommendations unless it provides reasons for alternative settings.

In consultation, some submitters questioned whether the Commission ought to have responsibilities for both mitigation and adaptation. While some thought the inclusion of both areas would distract the Commission from its focus on mitigation, others saw value in a comprehensive Commission that has the skills and expertise to advise Government on all

⁶³ This represents 99 percent of all long form submissions and 86 percent of all long unique submissions on this question. 95.5 percent of long submissions answered this question.

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climate change matters. It is worthwhile for the Commission to have the mandate and scope to provide advice to government that seeks to maximise the co-benefits of responding to adaptation and mitigation. In order to create enduring institutional arrangements that will keep climate policy on the agenda and ensure transparency and accountability for progress, it is advisable for the Commission to have responsibility for providing advice to government on both matters.

If the government sought to revise a future emissions budget or the long-term target, it would have to seek advice from the Commission on whether statutory revision thresholds had been met. The government could also seek advice from the Commission on any matter related to climate change.

Having the same independent body with oversight on both mitigation and adaptation will promote the realisation of co-benefits. It will also help to make sure that the information about climate change that the Commission produces is comprehensive and useful for supporting meaningful public conversation and action.

The proposed advisory functions of the Commission are not intended to preclude other statutory bodies from providing advice.

What options are available to address the problem?

We have considered the forms of an Officer of Parliament, an independent Crown entity and an autonomous Crown entity.

In order to provide for the advice of the Commission to be independent, and to ensure public trust in the independence of the Commission's advice, its membership should comprise experts in relevant fields, rather than representatives of particular sectors or stakeholders. All of the options would provide for this.

The "climate resilience" objective of the Bill is of equal importance with the "low-emissions" objective, and placing its consideration (at an institutional level) on an equal footing with mitigation could help to establish appropriate priority for adaptation policies. The UK model has a Climate Change Committee responsible for mitigation functions, and a separate Adaptation Sub-Committee (UK ASC) responsible for adaptation functions. The chair of the ASC sits on the Climate Change Committee. In contrast, it is recommended that New Zealand's Commission consider both adaptation and mitigation at the commission level, with some discretion for the Chair to direct commissioners to focus on specific areas as appropriate. The options presented, therefore, do not specify an adaptation sub-committee.

A number of submitters suggested additional expertise that commissioners should have. However, it has been considered necessary to balance assurance of essential expertise with flexibility for the expertise of the Commission to evolve over time. A critical objective of establishing the Commission is that it is an enduring institution. Therefore, it is not appropriate to pre-judge all of the matters that it will need to consider nor the expertise that it should have, even in the period to 2050. For that reason, the preference is that the statutory considerations of expertise retain as much flexibility as is possible.

The number of commissioners appointed needs to be large enough to provide sufficiently for the breadth of expertise required, but not so large as to make it unworkable for the Commission to meet and work together or to be excessively expensive. As an example, the UK has five to eight members sitting on its Climate Change Commission, plus a chair, with an additional six members sitting on the UKASC (twelve to fifteen members in total for the

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equivalent scope of considerations proposed for the Commission in New Zealand). New Zealand examples are typically smaller – for instance, the Productivity Commission has three to four members, and the Law Commission has three to six. Six commissioners would likely be an appropriate minimum for the New Zealand Commission, and it would be beneficial to allow flexibility for up to eight members to sit on the Commission at any time, understanding that the scope of considerations may differ from year to year. We anticipate that the appointment of commissioners will be staggered.

In order to provide for the breadth of expertise that will be required, it will be useful for the Commission to be able to appoint subcommittees and commission expert advice, as well as having the option of appointing expert advisers in the secretariat. All of the options considered would provide for this.

It is essential that the working of the Commission is consistent with obligations under Te Tiriti o Waitangi. A number of submissions from iwi/Māori groups and others sought a partnership approach to the membership and processes of the Commission, and measures to ensure careful consideration of Māori interests, along with equity outcomes more generally, across the scope of the work of the commission.

It is proposed that, whatever the form of the Commission, the person recommending appointments to the Commission has regard to specific matters (refer to **Box 1** in the **Implementation** section of this RIS).

In any of the forms described below, the Commission could be supported by:

- a secretariat with a range of technical, analytical and supporting capability, which may include expertise in relevant fields that are not within the collective expertise of the Commission at any given time
- appropriate arrangements for sharing information with government departments
- a dedicated Māori advisory committee to support consideration by the Commission of Māori perspectives and to facilitate effective engagement between the Commission and Māori.

Commission policy intervention options

Option 1: an Officer of Parliament	Option 2: an independent Commission	Option 3: an autonomous Commission
<p>Under option one, proposed functions of the Commission would be the responsibility of an Officer of Parliament.</p> <p>In this option, the body is responsible to Parliament rather than the executive government. This form would give a high degree of independence. It would provide well for the functions where the Officer is performing an accountability function (such as monitoring and reporting on government progress towards emissions budgets). However, it would not be appropriate for an Officer of Parliament to have functions in advising the executive (for instance, it would not be appropriate to advise the government on setting emissions budgets).</p> <p>The Officer would be appointed by the Governor-General on the recommendation of Parliament, which would include the following:</p> <ul style="list-style-type: none"> • The Officers of Parliament Committee recommends appointments to the House. • The Speaker initiates consultations with representatives of parties represented in the House. <p>There would be an Officer, along with a group of advisors, appointed for a term of up to five years. In recommending candidates, the person recommending advisors would have regard to the matters in Box 1.</p> <p>All advice would be provided to Parliament. Government policies would not be reflected in the advice.</p>	<p>Under option two, the Commission would be an independent Crown entity (ICE).</p> <p>In this option, the Commission is responsible to a Minister rather than Parliament, but retains independence in terms of its advice. This form would provide well for the Commission to give independent advice to the government. As an independent Crown entity, it would not have to give regard to government policy. This option would also allow the Commission to perform its monitoring functions at arms-length from government.</p> <p>Commissioners would be appointed by the Governor-General on the recommendation of a responsible Minister, which would include the following:</p> <ul style="list-style-type: none"> • Names are put forward by a nominating committee. The Chair of the Commission sits on the nominating committee (unless the position of Chair is vacant). • The Minister is required to consult with the leaders of other political parties in Parliament in making his or her recommendations. <p>There would be six to eight commissioners, appointed for a term of up to five years. In recommending appointments, the nominating committee and/or Minister would have regard to the matters in Box 1.</p> <p>All advice of the Commission would be provided to Ministers, and subsequently published and tabled in Parliament.</p>	<p>Under option three, the Commission would be an autonomous Crown entity (ACE).</p> <p>In this option, the Commission is responsible to a Minister rather than Parliament. It would have less independence than in the other two options, and as an autonomous Crown entity would need to give regard to government policy in its advice. This option would provide for the Commission to perform its advising functions with a close connection to government, and would provide for it to have a decision-making role in respect of the NZ ETS. This form fits less well with the accountability functions proposed for the Commission.</p> <p>Commissioners would be appointed by a responsible Minister, which would include the following:</p> <ul style="list-style-type: none"> • Names are put forward by a nominating committee. The Chair of the Commission sits on the nominating committee (unless the position of Chair is vacant) • The Minister is required to consult with the leaders of other political parties in Parliament in making his or her appointments. <p>There would be six to eight commissioners, appointed for a term of up to three years. In recommending appointments, the Minister would have regard to the matters in Box 1.</p> <p>All advice of the Commission would be provided to Ministers, and subsequently published and tabled in Parliament.</p> <p>In addition to the support required under options one and two, the Commission may need specialised operational capability.</p>
<p>Key features of option one:</p> <ul style="list-style-type: none"> • The Officer is appointed on the recommendation of Parliament and has a high degree of independence • The government would need the agreement of Parliament to request specific advice from the Officer • The Officer would act independently of government policy when providing advice to Parliament • The Officer would perform only monitoring functions (and not specifically advise the executive government). 	<p>Key features of option two:</p> <ul style="list-style-type: none"> • As an independent Crown entity, it would not have to give regard to government policy. • The Commission is appointed on the recommendation of the Minister but has a high degree of independence • The Commission would not have to take account of government policy when providing advice (unless and except where this is specified in legislation) • The Commission would perform both monitoring and advisory functions. 	<p>Key features of option three:</p> <ul style="list-style-type: none"> • As an autonomous Crown entity, it would need to give regard to government policy. • The Commission is appointed by the Minister, and has less independence than the other two options • The Commission must have regard to government policy when performing its functions • The Commission would perform both monitoring and advisory functions, and could have more scope for decision-making functions to be added.

What criteria, in addition to monetary costs and benefits, have been used to assess the likely impacts of the options under consideration?

As in previous sections, the options for the Commission were assessed against their own sub-criteria within the three overarching objectives of the Framework:

Leadership at home and internationally (promoting global action):

- i. contribute to creating an enduring institutional architecture
- ii. hold government to account for progress towards long-term climate change goals.

A productive, sustainable and climate-resilient economy (ensuring the optimal transition pathway):

- iii. help decision-makers to fully understand the costs, benefits, risks and trade-offs of policy levers across the economy, society and the environment.

A just and inclusive society (ensuring a careful transition):

- iv. drive proactive adaptation to ongoing climate change impacts and investment to build resilience across all hazards and risks
- v. ensure that information about climate change and its impacts is robust and accessible to aid decision-making
- vi. promote credible and transparent processes.

Contributing to an enduring institutional architecture (i) is an important sub-criterion in establishing the Commission. An enduring institutional architecture necessarily requires both independence for the Commission and flexibility for current and future governments to exercise appropriate discretion in decision-making. It will also be critical that the form of the Commission provides for all of the functions proposed.

What other options have been ruled out of scope, or not considered, and why?

As described above, the options to be considered are those consistent with the core functions proposed for the Commission. Further consideration was not given to options where:

- the membership of the Commission was constituted of stakeholder representatives, as this was considered to risk the ability of the Commission to provide independent advice
- the consideration of adaptation was devolved to a subcommittee, as this was considered to risk adaptation being treated as a secondary consideration to mitigation action
- the collective expertise required of the commission was prescribed in more detail, as this was considered to allow insufficient flexibility for the considerations of the Commission to evolve over time

- the functions proposed for the Commission are performed as a statutory independent function in a government department, as this would not provide for an independent body.

Impact analysis

	Option one: a Parliamentary Commission	Option two: an independent Commission	Option three: an autonomous Commission
Contributes to creating an enduring institutional architecture	<p>+</p> <p>Contributes well to creating an enduring institution for monitoring functions. Would not provide for proposed advising functions. May need to duplicate or replace some broader institutional functions.</p>	<p>++</p> <p>Contributes well to monitoring and advisory functions. More likely to endure than option three, as retains government discretion in decision-making.</p>	<p>+</p> <p>Contributes well in some ways but there is a risk that having the Commission too close to government will not provide the independence sought, particularly in monitoring functions. Allowing decision-making functions that would otherwise sit with government risks making the Commission less likely to endure.</p>
Holds government to account for progress towards long-term climate change goals	<p>++</p> <p>Provides a high level of accountability to government action.</p>	<p>++</p> <p>Provides a high level of accountability to government action.</p>	<p>+</p> <p>Provides some accountability to government action. However, the Commission would have less independence from government.</p>
Helps decision-makers to fully understand the costs, benefits, risks and trade-offs of policy levers across the economy, society and the environment	<p>0</p> <p>It would not be appropriate for a parliamentary body to provide advice to government.</p>	<p>++</p> <p>Would have greater distance from government policy in advice of the Commission than option three.</p>	<p>++</p> <p>Would have greater reflection of government policy in advice of the Commission than option two.</p>
Drives proactive adaptation to ongoing climate change impacts and investment to build resilience across all hazards and risks	<p>+</p> <p>Provides well for independent monitoring of the government's adaptation actions, but would not likely be able to prepare the national climate change risk assessment.</p>	<p>++</p> <p>Provides well for the national climate change risk assessment as well as independent monitoring of the government's adaptation actions.</p>	<p>++</p> <p>Provides well for the national climate change risk assessment but less independent monitoring of the government's adaptation actions.</p>
Ensures that information about climate change and its impacts is robust	<p>+</p> <p>Draws on best available information, and ensures that it is</p>	<p>++</p> <p>Draws on best available information, and ensures that it is</p>	<p>++</p> <p>Draws on best available information, and ensures that it is</p>

and accessible to aid decision-making	widely available.	available and relevant for government decision-making.	available and relevant for government and Commission decision-making.
Promotes credible and transparent processes	++ High level of transparency and credibility.	++ High level of transparency and credibility.	+ High level of transparency. Could be less credibility, especially in accountability functions, as Commission has a closer relationship to government.
Overall assessment	0 Better than the status quo in relation to monitoring role. Does not provide for significant advisory functions.	++ Much better than status quo in relation to all sub-criteria. Most likely to meet critical objective of enduring architecture.	+ Better than the status quo in relation to all sub-criteria. Risks that architecture may be less credible and enduring.

Key:

- ++ much better than doing nothing/the status quo
- + better than doing nothing/the status quo
- 0 about the same as doing nothing/the status quo
- worse than doing nothing/the status quo
- much worse than doing nothing/the status quo

What is the preferred approach?

An independent Commission (Option 2) is the preferred option. It is considered to be the most likely to meet the critical sub-criterion of establishing an enduring institutional architecture with the advisory and monitoring functions proposed. It is also an improvement on the status quo in respect of all other sub-criteria.

As an independent Crown entity, the Commission will be accountable to the Minister for Climate Change (and monitored in a de facto manner by the Ministry for the Environment), but would retain independence in terms of giving advice and would not have to give regard to government policy.

This option provides for the Commission to be independent while remaining close enough to government to make best use of information and provide relevant advice. The independence provided by this option is expected to support a high level of transparency and credibility, including in relation to functions for monitoring the government's progress in both mitigation and adaptation.

The advisory functions of the Commission will help ensure that information about climate change and its impacts is robust and accessible to aid decision-making, and help decision-makers to more fully understand the costs, benefits, risks and trade-offs of policy levers across the economy, society and the environment.

The form will be appropriate to the proposed function of the Commission to prepare the Risk Assessment, which is expected to help to drive proactive adaptation to ongoing climate change impacts.

Conclusions

5.1 What option, or combination of options, is likely best to address the problem, meet the policy objectives and deliver the highest net benefits?

The Zero Carbon Bill is an opportunity to tackle climate change action on both fronts – mitigation and adaptation – within a single, enduring framework.

Introducing a new 2050 target in primary legislation, alongside an emissions budgeting system, nationwide adaptation response and an independent Climate Change Commission, aims to meet the government's climate change objectives for:

- leadership at home and internationally
- a productive, sustainable and climate-resilient economy
- a just and inclusive transition.

The Bill has significant economic, fiscal and social implications in the short and long term, either by establishing new and enduring institutional architecture, or by signalling policies and plans that, over time, will alter the make-up of New Zealand's economy and society. Macroeconomic modelling (while highly uncertain over such a long timeframe) indicates the Bill's economic impacts will be a significant challenge compared with the 'do-nothing' baseline and status quo. Innovation, afforestation and sectoral shifts will be critical.

However, setting the 2050 target and overall neutrality goal, and establishing the enduring institutional framework, will not alone have these impacts. Therefore, a low-emissions development strategy will need to be introduced, including policies and plans, which may provide the optimal transition pathway for New Zealand to maximise opportunities and benefits (not reflected in the modelling) and minimise any costs or unforeseen impacts.

The Bill reflects a strong shift in the world's understanding of, and commitment to, the necessary global climate change response. It sends a strong signal and lays the foundations for decisive domestic action – commensurate with New Zealand's emissions profile, comparative advantage and developed country status – while also providing for flexibility and adaptability to insulate the New Zealand economy and society from any abrupt shocks.

The proposed framework for the Bill is outlined in detail below for each policy area. It provides the necessary direction and resourcing for climate change mitigation and adaptation in a way that the current legal and policy framework does not. The Bill's long-term, enduring focus will be better placed to meet New Zealand's climate change objectives while continuing to deliver prosperity and improve wellbeing out to 2050 and beyond.

2050 Target

The recommended target in the Bill is to reach net zero long-lived gases and reduce short-lived gases by [x] percent below 2016 levels by 2050. The Bill would also state the aim of achieving overall GHG neutrality in the second half of the century. This option provides the long-term stability and predictability necessary to drive domestic action and is consistent with New Zealand adopting a leadership position in global efforts to keep the average temperature increase to below 1.5 degrees above pre-industrial levels.

This option also balances a strong domestic signal with flexibility of implementation. If New Zealand faces unforeseen circumstances in future, such as another GFC or significant change in trade patterns, international units may be needed to offset emissions at a lower relative cost. Therefore, offsetting through international units will be allowed up to a level mandated by the Commission. This provides an important flexibility mechanism, allowing the target to be achieved without disproportionately affecting different social sectors.

Quantitative and qualitative economic analyses indicate that, under any of the target options, transitioning New Zealand's economy to lower emissions and climate resilience will be highly challenging but achievable, provided the necessary innovation, afforestation and sectoral shifts take place. The proposed 2050 target is modelled to reduce economic growth by 0.07-0.18 percent per annum compared to the status quo and impose an overall emissions prices of \$75-885/tCO₂-e. However, the models do not factor in the avoided costs and damages, co-benefits and positive 'spill-overs' to be derived from stronger climate change action, which, if the rest of the world acts too, may well be substantial.

The 2050 target will set the course of the future New Zealand economy and society. A comprehensive low-emissions development strategy will be necessary to implement the transition along the optimal abatement pathways. For a just transition, this strategy will also need to include transitional support policies to avoid or ease any uneven distributional impacts on particular sectors of the economy and society.

Emissions Budgets

The chosen system of five-year emissions budgets – with three budgets in place at any time and a look-ahead period of 10-15 years – ensures the establishment of enduring institutional architecture. This option provides the necessary 'stepping stones' to measure New Zealand's progress towards meeting each budget and, ultimately, the 2050 target.

The ability of future governments to revise the level of the second and third budgets in the sequence when certain criteria are met (informed by the advice of the independent Commission) also strikes the right balance between providing a stable policy environment and sending a strong signal to households, businesses and industry while remaining flexible to changing circumstances.

Under the proposed approach, banking and borrowing across consecutive budget periods would be allowed, but with borrowing capped in legislation at 1 percent of the total budget. The combination of banking and borrowing would make it easier for the government to adhere to the optimal abatement path and manage any adverse impacts of the transition to a low-emissions economy. Ultimately, the responsible Minister will decide whether banking or borrowing may occur and what the appropriate level would be. This decision will be informed by advice received from the Commission and subject to the statutory cap on borrowing.

The Commission's active role in relation to emissions budgets enhances the credibility, transparency and accountability of this process as it will be informed by independent expert advice. The preferred approach will also provide greater transparency around the decision-making process, as the Commission's advice and recommendations would need to be tabled in Parliament and made publicly available.

Interaction with the NZ ETS

Given the significant macro-economic policy implications, it is proposed that decision-making powers on NZ ETS unit supply settings will remain with the elected government.

However, the Commission will have an ‘advisory-plus’ role in recommending NZ ETS unit supply settings in accordance with meeting the emissions budgets and 2050 target. It will hold the government to account by requiring a response where decisions deviate from the Commission’s recommendations.

This is the preferred approach because it contributes to:

- enduring institutional architecture, by building trust in the effectiveness of the NZ ETS
- holding New Zealand to account on meeting its international commitments, due to decreased political influence on the NZ ETS
- driving behaviour change, due to greater improvements in trust and predictability of the NZ ETS settings.

Adaptation

The recommended option for adaptation is a combination of a National Climate Change Risk Assessment and National Adaptation Plan mandated in primary legislation with regular review of implementation.

Both options – the recommended primary legislation and regulation by way of a National Policy Statement (NPS) – are equal to or an improvement on the status quo across the various assessment sub-criteria. They have similar challenges associated with them in terms of potential uncertainty, cost and administrative burden.

However, primary legislation was assessed to be superior to an NPS across all sub-criteria, particularly as a legislative directive would have an expanded scope, align better with international best practice and increase accountability by providing a greater clarification of roles and responsibilities for climate change adaptation.

While an NPS may direct objectives and policies to guide decision-making on land-use and resource management issues within the scope of the RMA, it may not be as effective and coherent as primary legislation for dealing with the full scale of the adaptation challenge.

Although climate change adaptation and mitigation are separate challenges requiring separate policy responses, situating them alongside one another in the Bill provides appropriate context and coordination for policy-making. International evidence suggests this integrated approach is beneficial.

Adaptation reporting power

In addition, a mandatory adaptation reporting power used at the discretion of the government of the day provides certainty that information on the risks of climate change impacts on public services and infrastructure will be gathered on an ongoing basis and will give a clear picture of what action is being taken in risk management processes within organisations.

The information gathered through reporting will help to build a comprehensive national understanding of the most severe impacts and who is most vulnerable in the Risk Assessment and Plan. In turn, this understanding will help communities build resilience and inform policy, planning and decision-making at all levels. It will also encourage organisations to include climate change in their risk assessment processes and to plan for adaptation.

Commission

The preferred option is for the Commission to assume the form of an independent Crown entity with advisory and monitoring functions.

This form provides for the objectives of providing transparency and accountability and, in particular, was considered to be the most likely of the three options to meet the most critical sub-criterion of contributing to an enduring institutional architecture. Our analysis indicates that a Parliamentary Commission or Autonomous Commission may be inferior in this respect. An independent Crown entity is a marked improvement on the status quo.

In line with this option, the large majority of public submissions favoured the Commission advising on and monitoring New Zealand's progress towards its climate change goals (98 percent). The proposal includes a Māori Advisory Committee to ensure careful consideration of Māori interests along with equity outcomes more generally. A number of submissions from iwi/Māori groups and others sought a strong Crown/Māori partnership approach across the full scope of the Commission's work.

While an independent Crown entity would provide the high degree of independence appropriate for the Commission's proposed advisory and monitoring functions, any decision-making function would need to be managed differently. To balance this key consideration with the importance of political independence, the Commission will have an 'Advisory-plus' role with respect to NZ ETS unit supply settings: it will recommend the appropriate settings on the presumption that these will be given effect, or else the elected government will be required to respond and give reasons why its decision deviates from this recommendation.

5.2 Summary table of costs and benefits of the preferred approach

Affected parties	Comment	Impact (\$)	Evidence certainty
Additional costs of proposed approach, compared to taking no action			
Regulated parties	Costs to economy of policies to implement the 2050 target	Economic growth slowed by 0.07-0.18 percentage points compared to status quo target (\$12-15 billion over 2020-2050)	Medium
		Economy-wide emissions prices rising to \$75-885/tCO ₂ -e by 2050	Low
	Ongoing costs of implementing the	Unknown (cannot be	N/A

	National Adaptation Plan	estimated)	
Central government response	Ministry for the Environment	Total cost over first 4 years: 10,447,873	Medium-High
	Ministry of Culture and Heritage	250,000 per annum	Medium-High
Wider government	Climate Change Commission: <ul style="list-style-type: none"> • one-off establishment cost • ongoing costs of updating and improving the Risk Assessment • ongoing cost of monitoring and evaluating Plan implementation • ongoing cost of recommending emissions budgets 	Total cost over first 4 years: 42,227,048	Medium-High
	Environmental Protection Authority	400,000 per annum	Medium-High
Total Monetised Cost	Total cost related to establishment and ongoing costs associated with the Commission and government response only (2050 target costs will depend on plans and policies to implement the target)	55,274,921 over first four years	Medium-High
Non-monetised costs	Other departments and agencies involved in contributing to or leading on aspects of the Plan and its implementation will face costs	Medium	Low

Expected benefits of proposed approach, compared to taking no action			
Regulated parties	Improved planning and coordination of emissions reduction efforts	Medium	Low
	Stronger market signal and greater investment predictability	High	Low
	Innovation, competitiveness and productivity gains	Medium	Low
Regulators	Improved planning, coordination and delivery of climate change adaptation action	Medium	Medium-High
	Reduced duplication and increased cost effectiveness of climate change adaptation interventions	Medium	Medium
	Improved awareness and understanding of climate change risks and what can be done to address those risks	Low	Low

IN CONFIDENCE – NOT GOVERNMENT POLICY

	More investment in climate change adaptation measures across New Zealand society	Medium	Low
Wider government	Long-term direction, including plans and policies, for climate change mitigation and adaptation	High	Medium
	Alignment with international climate change obligations and objectives	High	High
Other parties	<p>Wider public health, environmental and social co-benefits of climate change policies, including:</p> <ul style="list-style-type: none"> health benefits from better home insulation: 4:1 benefit-cost ratio congestion, maintenance and safety co-benefits of switching from road to rail freight (at current estimated rates of \$346 million per year) reduced air pollution and congestion and improved safety improved health benefits from increased active transport (\$15 billion estimated net benefit of cycling infrastructure, benefit-cost ratio of 24:1) water quality, biodiversity and other environmental co-benefits from land-use change (added ecosystem-service value per hectare, per year of \$6,092 for exotic forestry, \$6,677 for indigenous forestry, and up to \$37,636 for wetlands and mangroves). 	Medium	Medium
All affected parties (especially central government, local government, businesses)	Greater certainty and predictability for long-term investment decision-making and prioritisation	High	Low
Total Monetised Benefits	Cannot be estimated	Medium-High	Medium
Non-monetised benefits	Enduring framework to support the transition to a low-emissions, climate-resilient New Zealand	Medium-High	Medium

Assumptions

2050 Target

- Assumptions in the economic modelling are discussed in the **2050 Target** section and in more detail in **Appendix 3**, including the use of international units.

Emissions Budgets/Interaction with the NZ ETS

- Costs covered by the Commission and government response (see section below).

Adaptation

- Cost estimates were obtained from the Ministry's Budget 2018 bid to establish the Commission, as well as an early draft business case for a Climate Change Adaptation Budget bid. Government response costs include funding for FTEs to work on the Plan and reporting power and a rough estimate of additional research funding. The first Risk Assessment will be funded through a tagged contingency obtained in Budget 2018.
- Gaps/exclusions:
 - The primary adaptation benefits achieved will relate to the particular adaptation interventions included in the Plan via avoided direct damage, so it is not possible to estimate these here.
 - Costs of implementing the Plan are difficult to predict and are not estimated here.
 - Costs of research and procuring the evidence base to update the Risk Assessment are also not estimated, the assumption being that investment can be re-directed from existing research funds, such as the National Science Challenges.

Climate Change Commission

	2019/20	2020/21	2021/22	2022/23 & out-years	Total over 4 Years
Operating	9,541,425	10,612,337	10,744,191	10,880,192	41,778,145
Capital	388,903	20,000	20,000	20,000	488,903
Total					42,227,048

Assumptions:

- There will be 8 Commissioners.
- There will be a Māori Advisory Committee with four dedicated members of the Secretariat to support the Committee.

- Start dates:
 - Commissioners: Late-September 2019
 - Māori Advisory Committee members: November 2019
 - Chief Executive: November 2019
 - Transferred Interim Climate Change Committee staff (on fixed-term contracts): 1 October 2019 (to be replaced with permanent positions from April 2020)
 - Remainder of Secretariat: 1 January 2020 (with some flexibility around individual start dates).
- Secretariat includes:
 - 13 Senior Analysts (including 3 for Māori Advisory Committee)
 - 8 Principal Analysts (including 1 for Māori Advisory Committee)
 - 3 Directors
 - 1 Corporate Services Manager/Chief Financial Officer
 - 1 Chief Executive
 - 1.5 Senior Communications
 - 2 Administrative Support
 - 2 Executive Assistants (to support Chief Executive and Commissioners)
- The Commission meets twice a month (Chair paid four days per meeting, members paid three days per meeting) and have one day of stakeholder engagement per month (Chair paid two days per stakeholder engagement).
- The Māori Advisory Committee meets once a month (Chair paid four days per meeting, members paid three days per meeting) and hold one day of stakeholder engagement per month (Chair paid two days per stakeholder engagement).
- Other costs include:
 - legal consultancy (\$160,000 per annum)
 - communications collateral and services/consultancy (\$200,000 in year one, \$50,000 per annum in out-years)
 - economics consultancy (\$1.8 million per annum)
 - adaptation research to support risk assessments (\$1 million per annum)

- international experts (one person visiting twice a year)
- travel costs for Commissioners to attend meetings and stakeholder engagement.

Gaps:

- The Commissioner and Committee member daily rates still need approval from the State Services Commission.
- This RIS still awaits confirmation of final estimates and arrangements for shared services. Owing to this uncertainty, the operating costs assume no shared services; however, if the Commission has a shared services arrangement, it should be no more than these operating costs.

Government response: Ministry for the Environment

2019/20 ⁶⁴	2020/21	2021/22	2022/23
\$2,754,042	\$2,586,777	\$2,563,027	\$2,544,027

- Total 16 FTE:
 - Adaptation (Plan): 1 Analyst, 2 Senior Analysts, 1 Senior Comms/Engagement
 - Adaptation reporting power: 1 Analyst, 1 Senior Analyst
 - Urban (or other transition): 0.5 Analyst (Hub)
 - Agriculture: 1 Senior Analyst (Agriculture work programme)
 - Energy, Transport: 1 Senior Analyst (Hub)
 - Emissions Budgets (Economics): 1.5 Senior Analysts (Hub)
 - Emissions Budgets (Evidence & Research): 1 Analyst, 1 Senior Analyst (CCA & LUCAS)
 - Emissions Budgets (Policy): 1 Senior Analyst (Hub)
 - Economics: 1 Principal Analyst (Hub)
 - Commission Liaison (including monitoring the Commission): 1 Analyst, 1 Senior Analyst
- Research (non-FTE):
 - \$100,000 in FY19/20 for Māori indicators development

⁶⁴ Includes set-up costs.

- \$50,000 in FY20/21 and out-years for adaptation
- Consultation (non-FTE)
 - National Adaptation Plan public consultation (every 6 years)
 - National Adaptation Plan targeted engagement (ongoing, regular)
 - Adaptation reporting power targeted engagement (2019/20 and 2020/21)
 - emissions budgets – budget-setting targeted engagement (2019/20, 2021/22, then every 5 years if required)
 - emissions budgets – revising budgets public consultation (if/when required)
 - emissions budgets – plans and policies targeted engagement (every 5 years, if required).

Commission Establishment Team:

- The Establishment Team will use full tagged contingency funding for the establishment of the Commission (\$515,000) over 1 November 2018-1 August 2019, which will cover:
 - 1 Principal Business Analyst/Project Manager
 - 2 Senior Analysts
 - HR, legal and other consultants.

Government response: Ministry of Culture and Heritage

- 2 FTE (Principal and Research Support)
- \$250,000 per annum (including salaries and overheads).

Government response: Environmental Protection Authority

- Up to 3 FTE (senior-level)
- \$400,000 per annum (based on Ministry for the Environment salaries and overhead costs).

NB: The Department of Conservation, Ministry for Primary Industries, Ministry of Business, Innovation and Employment and Ministry of Education will also require additional resourcing, but specific details in terms of how many FTEs are not yet known. A number of other government agencies are also likely to require additional resources, depending on the nature of future decisions (eg, sector-specific budgets, adaptation reporting requirements, etc).

5.4 Is the preferred option compatible with the Government’s ‘Expectations for the design of regulatory systems’?

The options analysed are generally compatible with the Government's 'Expectations for the design of regulatory systems'. They attempt to balance the purpose and objectives of the proposed legislation with providing for flexible and efficient implementation.

However, due to time constraints, this assessment has not benefitted from the finalised macroeconomic modelling figures or from further consultation on the additional 2050 target options identified outside of government agencies.

Implementation and operation

6.1 How will the new arrangements work in practice?

Among the proposed policy decisions to be agreed by Cabinet will be a recommendation to delegate power to the Legislation Committee (LEG) to approve the draft Bill without needing to revert to Cabinet. The purpose of this recommendation is to streamline the introduction of the Bill to ensure this happens by the end of 2018.

Timely and transparent implementation of the Bill will be essential in order to provide certainty and allow businesses, households and individuals to start taking action to reduce their emissions and understand the risks of climate change.

For that reason, some parts of the Bill will include transitional arrangements to enable full implementation by mid-to-late 2022, which will align with requirements under the Paris Agreement to the greatest extent possible. It will also establish much-needed market signals for NZ ETS participants on the early emissions reduction pathway for New Zealand.

The statutory timeframes will apply to the provision of advice and requirements to respond once the framework is fully operational. Following the conventional parliamentary process, the Bill will receive royal assent and pass into law, and the entry-into-force of the Act will result in the following new arrangements:

2050 Target

The setting of a 2050 target in primary legislation does not prescribe any particular policy pathway to its achievement. Responsibility for providing advice on the appropriate package of policies and measures in support of achieving the target will rest with the Commission.

While the government's response to such advice is likely to entail downstream policy implications (to which implementation risks can more properly be assigned), the setting of the target itself prescribes an outcome rather than a method for achieving that outcome.

Therefore, we consider that consideration of these matters are not applicable in the context of setting a 2050 target.

Emissions Budgets

Under the proposed approach, the Commission and the responsible Minister will both have roles in determining the level of emissions budgets and the plans and policies for achieving them.

In the general process, the Commission will advise the government on the emissions budget settings, up to three emissions budgets out. Its involvement will keep the government accountable and bolster public confidence that decisions are founded on a comprehensive evidence base and rigorous analysis. The Commission's advice will include:

- the level at which the emissions budgets should be set
- the accounting methodologies that will apply
- plausible pathways for meeting these budgets

As three emissions budgets must be in place at all times, the Commission will be required to provide advice on a rolling basis. This means that the Commission must provide advice on the level of the third emissions budget in the sequence no later than 12 months before the government is required to set the next emissions budget (note that this will be required by the end of the existing budget period), extending to 15 months in an election year.

The responsible Minister will be required to present the Commission's advice in the House. The Minister will be required to respond to the Commission's advice and recommendations and gazette the emissions budget within 12 months of the Minister presenting the proposed budget to the House (extending to 15 months in an election year). The Minister's response should include a proposed emissions budget that takes the Commission's advice into account. Prior to developing this, the Minister must consult with other political parties. Where the Minister proposes to depart from the Commission's advice, there will also be a requirement to consult with persons and/or sector representatives that have an interest in the level of an emissions budget.

The Minister's response should also include an explanation of any departure from the Commission's recommendations.

Following this process, an emissions budget will be set and notified via Gazette notice. This will provide for a level of required flexibility when setting emissions budgets into the future and allow them to be revised without requiring legislative amendments.

The following table sets out the timeframes in greater detail:

Budget period	Commission's advice	Government response and Gazettal
Budget period 1 (2021-2025)*	February 2020	31 December 2020
Budget period 2 (2026-2030)*	February 2020	31 December 2020
Budget period 3 (2031-2035)*	February 2020	31 December 2020
Budget period 4 (2036-2040)	31 December 2024	31 December 2025
Budget period 5 (2041-2045)	31 December 2029	31 December 2030
Budget period 6 (2046-2050)	31 September 2034	31 December 2035

The Bill will require that, in providing advice and making decisions on emissions budgets, the Commission and the Minister must have regard to the following factors:

- plausible pathways to achieving the 2050 target and existing emissions budgets, including projected emissions and removals
- science, including mātauranga (in fields such as climate, environment and ecology)
- technology relevant to climate change

- economic circumstances and, in particular, the likely impact of the government's decision on the economy and the competitiveness of particular sectors of the economy, including the Māori economy
- fiscal circumstances and, in particular, the likely impact of the government's decision on taxation, public spending, and public borrowing
- the distribution of impacts and their equity implications, for example regional differences in the capacity to mitigate and adapt to climate change, and social circumstances
- any other relevant matter.

In addition, the Minister must also have regard to the advice and recommendations of the Commission when making decisions on a budget.

Transitional provisions

The Commission will be required to advise on the level of the first three emissions budgets by mid-February 2020 so that businesses, households and individuals can start taking action to reduce their GHG emissions. The first three emissions budgets should be accepted by government, or alternatives provided, and gazetted by 31 December 2020 at the latest.

The general statutory process under the Bill would require budgets to be notified by Gazette at least ten years prior to their commencement. However, the first emissions budget (and plans and policies) would need to be set on accelerated timeframes to enable the first emissions budget to commence on 1 January 2021. The first emissions budget will be based on evidence and analysis that is developed by the Interim Committee and officials in parallel and handed over to the Commission as soon as it is established. The Commission will then consider this advice and develop its own advice and recommendations to be provided in mid-February 2020 (for Interim Committee handover, refer to **Commission** section below).

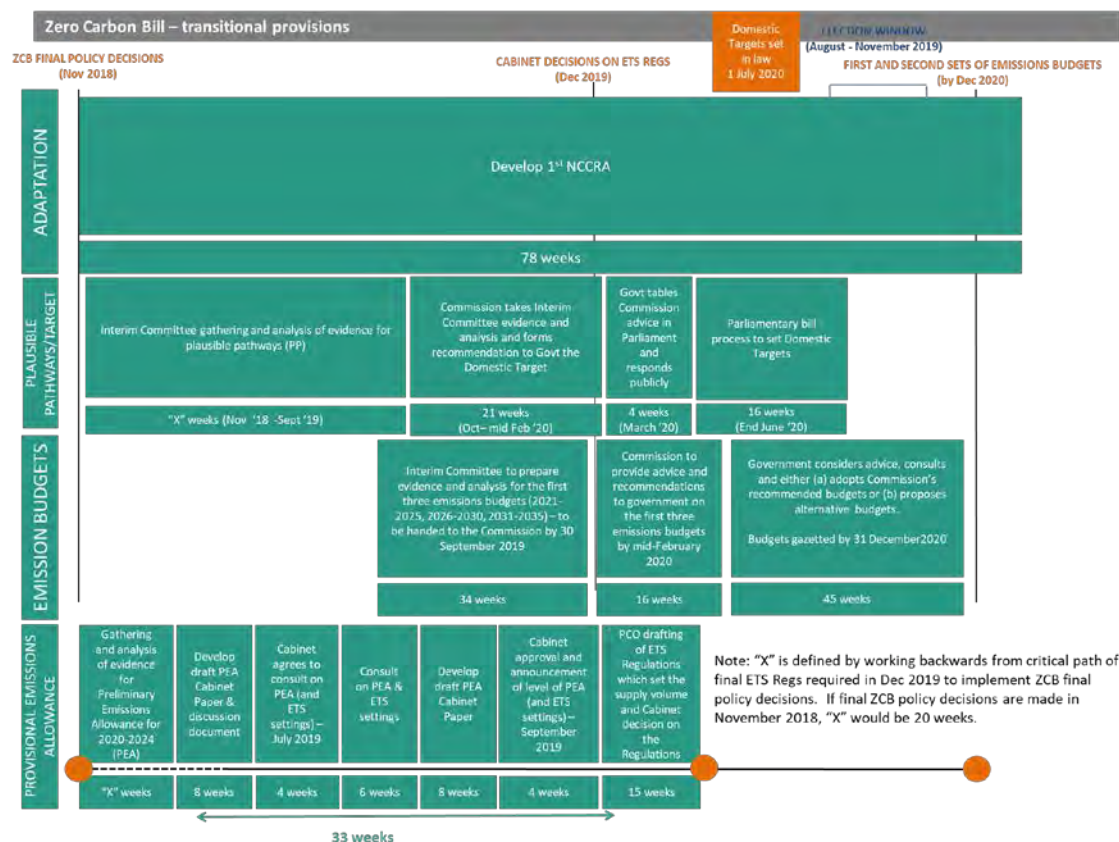
Given the Commission will not be operational until mid to late-2019 and the first emissions budget (2021-2025) will not gazetted until mid-2020, however, means that decisions on NZ ETS unit supply settings for 2020 and 2021 will be needed before the first emissions budget is in place.

In the absence of an emissions budget, there is significant uncertainty around the level of emission reductions the NZ ETS will be expected to deliver. This creates a risk that businesses will delay investments in low emissions technologies and forestry.

To remove this uncertainty and inform the first round of unit supply decisions, officials will develop a Provisional Emissions Allowance (PEA) for the period 2020-2024. The PEA would be set to provide certainty for NZ ETS participants, while retaining the Commission's ability to provide independent advice on the first three emissions budgets. The PEA will be superseded by the emissions budget for 2021-2025 in mid-2020.

Figure 1, over the page, outlines the timeframe for implementation of the Zero Carbon Bill transitional provisions.

Figure 1: Timeframe for implementation of Zero Carbon Bill transitional provisions



Interaction with the NZ ETS

Every five years, the Commission will recommend emissions budgets (with a mandated government response) and advise on macro-level policy to meet the budgets set by the government, including an outlook for the NZ ETS unit supply settings.

Decision-making on these settings will remain with the elected government. However, the Commission will have an 'advisory-plus' role, in which it will be required to recommend the technical NZ ETS settings annually (within the constraints of the set 2050 target and emissions budgets) and on the presumption that its recommendations be given effect unless government provides otherwise and gives reasons.

In addition to considering the 2050 target and set budgets in its recommendations, the Commission will need to:

- take account of the government's other policies for the period and what effect these will have on the level of abatement that can and should be achieved through the NZ ETS (using information provided by the government in a transparent manner)
- consult broadly in preparing its recommendations.

The Commission will report annually on government's progress toward each budget and the target, with regular review every five years.

Adaptation

The responsible Minister will be responsible for preparing the very first Risk Assessment. Subsequent to this, the Commission will be tasked with preparing the Risk Assessment on an ongoing basis every six years.

The responsible Minister will develop the Plan in consultation with mana whenua and key stakeholders, including local authorities and relevant agencies, every five years. The Commission will be required to monitor the Plan's implementation on an ongoing basis and report on progress two years following the publication of the most recent Plan.

Although the Risk Assessment and Plan will establish national priorities, it is likely regions, cities, businesses and sectors will have a role in undertaking more detailed assessments of risks and prioritisation of actions.

Adaptation reporting power

An adaptation reporting power in the Bill will allow for the collection of information about the current and future predicted impacts of climate change on the reporting organisations and their proposals for adapting to climate change.

The power would be held by the government, with the Secretary for the Environment having the discretion to request information on a mandatory or voluntary basis from organisations that own or operate public infrastructure and services.

The Bill will include a regulation-making power which will be used to enable the necessary information to be prescribed in regulation, through a full consultation process.

Aspects to which the regulation would apply would be, as a minimum:

- the materiality of a climate change related risk to the operation of the organisation
- the significance of failure of the operation of the infrastructure or service due to the climate related risk, as it affects people and communities
- the ways in which unnecessary duplication between existing reporting frameworks and this one can be avoided
- the ability to protect commercially sensitive information
- the flexibility that should be provided for in relation to reporting time intervals and information requirements for different sectors.

Commission

The Governor-General will establish the Commission by appointing the Chair and Commissioners, based on the recommendation of Ministers that they fulfil the necessary expertise, as outlined in Box 1:

Box 1: Proposed considerations for appointing commissioners

In recommending appointments, the person making the recommendation would have regard to:

- the need for the Commission to consider both mitigation and adaptation

- the need for the Commission to give due consideration, across the whole scope of its work, to:
 - Māori interests
 - equity outcomes.
- the need for the Commission to include expertise on:
 - climate change policy (such as emissions trading and international climate policy)
 - economics (such as resource economics and behavioural economics)
 - Te Tiriti o Waitangi, te reo me ona tikanga Māori and Māori interests
 - science, including mātauranga Māori (in fields such as climate, terrestrial and marine environments and ecology)
 - social and distributional impacts
 - risk management
 - public health
 - urban planning and local government
 - community engagement and communications
 - other necessary expertise
- the desirability of the expertise of the Commission, including:
 - such sector-specific matters as the person making the recommendation considers are likely to be relevant during the proposed term of appointment
 - business competitiveness
 - knowledge of the public and private innovation and technology development system
 - insurance
 - engineering and/or infrastructure.

When considering 'desirable' expertise, the person making the recommendation may have regard to the availability of this expertise to the Commission by other means (for instance, whether that expertise exists in the secretariat, or could be obtained by contracting specific advice).

As noted in the previous sections, the Commission will be responsible for:

- monitoring and reporting on the government's progress towards meeting the 2050 target
- recommending emissions budgets to be set by the government

- recommending the NZ ETS unit supply settings
- updating the Risk Assessment (first prepared by the responsible Minister) and monitoring and evaluating the implementation of the Plan on an ongoing basis.

Transitional provisions

The Commission would be operational within 4-6 weeks of the Bill passing to ensure it has the time required to deliver its first set of advice prior to the 2020 General Election period.

The Risk Assessment will be prepared, in the first instance, by the Minister for Climate Change within a year of the Zero Carbon Act coming into force. This will enable the Commission to focus initially on its establishment and the provision of advice on emissions budget settings. The statutory timeframes and the role of the Commission would then apply to subsequent Risk Assessments, undertaken at least every 6 years.

Preparatory work undertaken while the Bill is going through Select Committee will be critical to meeting emissions budget timeframes. It is proposed that the relevant Secretariat staff from the Interim Climate Change Committee transfer to the Commission upon the disestablishment of the Interim Committee for a six-month term to provide continuity and certainty for the Commission to deliver its advice on the first emissions budget.

To provide the least disruption for the transfer and continuation of functions, this transfer would apply to existing Secretariat staff working on the analysis and evidence for the first emissions budget and any operational staff required.

6.2 What are the implementation risks?

2050 Target

Any assessment of implementation risks with respect to setting a 2050 target in primary legislation would more appropriately be carried out as part of the regulatory impact assessment process of any policies and measures implemented in pursuit of its achievement.

There is inherent uncertainty in setting a long-term target, due to the unpredictability of future market conditions. We consider that allowing for the revision of the target helps to mitigate this risk by accommodating better quality information as it becomes available (eg, with respect to the availability of anticipated technological solutions). The opportunity to revise the 2050 target is discussed in greater detail below, in section 7.2.

Emissions Budgets

The key implementation risk concerns the establishment of the first three emissions budgets, particularly in terms of the time necessary to agree and gazette the emissions budgets.

These risks are exacerbated if the government does not accept the advice of the Commission. In this event, the government would be required to develop an alternative emissions budget for the period. In doing so, the government may request further advice from the Commission or alternatively rely on what has been provided.

Interaction with the NZ ETS

There are additional implications with regard to an Advisory-plus model for the Commission's role advising on NZ ETS unit supply settings, including:

- a risk of draining expertise from existing institutions (although this could also make a larger pool of expertise available)
- additional cost, time and administrative burden
- the need to make explicit provision in the Bill for giving regard to government policy in respect of this additional function
- the legislative mechanism needed for presumption may depart from usual design principles.

Adaptation

There is a risk that assessments and prioritisation of actions at the regional, city, business and/or sector level may not align with the national priorities set by the Risk Assessment and the Plan and, therefore, that implementation is fragmented. This risk will be mitigated by close consultation on the Risk Assessment and Plan with agencies, mana whenua and key stakeholders, particularly local authorities, to ensure the Risk Assessment and Plan are aligned and cohesive.

There is also a risk, as some submitters have noted, that adaptation measures in the Bill could draw focus away from mitigation measures (and vice versa) or create competing priorities. Submitters suggested using existing legislation or creating new legislation specific to climate change adaptation.

However, experience from overseas indicates that it is beneficial to have an integrated, national-level framework for both adaptation and mitigation. Furthermore, this risk will be mitigated by the Commission having a mandated monitoring and evaluation role, and the ability to report on progress, to ensure that policy measures are robust and coordinated.

Adaptation reporting power

As identified through public consultation, the adaptation reporting power presents risks of duplicating reporting requirements, compromising commercial confidentiality and not prioritising the materiality and significance of adaptation risks and action.

As noted, the Bill's regulation-making power will require specific information to be gathered in consultation and engagement with reporting authorities in an effort to mitigate these risks.

Commission

Notwithstanding the need for the Commission to remain independent, there is a potential risk of duplication among the Commission and wider government processes, for example in data collection, research, monitoring and tendering advice. This will be somewhat mitigated by a clear delineation in the Bill of the roles and responsibilities of the Commission vis-à-vis the government, as well as open communication and collaboration between entities.

General risks

There is a general risk that other countries do not act in kind, leaving New Zealand to bear the disproportionate costs of ambitious climate change action, with little to no material impact on levels of global warming. Given the world's commitment under the Paris Agreement to resourcing and financing the global transition to a low-emissions and climate-resilient future (including ambitious commitments by many of New Zealand's like-minded developed country partners), this risk is highly unlikely.

However, New Zealand's international engagement on climate change – through the Paris Agreement work programme, as well as bilateral, regional and multilateral cooperation on foreign and trade policy – will aim to mitigate this risk by: communicating its ambitious domestic emissions reduction target; demonstrating its efforts towards mitigation and adaptation; and helping shape the international rules set. This will aim to influence other countries and hold them to account for acting in accordance with the spirit and letter of the Paris Agreement.

As noted in the economic impact analysis of the 2050 target options, macroeconomic modelling is based on specific, in-built assumptions that significant levels of afforestation, land use change, technological developments and sector-specific innovation (eg, EVs, methane vaccine) will take place in the coming decades to 2050. These assumptions are highly uncertain and pose a significant risk of the ability to meet the new 2050 target becoming even more challenging if these assumptions do not come to pass.

The Bill accounts for this risk of future uncertainty through the provision of a number of 'safety valves' and flexibility mechanisms, such as allowing for the target and budgets to be revised and international units to be purchased under limited circumstances. This will give New Zealand the ability to remain flexible and adaptable to changing circumstances throughout the transition, as necessary, and also somewhat mitigates the risk of New Zealand shouldering the climate change burden should others choose not to act.

Monitoring, evaluation and review

7.1 How will the impact of the new arrangements be monitored?

Monitoring, evaluation and review are built into the architecture of the Bill.

The Commission has a key role in monitoring and evaluation: its core function will be to review the government's progress on climate change mitigation and adaptation and hold it to account. As an independent Crown entity, the Commission itself will still be accountable to the Minister for Climate Change and, therefore, the Ministry would become the de facto monitoring agency. The Ministry will review the effectiveness of the Commission seven years after it becomes operational.

To monitor progress on climate change mitigation, the Commission will prepare recommended emissions budgets, with particular regard to the target, and require the government to respond where the budgets it sets differ from those recommendations.

Emissions budgets will play a critical role in determining how fast New Zealand transitions to a low-emissions economy and may also indicate the sectors of the economy where we need to focus our abatement efforts (eg, agriculture, transport). These decisions will have wide-ranging social, economic and environmental impacts distributed differently across the country. It is critical that there is transparency around the process by which emissions budgets are set, including the matters that are taken into account.

Therefore, the Bill will require the following factors to be taken into account by the Commission when advising on the level of emissions budgets and by the Government in responding to that advice and setting emissions budgets:

- scientific knowledge about climate change, including mātauranga Māori
- technology relevant to climate change
- economic circumstances and, in particular, the likely impact of the decision on the economy and the competitiveness of particular sectors of the economy, including the Māori economy
- fiscal circumstances and, in particular, the likely impact of the decision on taxation, public spending, and public borrowing
- the distribution of impacts and the consideration of equity, for example in respect of regional differences in the capacity to mitigate and adapt to climate change, and social circumstances
- plausible pathways to achieving the 2050 target and meeting the recommended budget, taking into account New Zealand's progress towards existing emissions budgets and the 2050 target.

On adaptation, the Risk Assessment – developed in the first instance by the Ministry and thereafter on an ongoing basis by the Commission – will identify national climate change risks and prioritise adaptation actions by local authorities and private actors. The Commission will also be responsible for monitoring and evaluating the effectiveness of the Plan.

The adaptation reporting power will result in the collection of data from relevant organisations on the risks of climate change to public infrastructure and services. This comprehensive data set will support decision-making across the public sector to take into account climate change risks and encourage better informed action on adaptation.

7.2 When and how will the new arrangements be reviewed?

As noted, the Commission has a key role in this area: its core function will be to review the government's progress on mitigation and adaptation and hold it to account by reporting on New Zealand's progress towards meeting the 2050 target and interim budgets.

With regard to adjusting New Zealand's legislated 2050 target, a one-off 'review clause' is considered to be the only appropriate mechanism to be built into the Bill. Its specific purpose would be to assess whether the ambition set in the legislation aligns with what is appropriate in future. To allow time for current and expected mitigation policies to trigger a bend in emissions reductions, we consider reviewing the target during the third budget period (ie, from 2035-2040) is appropriate.

Emissions budgets will only be able to be revised by the government of the day under certain circumstances: the second budget in the sequence in exceptional circumstances only (as determined by the responsible Minister); and the third emissions budget in the sequence subject to certain criteria (scientific and technological developments; methodological improvements; accelerating global temperature rise; changes to international law or policy).

With regard to adaptation, as noted, the Commission will regularly refresh the Risk Assessment, and the Plan will be updated every five years by the Minister for Climate Change and required to have regard to the regularly updated Risk Assessment. The Plan will be updated in consultation with mana whenua and key stakeholders, including local authorities and businesses, to ensure their priorities and interests are accounted for.

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Appendix 1: All-of-government framework for climate change policy

2020 OUTCOMES	<p>By the end of 2019, New Zealand will:</p> <p><i>(1) Put in place the necessary enduring institutional architecture to enable a just transition to a net-zero emissions economy</i></p> <p>And by 2020, we will:</p> <p><i>(2) Demonstrate our commitment to leadership on climate change and promote global action to achieve the Paris Agreement's temperature goal</i></p> <p><i>(3) Be on track to meeting our first emissions budget under the proposed Zero Carbon Act.</i></p> <p>The three pillars of this framework are:</p>		
PILLARS	LEADERSHIP AT HOME AND INTERNATIONALLY	A PRODUCTIVE, SUSTAINABLE AND CLIMATE-RESILIENT ECONOMY	A JUST AND INCLUSIVE SOCIETY
NECESSARY OBJECTIVES	<p>To promote global action, we will:</p> <ul style="list-style-type: none"> • Create an enduring domestic institutional architecture • Reduce our emissions out to 2050 and beyond • Hold ourselves and other countries to account to meet international commitments, e.g. Paris Agreement • Secure a multilateral rules system that delivers action with environmental integrity by all countries • Stand with the Pacific to support the region's climate action and resilience • Invest in globally significant research, strategic alliances and capacity-building in developing countries • Place primary reliance on domestic measures, while retaining options for international cooperation. 	<p>To ensure the optimal transition pathway, we will:</p> <ul style="list-style-type: none"> • Encourage innovation, diversification and the uptake of new technologies • Seek to fully understand the costs, benefits, risks and trade-offs of policy levers across the economy, society and environment • Identify the best-value opportunities to reduce emissions • Increase our international competitiveness by speeding up the decoupling of emissions from growth • Drive behaviour change via a range of policy tools, including regulation, education, price-based and support levers • Proactively adapt to ongoing climate change impacts and invest to build resilience across all hazards and risks. 	<p>To ensure a careful transition, we will:</p> <ul style="list-style-type: none"> • Consider the optimal speed and pathways for transition • Take early action where this prevents greater costs in the long run, also recognising the rights and needs of future generations and honouring existing Treaty settlement commitments • Support the transitional shift to lower emissions and resilient sectors, and recognise and mitigate impacts on workers, regions, iwi/Māori rights and interests and wider communities • Support those affected by climate impacts to adjust • Ensure information about climate change and its impacts is robust and accessible to aid decision-making.

Appendix 2: Key considerations for 2050 target option assessment

KEY PILLARS FOR CLIMATE CHANGE POLICY	Criteria against which target options will be assessed	Key considerations for options analysis of potential target designs
LEADERSHIP AT HOME AND INTERNATIONALLY	Represents bold domestic action and ambition, particularly in areas where New Zealand leads or can take the lead	<ul style="list-style-type: none"> a. Is ambitious: achieves more emissions reductions than New Zealand's current targets <ul style="list-style-type: none"> a. Alignment between 2030 Nationally Determined Contribution and domestic target is clear and easily communicated b. Places primary reliance on domestic measures b. By setting ambitious and achievable targets, what New Zealand does domestically has a demonstration effect on other countries c. Compares favourably with other 'early moving' countries who have already set a 2050 target d. Compares favourably with targets taken by other countries with similar emissions profiles e. Has environmental integrity
	Is informed by science	<ul style="list-style-type: none"> f. Considers greenhouse gases' different atmospheric lifetimes and subsequent roles in climate change forcing g. Considers the net impact of all greenhouse gas emissions
	Aligns with New Zealand's international commitments	<ul style="list-style-type: none"> h. New Zealand holds itself and other countries to account to meet international commitments, eg, Paris Agreement i. Honours the spirit of the Paris Agreement, which includes that: [these sub-elements are not of equal weighting in the context of the Paris Agreement] <ul style="list-style-type: none"> a. Developed countries should continue taking the lead by undertaking absolute, economy-wide emission reduction targets into the future b. Should pursue limiting temperature increase to well below 2 degrees Celsius above pre-industrial and if possible 1.5 degrees above preindustrial levels c. Does not run counter to global goals of food security and ending hunger, and takes into consideration the particular vulnerabilities of food production systems to the adverse impacts of climate change d. Calls for global peaking of greenhouse gas emissions as soon as possible e. Expects global emissions to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases (ie, achieve net zero emissions) in the second half of this century j. Is consistent with the coalitions and initiatives that New Zealand has committed to, including the 2050 Pathways Platform, Towards Carbon Neutrality Coalition, the High Ambition Coalition, Global Research Alliance on Agricultural Greenhouse Gases, Friends of Fossil Fuel Subsidy Reform, etc. k. Supports New Zealand to engage and collaborate actively to establish and maintain the international rules based system l. Maintains ease and consistency of reporting with international accounting obligations m. Is consistent with New Zealand's commitment to stand with the Pacific in responding to climate change
A PRODUCTIVE, SUSTAINABLE, AND CLIMATE-RESILIENT ECONOMY	Maximises the economic, social and environmental benefits, including: <ul style="list-style-type: none"> a. economic benefits: <ul style="list-style-type: none"> • Innovation effects and productivity • Increasing competitiveness • further positive economic externalities b. social, health and environmental co-benefits 	<ul style="list-style-type: none"> n. Drives behaviour change towards lowering emissions by New Zealand individuals, communities and businesses via regulation, education, price-based and support levers <ul style="list-style-type: none"> a. Supports diversification into low-emissions sectors b. Supports building from comparative advantage in traditional sectors (may still involve moves into different activities, also need to get across notion of doing things better in these sectors) c. Creates new brand opportunities for New Zealand exporters and provides opportunities for New Zealand's businesses to exploit trade competitiveness and comparative advantage d. Does not drive efficient production offshore to countries where production of similar goods/services is less efficient o. Maximises the economic, social, and environmental net impacts to New Zealand of meeting the target (benefits less costs) assessed over the short (0-10 years) and long term (30-50 years). This requires that the new target(s): <ul style="list-style-type: none"> a. Allow for simple measurement of progress b. Supports the increasing speed of decoupling of emissions from growth, so increasing our international competitiveness <ul style="list-style-type: none"> ▪ Encourages a higher rate of innovation than the status quo, and innovation to be adopted and developed across all sectors ▪ Does not significantly harm the rate of productivity and encourages a higher rate of productivity than the status quo ▪ Does not significantly raise barriers to entry or expansion in low emission sectors c. Considers the optimal speed of transition
	Minimises perverse incentives and economic distortions, including: <ul style="list-style-type: none"> c. an impact on competitiveness or further economic costs d. social and environmental costs 	<ul style="list-style-type: none"> p. Minimises economic distortions and perverse incentives q. The target [and ETS settings or other systems to allocate liability for adaptation or mitigation] are communicated in advance and are transparent- to provide regulatory certainty and investment predictability r. Is communicated in a manner consistent with a more proactive approach to planning for ongoing changes to climate and invest to build resilience to climate impacts s. Minimises fiscal costs
A JUST AND INCLUSIVE SOCIETY	Enables planning ahead	<ul style="list-style-type: none"> t. Target is simple to understand, and expected transitions under New Zealand's Long Terms Low Emissions Development Strategy (or similar government strategy for transition) u. Accountability for decision-makers [a successful option will incentivise decision-makers to look ahead and make long-term investments in infrastructure, etc.
	Protects those who may face challenging effects	<ul style="list-style-type: none"> v. Minimises distributional impacts across income bands, households, communities, generations and the Māori economy

Appendix 3: Summary of economic impact analysis of 2050 target options

Key findings

The analysis shows that all 2050 target options considered in the analysis reported in this RIS, including the most ambitious target — net zero emissions (all gases, domestically) — are challenging but achievable if specific innovations arise.

The transition will need progress to lower emissions across the energy, transport and agricultural sectors...

Meeting any ambitious emissions reduction target at manageable cost will require:

- high levels of innovation across the economy;⁶⁵
- decarbonisation of agriculture, transport, process heat and electricity generation.

... and substantial land use change into forestry

As emissions prices rise, it will become increasingly cost-competitive to switch from other land uses into forestry. Modelling finds that New Zealand will see sustained high rates of afforestation to achieve potential emissions targets.

The modelling foresees around 1.3–2.8 million hectares of new forestry by 2050 to deliver sufficient sequestration.⁶⁶ The annual rates of planting required to achieve these levels may be challenging.

Stronger action to reduce emissions can create substantial upsides

Research undertaken by the Ministry has identified potentially substantial upsides available from a domestic transition to a low-emissions economy. The nature and magnitude of these upsides depend on the transition pathway.

Domestic and international evidence indicates that climate action stimulates faster innovation rates in low-emissions technologies that are of high economic value.⁶⁷ Businesses in emitting sectors and sectors where we are world-leading in our research and development may thrive, and increased innovation will soften any competitiveness impacts from strong climate action.

⁶⁵ Innovation refers to scaling up deployment of existing commercially available solutions and increasing the uptake and technology readiness of other known solutions.

⁶⁶ Page 7 of Productivity Commission, September 2018. *Low emissions economy: Final report*. https://www.productivity.govt.nz/sites/default/files/Productivity%20Commission_Low-emissions%20economy_Final%20Report_FINAL.pdf

Note that the high end of the range is from a scenario in which one-third of the afforestation was assumed to be permanent native forest. Other scenarios assumed all afforestation was exotic plantation forest.

⁶⁷ Dechezlepretre et al (2016) find evidence that innovation closely correlates with stronger climate action.

We can also expect wider ‘co-benefits’ (besides reduced climate impact) from taking stronger climate action.⁶⁸ These include reduced congestion, health benefits, cleaner air, cleaner water, and improved biodiversity. Which co-benefits arise will depend on the measures taken to reduce emissions – for example, measures which encourage the use of public transport will have different co-benefits than measures that improve home insulation. The Intergovernmental Panel on Climate Change (2014) noted that the co-benefits can be as large as, or even larger than, the emissions reductions benefits. Many studies have calculated substantial benefits from transitioning to a low-emissions economy. The Ministry’s analysis relies on a broad scan of this relevant literature.

To meet any of the new targets evaluated, we can expect ongoing economic growth but at a slower rate

Modelling has been carried out, and must be read with care

Economic modelling has been commissioned from Concept, Motu and Vivid (CMV) and the New Zealand Institute of Economic Research (NZIER) to evaluate the feasibility and impact of potential targets. The modelling exercises are limited by known omissions, such as:

- they include only specific innovations and upsides;
- they largely exclude potential social and behavioural change;
- they exclude wider potential co-benefits.

Further, the baseline scenario in NZIER’s macroeconomic analysis excludes consideration of:

- the impact of a changing climate on New Zealand’s economy;
- the economic impact of New Zealand remaining a high-emissions economy while trading partners transition towards lower emissions.

These omissions and other limitations mean the modelling is likely to overstate the challenge of the transition.

A peer review of NZIER’s work was undertaken by an expert in the method of modelling used, and concluded that, while the modelling framework is appropriate and the “analysis is appropriate under the time constraint for the study”, the assumptions present in the modelling mean that on balance the cost estimates produced are “likely in the high end of the probable range”.

The modelling tells us ongoing growth is consistent with meeting targets, just at a slower rate

The modelling commissioned indicates the following key findings:

- All target options pose an economic cost to New Zealand compared to the current domestic target. The cost of meeting targets is very sensitive to the amount of

⁶⁸ Ministry for the Environment, 2018. *The co-benefits of emissions reduction: An analysis*.
<https://www.mfe.govt.nz/publications/climate-change/co-benefits-of-emissions-reduction-analysis>.

afforestation.⁶⁹ The targets could be met with much lower emissions prices and economic impacts if there is substantial afforestation.

- For all target options, sector-specific, regional and distributional impacts could arise. For example, NZIER's modelling finds that potential target options have the greatest impact on households in the two lowest-income quintiles, in the absence of safety-net policies designed to mitigate this.
- A split-gas target allowing a reduced stabilised level of methane emissions will incur lower costs than a net zero, all gases target by 2050.

Allowing 'fungibility' (the ability to substitute emissions of one type of gas with abatement or sequestration of another) under a given split-gas target would be expected to lower the cost of meeting it, as it would allow abatement (or sequestration) to occur wherever this is at least cost to the economy. However, modelling limitations and specific scenario designs did not allow direct assessment of the economic impact of fungibility in isolation of other assumptions.

The modelling undertaken by Concept, Motu and Vivid (CMV) for the Productivity Commission and the Ministry indicated that transition to net zero emissions at 2050 is feasible at lower emissions prices than were modelled by NZIER. Whilst the CMV model does not estimate impacts on growth rates and GDP, we can reasonably assume lower emissions prices would give rise to a lower overall economic impact.

Some industries may face competitiveness challenges

Analysis commissioned by the Ministry for the Environment⁷⁰ explored the sectors of New Zealand's economy that could face challenges competing with competitors from other countries if New Zealand's climate change policies are more stringent than the rest of the world's. In the scenario where New Zealand's climate policies are more stringent than other countries', these sectors may need policies to ease these challenges (such as continued free allocation of New Zealand Units (NZUs)).

Allowing international units may reduce the domestic cost of meeting a target

Given the significant uncertainty of how the future will play out, policy consideration is being given to the role international units could play in meeting targets as a *safety valve*, allowing flexibility if innovation and afforestation rates as modelled do not eventuate. NZIER's modelling indicates allowing the use of international units could lessen the overall economic impact of meeting a target if it reduces (or delays) the need for higher-cost domestic abatement or sequestration. However, this depends on the relative costs of available international units and domestic abatement and sequestration in the future, which the model cannot predict. Signalling the use of international units today risks diluting incentives for domestic transition, which could lead to higher costs and lower co-benefits over the long run.

⁶⁹ Increasing the amount of forestry sequestration assumed for the net zero emissions target by one-third (10 MtCO₂e) reduces the modelled economic impacts by an order of magnitude.

⁷⁰ Sense Partners, 2018. *Countervailing forces: Climate targets and implications for competitiveness, leakage and innovation*. <https://www.mfe.govt.nz/publications/climate-change/countervailing-forces-climate-targets-and-implications-competitiveness>.

Acting sooner could reduce the overall cost of the transition

CMV note in their work that stronger near-term action could result in lower overall costs to New Zealand.⁷¹ Strong policy action (for example through higher emissions prices) prior to 2030 leads to lower emissions price pathways between 2030 and 2050, regardless of whether innovations occur that disrupt or support existing industries.

Economic analysis (qualitative and modelling) informs on the potential impacts of target options

A wide suite of economic analyses have been carried out to investigate the economic impact of potential new 2050 targets. Each study is part of a wider jigsaw: no single economic study or model can provide perfect insight into how New Zealand's economy and communities will respond to the proposed targets.

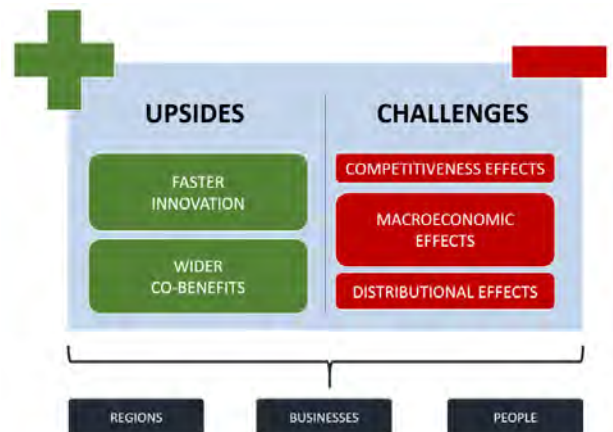
The models are not perfect predictions or forecasts:

- the economy, technologies, and land uses will evolve and change in the next 32 years, sometimes in ways difficult to understand now. The models cannot capture unforeseen technologies developing or new sectors emerging in response to higher emissions prices as we do not know today what these are likely to be
- what will *actually* happen will depend on the actions of individual businesses, consumers and households, and policy choices by future governments.

The economic analyses look broadly at three areas:

- **Challenges for the economy — impacts on growth, households and sectors.** Two different modelling approaches have been used:

- a 'bottom-up, linked sector' model by CMV that informs on emissions prices for pathways to low emissions, commissioned jointly by the Productivity Commission and the Ministry for the Environment;
- a 'top-down' dynamic computable general equilibrium (CGE) model by NZIER to assess the impact of specific targets on emissions prices and macroeconomic variables.⁷²



⁷¹ Vivid Economics, 2018b. *Modelling the transition to a lower net emissions New Zealand: Uncertainty analysis*. Prepared in conjunction with Concept Consulting and Motu Economics and Public Policy Research for the NZ Productivity Commission and Ministry for the Environment.

⁷² New Zealand Institute of Economic Research. 2018. *Economic impact analysis of 2050 emissions targets. A dynamic computable general equilibrium analysis*. Wellington: Ministry for the Environment. Available at: <http://www.mfe.govt.nz/publications/climate-change/economic-impact-analysis-of-2050-emissions-targets-dynamic-computable>. Stage 2 report in preparation (October 2018).

- **The competitiveness challenges businesses may face and the potential for businesses to innovate faster.** Qualitative and empirical assessments were carried out by Sense Partners and Ministry economists on the potential for stronger targets to affect firm competitiveness and to drive faster innovation.^{73,74}
- **The wider co-benefits to climate action.** A literature review was carried out by Ministry economists on the potential for targets to drive wider co-benefits (eg, health outcomes).⁷⁵

The studies on competitiveness challenges, innovation effects and wider co-benefits tell us about economic impacts that can be expected to arise with *all* new 2050 targets. The 'bottom-up' CMV and 'top-down' NZIER modelling tells us about emissions prices that could be necessary to achieve Option 4 and Option 2 with biogenic methane stabilised at 75 per cent of 2016 levels.

Only the NZIER modelling tells us about the potential difference in economic impact across the specific target options, defined in this RIS as Options 1-4, and allows comparison of the impact of each of Options 1-4 to a 'do-nothing' baseline or to the current domestic target. Only the NZIER modelling investigates the economic impact of split-gas targets with different reduction levels for biogenic methane.

This appendix first explains the wider economic impacts relevant to all targets and then expands on the potential impacts of Options 1–4.

For a full overview report on the economic modelling undertaken prior to the Zero Carbon Bill's consultation and the underlying economic analysis and modelling reports, see the Ministry's website.⁷⁶ CMV's Stage 2 modelling results have already been published,⁷⁷ and NZIER's Stage 2 results will be published once the report is finalised. Dr Niven Winchester (a global expert on CGE models based at Motu Economic and Public Policy Research) conducted a peer review of NZIER's work, which will be published alongside NZIER's report.

There are significant uncertainties about the impacts

The economic impacts of setting an emissions target 32 years in the future are not possible to determine with certainty. The economic analysis undertaken can tell us what *may* happen, under particular assumptions about the future and the pathway New Zealand follows to meet

⁷³ Sense Partners. 2018. *Countervailing forces: Climate targets and implications for competitiveness, leakage and innovation*. Wellington: Ministry for the Environment. Available at: www.mfe.govt.nz/publications/climate-change/countervailing-forces-climate-targets-and-implications-competitiveness

⁷⁴ Ministry for the Environment. 2018. *Emissions pricing impact on innovation and competitiveness: A review of the international literature*. Wellington: Ministry for the Environment. <http://www.mfe.govt.nz/publications/climate-change/emissions-pricing-impact-innovation-and-competitiveness-review-of>

⁷⁵ Ministry for the Environment. 2018. *The co-benefits of emissions reduction: An analysis*. Wellington: Ministry for the Environment. Available at: www.mfe.govt.nz/publications/climate-change/co-benefits-of-emissions-reduction-analysis.

⁷⁶ <http://www.mfe.govt.nz/publications/climate-change/our-climate-your-say-consultation-zero-carbon-bill> (refer to Related publications).

⁷⁷ New Zealand Productivity Commission, 2018.

a given target. It cannot predict what *will* happen: this will depend on how a range of key uncertainties resolve (such as the pace and nature of technological change and international climate policy), on the actions of individual businesses, consumers and households, and on policy choices by future governments.

The results must be read with care because of uncertainties and limitations in the analyses. For example:

- modelling is subject to many general and specific limitations, discussed further below;
- competitiveness risks depend on what action our international competitors take in the future, and innovation is an uncertain and risky process;
- the nature and scale of any wider co-benefits can only be determined once specific emissions reduction policies are considered.

The results presented should be treated as indicative only and not predictions of the future. Despite this, the results are still helpful as they provide a picture of future trends and the relative differences in potential impacts from setting different targets. The work also supports the future transition by helping to inform choices to guide actions that could allow us to maximise the benefits and upsides, and minimise or mitigate the risks.

Limitations of economic modelling

All models have limitations, as they necessarily simplify complex reality into a defined set of actors, drivers and relationships. Attempting to simulate an economic transition over three decades — likely to involve major shifts in technology, markets and behaviour — is an enormous challenge.

In a general sense, economic models are often calibrated to the past, and tend to assume the economy will react to future changes fundamentally the same way as it has before. While this is reasonable for looking at changes over relatively short time periods (e.g. to 2030), looking out to 2050 is more speculative and means we are stretching the models we have to their limits. Looking back at the changes in technology and shifts in our economy over the past three decades shows we can expect major changes between now and 2050, regardless of New Zealand's climate policy choices. Economic activities, technologies and behaviours will evolve in ways that could be difficult to understand and predict now.

NZIER and CMV used very different modelling approaches:

- CMV built a model of emissions from the bottom up, allowing a high level of detail on transition and abatement options within each emitting sector. The CMV model produces emissions prices required to meet the targets, but does not simulate macroeconomic impacts and interactions.
- NZIER's CGE model has less sectoral detail, but simulates macroeconomic impacts across the whole economy, including flow-on effects from changes in one sector to another. By design, the NZIER model will result in higher estimated impacts, as every action in a CGE model has an opportunity cost.

To attempt consistency, inputs and assumptions into the two modelling exercises have been aligned where feasible.

Both modelling exercises contain known limitations, such as:

- *they included only specific innovations and associated upsides* through assumptions – neither model simulates how the emissions price could stimulate further innovation (e.g. efficiency improvements or new low-carbon technologies);
- *they largely excluded potential social and behavioural change* and focused on technological change;
- *they excluded wider co-benefits* as, given the structure of the models used, it has been not been possible to feed this in.

The NZIER model to evaluate target options focuses on the cost of achieving each target compared to a ‘do-nothing’ baseline or compared to the current target of a 50 percent reduction on 1990 emissions by 2050. The baseline is based on Treasury’s economic projections, and emissions projections received from agencies, out to 2050. Critically, these projections do not include consideration of two important factors:

- *the impact of a changing climate on New Zealand’s economy*, such as the damages caused by a more unpredictable climate with more frequent extreme weather events;
- *the economic impact of New Zealand remaining a high emissions economy* while trading partners transition towards lower emissions.

Neither of these omitted factors have been assessed in detail. However both factors could be expected, in a modelling sense, to ‘shift’ the baseline to lower economic growth projections. Put another way, the results omit the potential benefits, if the rest of the world also acts, of avoiding damage to the economy caused by a changing climate. A model that was able to incorporate these factors would likely estimate lower economic costs of meeting the target options.

The macroeconomic modelling by NZIER also has a particular limitation that should be highlighted: levels of carbon sequestration from afforestation are not determined within the model in response to the emissions price. Rather, these have been imposed as a fixed assumption for each target scenario.⁷⁸ In reality, we would expect rising emissions prices to drive higher afforestation and sequestration, thereby moderating the emissions price growth (as occurs in CMV’s model). Constraining sequestration to a fixed level, therefore, leads to unrealistically high emissions prices and economic impacts in some cases. NZIER’s results are very sensitive to the sequestration assumptions, meaning uncertainties are large.

Dr Winchester’s peer review of NZIER’s study highlights several of the above limitations, while noting that overall it is an appropriate modelling framework that meets global best practice standards in most areas.⁷⁹ On one hand, the innovations that lower emissions (such as higher uptake of renewable energy and electric vehicles, and adoption of a methane vaccine) are optimistically assumed to come at no cost. On the other hand, the other

⁷⁸ NZIER attempted to endogenise sequestration in their model in Stage 2, but were unable to do so in the time available. They reverted to their Stage 1 approach using exogenously imposed levels of sequestration (but with different assumptions from Stage 1).

⁷⁹ Winchester, N. 2018. *Review of ‘Economic impact of meeting 2050 emissions targets: Stage 2 modelling; by the New Zealand Institute of Economic Research*. Awaiting publication (October 2018).

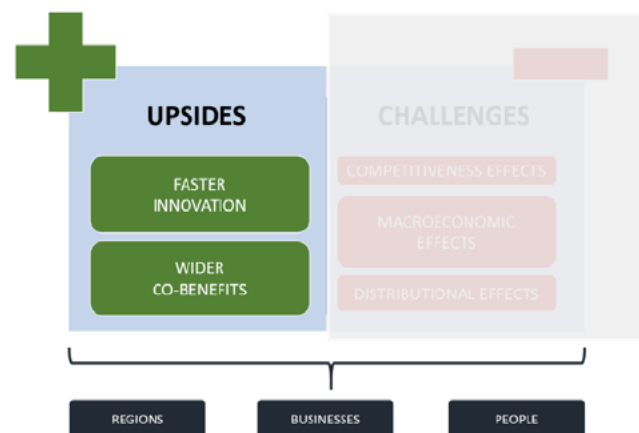
assumptions will tend to lead to costs being overestimated. Dr Winchester concludes that, “On balance, the costs of meeting emissions targets estimated in the study are likely in the high end of the probable range”.

In summary, modelling economic impacts from stronger climate action out to 2050 is speculative and uncertain. In particular, the approach used to assess macroeconomic impacts is likely to overstate the challenge of the transition. Interpretations of the results should focus on the relative differences between scenarios – not on any absolute cost estimates produced.

Economic considerations that apply to all targets

Doing nothing could also damage the economy

Recent modelling analysis published in the journal *Nature* suggests that limiting global warming from climate change to 1.5°C instead of 2°C by mid-century could have a significantly beneficial impact globally: an increase in global GDP of 1.5 to 2 per cent and avoided damages from climate change globally of approximately \$11 trillion to \$16 trillion.⁸⁰



Other recent research by the Global Commission on the Economy and Climate estimates a US\$26 trillion direct benefit from taking bold climate action compared with business as usual.⁸¹ The authors of this work note that the last 19 years included 18 of the warmest years on record, and globally there was poorer food and water security risks and increased frequency and severity of natural hazards.⁸² In particular, weather and climate related hazards accounted for US\$320 billion in losses in 2017 alone. The authors also highlight work by the International Monetary Fund (IMF) which states that traffic congestion could cost over US\$350 billion per year from lost productivity and health impacts.⁸³

The full costs from climate change on New Zealand (and its economy specifically) are difficult to estimate. In many areas, there is little economic evidence available as to the impacts from climate change including on migration, water resources, conflict, energy

⁸⁰ The avoided damages are calculated using a three per cent discount rate, and mid-century refers to the period between years 2046 to 2065. The authors report the discounted avoided damages in US dollars as between US\$7.7 trillion to US\$11.1 trillion. Burke M, Davis WM, Diefenbaugh NS. 2018. Large potential reduction in economic damages under UN mitigation targets. *Nature*, 557: 549-553.

⁸¹ The New Climate Economy, 2018. *Unlocking the inclusive growth story of the 21st Century: Accelerating climate action in urgent times*. Report published for The Global Commission on the Economy and Climate. Retrieved from <https://newclimateeconomy.report/2018/>.

⁸² Ibid. Page 8.

⁸³ Coady, D., Parry, I., Sear, L., and Shang, B., 2015. *How Large Are Global Energy Subsidies?* International Monetary Fund (IMF), Washington, DC. Available at: <http://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf>.

supply, labour productivity and tourism. Despite the limited economic evidence on the impact of climate damage on New Zealand, some studies do exist. For example, the OECD has estimated the economic impact of climate change on New Zealand and Australia (combined) as a one per cent reduction in GDP levels by 2060, maybe up to two per cent.⁸⁴

The Intergovernmental Panel on Climate Change (IPCC) identified key climate risks to New Zealand being continuing sea-level rise and the increased frequency and intensity of flood damage on our low-lying and coastal infrastructure.⁸⁵ The Climate Change Adaptation Technical Working Group (CCATWG) supports this idea and reports that the cost of weather events on New Zealand's land transport network have increased from \$20 million to \$90 million per annum in the last 10 years.⁸⁶

In addition to sea-level rise and flooding events, the projected changes to the frequency and intensity of storms will increase the reach of storm surges and king tides and the extent of rising groundwater.⁸⁷ The Parliamentary Commissioner for the Environment (PCE) indicates that the cost of replacing every building within half a metre⁸⁸ of the average high tide mark⁸⁹ could be \$3 billion and within 1.5 metres as much as \$19 to \$20 billion.⁹⁰

The modelled baseline is a business-as-usual scenario that excludes consideration of the cost of damage that a changing climate could have on New Zealand's economy. The modelled baseline also excludes consideration of economic impacts New Zealand could face if taking weaker action to reduce emissions than comparable countries.

Stronger climate change action may stimulate economic benefits of innovation

International evidence suggests that climate action stimulates innovation in emitting sectors as the companies in these sectors look to cut costs and use resources more efficiently.⁹¹ There is also evidence that the amount of innovation is highly correlated to the stringency of climate change policy⁹² and that innovation is subject to knowledge "spill-overs" (where innovations in a particular sector spill over into successful innovations in other sectors).

⁸⁴ OECD. 2015. *The Economic Consequences of Climate Change*. OECD Publishing: Paris.

⁸⁵ IPCC, 2014. *Climate Change 2014: Impacts, Adaptation and Vulnerability. Part A: Global and Sectoral Aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge & New York: Cambridge University Press.

⁸⁶ Climate Change Adaptation Technical Working Group, 2017. *Adapting to climate change in New Zealand. Stocktake report from the Climate Change Adaptation Technical Working Group*. Wellington: Ministry for the Environment.

⁸⁷ White I, Connelly A, Garvin S, Lawson N, O'Hare P. 2016. *Flood resilience technology in Europe: identifying barriers and co-producing best practice*. Journal of Flood Risk Management, 11: S468-S478.

⁸⁸ The mid-range projected sea-level rise over the next 50 years is about 30 cm, and could vary between 20 and 50 cm. Note in the past 100 years seas have risen around 14–22 cm in New Zealand ports.

⁸⁹ Defined as the Mean High Water Springs.

⁹⁰ Parliamentary Commissioner for the Environment. 2015. *Preparing New Zealand for Rising Seas: Certainty and Uncertainty*. Office of the Parliamentary Commissioner for the Environment, New Zealand.

⁹¹ Ministry for the Environment. 2018. *Zero Carbon Bill Economic Analysis: A synthesis of economic impacts*. Wellington: Ministry for the environment. <http://www.mfe.govt.nz/publications/climate-change/zero-carbon-bill-economic-analysis-synthesis-of-economic-impacts>.

⁹² Dechezlepretre A, Martin R, Bassi S. 2016. *Climate change policy, innovation and growth*. Policy Brief. London: Grantham Research Institute on Climate Change and the Environment.

International evidence also suggests that low-emission technology innovations can be as valuable to the economy as innovations in high-technology industries (eg robotics).⁹³

The Productivity Commission notes that there has been a wide range of innovations in low-emissions technologies, despite international emissions prices being low. These innovations have occurred in wind and solar power generation, green supply chains and electric vehicles, to name a few.⁹⁴ A higher emissions price should incentivise businesses to innovate more, thereby enabling technologies that were not economically viable at lower prices. Furthermore, we can expect the costs of new technologies to reduce over time as technologies improve — battery technology for EVs are a good example of this.⁹⁵

New Zealand's investment in innovation, research and development (R&D) is low by international standards.⁹⁶ However, in some areas, New Zealand is a world leader. New Zealand spends almost 10 per cent of all government research funding on environmental related R&D (the highest in the OECD). The (on-farm) emissions intensity of livestock agriculture has improved at over 1 per cent each year since 1990.⁹⁷

Although innovation is difficult to predict (in terms of when, how and what the innovation(s) will be), it presents substantial upsides for New Zealand. The scale of these upsides, however, is also very uncertain.

Box 1: New research from the New Climate Economy⁹⁸ — Innovation is key to decarbonising industry and transport sectors

The New Climate Economy recently published new research in their report *Unlocking the inclusive growth story of the 21st century: Accelerating climate action in urgent times*. This box draws from the content in the Industry, Innovation and Transport chapter of the report (pages 131–156).

This report notes that the heavy industrial and transport sectors across the world will be difficult to decarbonise, but also there are important benefits at stake if this is not achieved.

⁹³ Dechezlepretre A, Martin R, Mohnen M. 2013. *Knowledge spill-overs from clean and dirty technologies: A patent citation analysis*. Centre for Climate Change Economics and Policy Working Paper no. 151 and Grantham Research Institute on Climate Change and the Environment Working Paper no. 135. London: Grantham Research Institute on Climate Change and the Environment.

⁹⁴ Productivity Commission, 2018. *Low emissions economy. Final Report*. Wellington: New Zealand Productivity Commission. Retrieved from: https://www.productivity.govt.nz/sites/default/files/Productivity%20Commission_Low-emissions%20economy_Final%20Report_FINAL.pdf

⁹⁵ Box on page 26 of MfE Economic Synthesis report. Ministry for the Environment. 2018. *Zero Carbon Bill Economic Analysis: A synthesis of economic impacts*. Wellington: Ministry for the environment. <http://www.mfe.govt.nz/publications/climate-change/zero-carbon-bill-economic-analysis-synthesis-of-economic-impacts>.

⁹⁶ Conway P. 2016. *Achieving New Zealand's productivity potential*. Research paper no. 2016/1. Wellington: New Zealand Productivity Commission.

⁹⁷ Figure 6 on page 29 of MfE Economic Synthesis report. Ministry for the Environment. 2018. *Zero Carbon Bill Economic Analysis: A synthesis of economic impacts*. Wellington: Ministry for the environment. <http://www.mfe.govt.nz/publications/climate-change/zero-carbon-bill-economic-analysis-synthesis-of-economic-impacts>.

⁹⁸ The New Climate Economy, 2018. *Unlocking the inclusive growth story of the 21st Century: Accelerating climate action in urgent times*. Pages 131–156. Report published for The Global Commission on the Economy and Climate. Retrieved from <https://newclimateeconomy.report/2018/>.

The report presents the opportunities offered by energy efficiency, fuel switching, lowering waste, and promoting different business and financing models.

Cement and steel manufacturing

Cement and steel are key materials that comprise much of our key infrastructure — including: buildings, roads and bridges, power generation and energy transportation. These sectors are among the most energy intensive processes, and have long asset lifetimes (which slows progress on emissions abatement). The UN Industrial Development Organization (UNIDO) estimates that changing to the best available industrial technologies globally could reduce energy intensity by 26 percent over the next 25 years, reducing global energy sector greenhouse gas emissions by 32 percent. In addition to better energy efficiency technologies, increasing the rates of recycling of energy-intensive products improves energy intensity of processes and improves profits in these sector. The report highlights the example of the scrap industry in the United States playing a prominent role as a job creator in locations where the steel manufacturing industry is declining — generating 150,000 direct jobs, and 323,000 indirect jobs in 2015. There are also benefits from substituting energy-intensive construction materials for timber in many cases.

Commercial-scale Carbon Capture Utilisation and Storage (CCUS) will be an important technology in decarbonising sectors like steel and cement manufacturing. Some examples of successful implementations of CCUS include China's Yanchang Integrated Carbon Capture and Storage facility (which captures 410,000 tonnes of carbon per year from a coal plant in Shaanxi province) and Abu Dhabi's Al Reyadah (a company focused on exploring and developing commercial scale CCUS).

Reducing emissions from the plastics value chain

Six percent of the world's oil production is used for manufacturing plastics, and this could grow to 20 percent by 2050. Furthermore, 90 percent of plastics are manufactured from virgin fossil fuel sources. In 2050, plastics could account for 15 percentage of the annual global carbon budget if industry practices do not change. Aside from being a large source of carbon emissions, plastics are also very damaging to the environment, especially marine environments.

About half of plastics are made for single use, and are disposed of quickly. Recycling of plastics is low — in Europe only about 10 percent of plastics are recycled due to the plastics value chain being fragmented. The report stresses the importance of improving vertical integration in the plastics value chain in improving recycling rates for plastics. Recycling has an estimated social value of over US\$100 per tonne of plastics recycled (based on reduced impacts on future generations).

Bio-plastics are a viable alternative to oil-based plastics, but these are not yet cost-competitive in all countries, and feedstocks for bio-plastics can be in competition for land with food production in some cases.

Developing low carbon transport systems

The report notes that transportation is a key element of economic activity, as it enables the distribution of goods and services around the world. However, transport accounts for about a

quarter of global emissions today.

Decarbonising transport offers direct economic benefits (through energy savings) as well as significant co-benefits (through lower pollution and traffic congestion). Taking advantage of efficiency improvements is a key way for these benefits to be realised. Such measures include adopting shipping design efficiency standards — this could save US\$200 billion in annual fuel costs by 2030, and save 300 Mt of carbon emissions. Other efficiency opportunities exist in aviation — American Airlines invested US\$300 million in fuel saving measures since 2005, resulting in about US\$1.5 billion in fuel savings.

The report also notes that modal shifts are important for decarbonising the global transport system. These include moving road freight to rail, moving from individual vehicles to public transport, from short-haul air travel to rail and from large to smaller cars. They estimate that adopting these modal shifts could reduce transport energy demand by about 10 percent.

To facilitate decarbonising transport, the authors recommend strengthening the taxation of externalities (including carbon emissions), governments investing in 'no-regrets' technologies (eg EVs/batteries, charging infrastructure, fuel cells, green hydrogen and sustainable biofuels) and encouraging private sector firms to make commitments to reduce transport emissions.

There are also co-benefits from transitioning to a low-emissions economy

Ministry research⁹⁹ has explored the opportunities for stronger climate change policy to deliver wider positive effects. While benefits are often more difficult to quantify than economic costs, many previous studies (from both New Zealand and overseas) have calculated substantial wider benefits of transitioning to a low-emissions economy.

The table below identifies the specific co-benefits for emissions reductions that come from pursuing policies with an environmental or social goal. The table shows that the co-benefits of transitioning to a low-emissions economy could be substantial. These benefits positively impact the wellbeing of people, through:

- improved health outcomes (eg, improved health from exercise and reduced air pollution and avoided health costs from insulation)
- economic outcomes (eg, from reduced traffic congestion and lower maintenance costs)
- safety outcomes (eg, lower risk of traffic accidents)
- environmental outcomes (eg, improved water quality, lower soil erosion and improved biodiversity).

⁹⁹ Ministry for the Environment. 2018. The co-benefits of emissions reduction: An analysis. Wellington: Ministry for the Environment. Available at: www.mfe.govt.nz/publications/climate-change/co-benefits-of-emissions-reduction-analysis.

Table 1: Potential benefits of transitioning to a low emissions economy¹⁰⁰

Emissions reduction policy	Types of benefit	Estimated scale of benefit and/or problem	Strength of evidence
Energy efficiency/ home insulation	1. Better health from drier warmer homes	Every \$1 spent on the 'Warm Up New Zealand: Heat Smart' programme generates benefits of around \$4. Retrofitting insulation can help deliver particularly strong health cost savings from at-risk groups (eg children and the elderly). The emissions reduction benefits are relatively small.	Strong
Active transport (walking and cycling)	2. Better health from more exercise and improved air quality 3. Reduced road traffic congestion	An investment of \$630 million in infrastructure to support active transport could generate net benefits of \$13 billion by 2050, mostly due to the health benefits from increased exercise. Human-caused air pollution can cost up to \$4.3 billion each year, which includes costs from premature deaths, hospital visits and restricted activity days. Traffic congestion in Auckland costs \$0.9–1.3 billion each year.	Strong
Public transport	4. Reduced road traffic congestion 5. Better health outcomes from improved air quality and fewer road accidents	The benefits from the existing passenger rail network in Wellington and Auckland are estimated at between \$1.1 billion and \$1.2 billion, almost all from reduced congestion. Safety and air quality benefits made more modest contributions.	Moderate

¹⁰⁰ Table taken directly from page 25-26 of Ministry for the Environment. 2018. *Our Climate Your Say: Consultation on the Zero Carbon Bill*. Wellington: Ministry for the Environment. Retrieved from: <https://www.mfe.govt.nz/sites/default/files/media/Consultations/FINAL-%20Zero%20Carbon%20Bill%20-%20Discussion%20Document.pdf>.

Emissions reduction policy	Types of benefit	Estimated scale of benefit and/or problem	Strength of evidence
Forestry	<ul style="list-style-type: none"> 6. Improved freshwater quality 7. Reduced soil erosion 8. Improved biodiversity and species protection 	<p>Forestry can improve water quality, enhance biodiversity, reduce soil erosion, improve land use productivity and stimulate regional economic development.</p> <p>Nearly one million hectares of private land subject to moderate to extreme erosion are potentially well suited to afforestation.</p> <p>For example, the ecosystem value of each hectare of exotic plantation forestry in the Ōhiwa catchment was estimated at \$6,092 per annum, over half of which came from improved water quality. The ecosystem value in the same catchment study (per hectare, per year) was estimated at \$6,677 for indigenous forest and up to \$37,636 for wetlands and mangroves.</p>	Moderate
Road freight to rail	<ul style="list-style-type: none"> 9. Reduced traffic congestion 10. Reduced road maintenance costs 11. Improved road safety 	Estimated benefits of current rail freight are about \$200 million per year from reduced congestion, \$80 million per year from reduced maintenance costs and \$60 million per year from safety.	Moderate
Use of electricity for home and industrial heat	<ul style="list-style-type: none"> 12. Better health from improved air quality 	<p>See 'active transport' for scale of possible air pollution costs in New Zealand.</p> <p>Heat generation from burning fossil fuels contributes to air pollution. This includes domestic coal burners as well as industrial coal-fired boilers.</p>	Moderate
Electric vehicles	<ul style="list-style-type: none"> 13. Better health from improved air quality 	See 'active transport' for scale of air pollution costs in New Zealand.	Moderate
Improved farm practices	<ul style="list-style-type: none"> 14. Improved freshwater quality 	Reduced nitrogen use (eg, fertiliser) and improved pasture management could reduce nitrogen leaching into rivers by 13 per cent.	Weak

Some businesses could face competitive challenges, if they do not adapt and innovate fast enough

In the absence of policies to ease the transition, exporters (especially those in EITE industries) could face higher costs than international competitors if other countries delay (or do not take) strong climate change action. Under such a scenario, some current industrial emitters could exit New Zealand and move to another country with less stringent climate change policy (so-



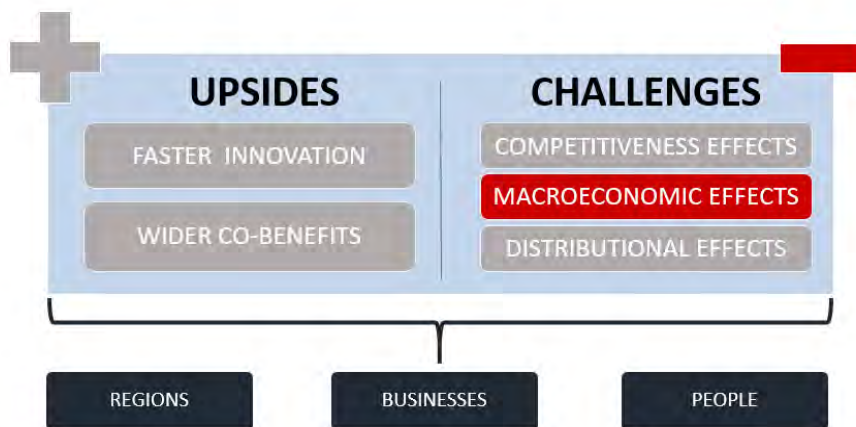
called carbon or emissions ‘leakage’).

Sense Partners inspected how the ratio of operating surplus to costs for New Zealand’s sectors varies with the emissions price and compared this with the historical minimum ratios for each sector. This tells us at which emissions price the New Zealand sectors’ operating surplus to cost ratio would be the same as their worst ever profitability (ie, a ‘break-even’ emissions price). Sense Partners found that for many sectors these break-even emissions prices¹⁰¹ were \$100/tCO₂e or lower (see Table 5 on page 57), including:

- dairy farming (and dairy product manufacturing), sheep and beef farming (meat product manufacturing)
- aluminium manufacturing, steel manufacturing, primary metal and metal product manufacturing
- petrochemicals manufacturing (eg, methanol production, urea production).

These sectors are those that are most at risk of competitiveness impacts and leakage. If the world’s response to climate change is uneven, leakage may actually *increase* global emissions.¹⁰² Sense Partners conclude that livestock agriculture (which includes dairy farming and sheep and beef farming) would struggle with the costs of on-farm emissions.

On the other hand, as considered above, climate change policies driving faster innovation could mean some New Zealand businesses benefit by becoming more efficient than overseas counterparts. For example, businesses in sectors where we are world-leading in our research and development may be able to innovate, and so thrive, as increased rates of innovation will soften competitiveness impacts from strong climate change action.



Macroeconomic modelling suggests the economy will continue to grow but less quickly compared to a future without carbon constraints

The NZIER modelling considers the impact of achieving the targets on macroeconomic metrics. NZIER finds that meeting New Zealand’s current domestic target at 2050 (the policy

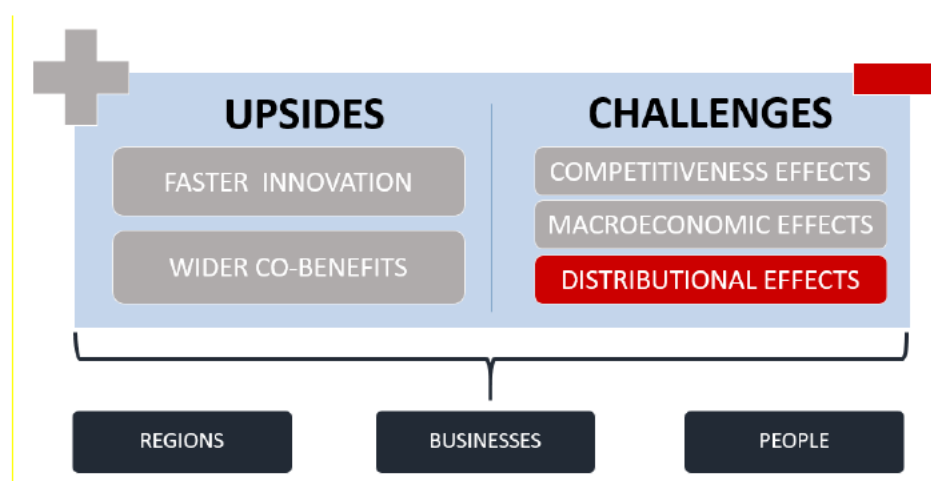
¹⁰¹ Assuming that the NZ ETS is extended to include biological methane emissions.

¹⁰² For example, the NZ aluminium smelter at Tiwai Point uses electricity generated from the Manapouri hydro dam to turn aluminium ore into aluminium metal. If this firm was to exit NZ and produce aluminium in China the electricity required would probably be generated from coal, thereby increasing global emissions.

status quo) results in an average annual GDP growth rate (from 2020-50) 0.09 percentage points lower than in the baseline ‘do-nothing’ trajectory. This means GDP grows from \$259 billion in 2017 to \$522 billion in 2050, compared with \$536 billion in the baseline.

As noted earlier, the baseline excludes the cost of damage that a changing climate could have on New Zealand’s economy, and the potential economic impacts New Zealand could face if taking weaker action to reduce emissions than comparable countries.

Increasing the ambition of the target increases the modelled economic costs. The modelling finds that all target options under consideration will reduce average GDP growth compared with the status quo.



For all targets, sector-specific, regional and distributional impacts could arise

Sector-specific and distributional impacts could arise

The transition pathway will be developed over time: government will need to consider which policy levers to use across energy, transport and land uses to incentivise or mandate change.

Similarly, sector-specific support via free allocations of NZUs and policies to safeguard against negative distributional effects and ease the transition for specific regions, industries and workers will form a core pillar of ensuring a just transition.

Therefore, the modelling can, at best, warn what the sector-specific or distributional impacts could be, absent any government policies to ease the transition.

The modelling tells us that unless safety-net policies are put in place, we might see uneven regional and distributional impacts

Regional and distributional impacts could be significant if no government action is taken to mitigate the more challenging effects of an economic transformation. The modelling finds that achieving net zero emissions would have a greater impact on households in the two lowest-income quintiles.¹⁰³ The modelling assumed no policies to mitigate against uneven effects and so

¹⁰³ Option 4 was modelled, but the impacts of the target on low income households would be higher under all of the options.

implies that the adoption of a 2050 emissions reduction target should be accompanied by a suite of policies to help mitigate the impacts of the target on lower-income households.

The Productivity Commission notes in its final report on the transition to a low-emissions economy that the existing system of tax credits and welfare system can mitigate these distributional effects, provided that the tax credits and benefits system are regularly adjusted for inflation.¹⁰⁴

Differentiating the economic impacts of Options 1–4

Target options 1–6 are described in detail in **Table 2**, below. The options differ in terms of ambition, treatment of different gases, and the ability to offset New Zealand's GHG emissions with the purchase of high-integrity international units.

Across all the scenarios modelled, key findings of NZIER's Stage 2 modelling include:

- All target options pose an economic cost to New Zealand compared to the current domestic target.
- The cost of meeting targets is very sensitive to the amount of afforestation.¹⁰⁵ The targets could be met with much lower emissions prices and economic impacts if there is substantial afforestation.
- A split-gas target allowing a reduced stabilised level of methane emissions will incur a lower cost than a net zero, all gases target by 2050.

Allowing 'fungibility' (the ability to substitute emissions of one type of gas with abatement or sequestration of another) under a given split-gas target would be expected to lower the cost of meeting it, as it would allow abatement (or sequestration) to occur wherever this is at least cost to the economy. However, modelling limitations and specific scenario designs did not allow direct assessment of the economic impact of fungibility.

NZIER modelling: from Stage 1 to Stage 2

NZIER was commissioned to assess quantitative impacts on emissions prices and macroeconomic measures including economic growth. To do this, NZIER first created a 'do-nothing' baseline that reflects expected growth of the economy with no new climate change policies.

NZIER's Stage 1 was prepared prior to consultation on the Zero Carbon Bill, with Stage 2 due to be finalised in September 2018. The baseline projections are based on Treasury's Long-Term Fiscal Model¹⁰⁶, which predicts a per annum average growth rate of 2.2 percent from 2017 to 2050. The baseline was updated at Stage 2 (July 2018) to reflect the most recent emissions projections. For purposes of the NZIER research and for use in updating

¹⁰⁴ NZ Productivity Commission, September 2018. *Low emissions economy: Final report*. See page 271. Retrieved from https://www.productivity.govt.nz/sites/default/files/Productivity%20Commission_Low-emissions%20economy_Final%20Report_FINAL.pdf.

¹⁰⁵ Increasing the amount of forestry sequestration assumed for the net zero emissions target by one-third (10 MtCO₂e) reduces the modelled economic impacts by an order of magnitude.

¹⁰⁶ November 2016 update

New Zealand's 2018 Net Position and related information on projected greenhouse gas emissions, MfE asked Government agencies to provide updated projections out to 2050. These projections relied on the same assumptions used in both New Zealand's Seventh National Communication and Third Biennial Report. The emissions projections produced by NZIER contained a consistent projected trend of greenhouse gas emissions relative to agency projections.¹⁰⁷

To respond to limitations in Stage 1, NZIER's Stage 2 analysis looked to endogenise afforestation and land use change, as well as refining and extending the modelling. The decision to endogenise afforestation and land use change made it very difficult for the CGE model to solve and was, therefore, reversed. Instead, the Ministry worked with NZIER to develop forestry sequestration assumptions. NZIER integrated these assumptions, modelling land use change from livestock agriculture to forestry (through a productivity improvement shock).¹⁰⁸ Other improvements to the scenarios included testing the impact of split-gas targets (with and without fungibility) and lower levels of innovation. These refinements mean the impacts estimated in Stage 2 differ slightly from those estimated at Stage 1.

The modelling allows for comparison of:

- the impact of achieving each 2050 target with the 'do-nothing' baseline
- the impact of achieving each 2050 target with the policy status quo, which is the current domestic target of a 50 percent reduction on 1990 gross emissions by 2050.

Readers should note that it is highly unlikely that the Government will take no further action on climate change, and the baseline scenario assumes that the New Zealand economy can continue sustained economic growth to 2050 unaffected by the effects of climate change (eg, more frequent storms and rising sea levels) or by international pressures to reduce emissions. Therefore, comparisons in this report are made primarily with the status quo scenario rather than the baseline.

Mapping the targets in this RIS to targets modelled by NZIER

Officials' policy work on the potential definition of targets has evolved over time: before, through and after consultation. To recap, the target options considered in this RIS are set out in general terms in the **2050 Target** section, which in more technical terms of permitted emissions represent the constraints presented in **Table 2** over the page.

Not all targets in this RIS have specifically been modelled by CMV and NZIER. That is because this final RIS contains a wider set of target options (Options 1–6) than was considered prior to consultation, and so Options 5 and 6 in this RIS were not originally in the set of targets NZIER were commissioned to model. CMV modelled all-gas targets of net zero emissions (Option 4) and 25 MtCO₂e in 2050 (very close to Option 2 with methane emissions reduced to 75 percent of 2016 levels).

NZIER modelling is still underway to inform on Options 5 and 6, which were identified post-consultation.

¹⁰⁷ Ministry for the Environment. 2018. *Latest update on New Zealand's 2020 net position*. Wellington: Ministry for the Environment. Retrieved from <https://www.mfe.govt.nz/climate-change/what-government-doing/emissions-reduction-targets/reporting-our-targets/latest-2020>.

¹⁰⁸ Note that NZIER's modelling assumed all sequestration comes from exotic plantation forests.

Table 2: Defining target options in this RIS by permitted emissions levels and mapping to targets modelled by NZIER

	Baseline	Status Quo	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Description	'Do-nothing' pathway: no further action on climate change	The existing domestic target: 50% of 1990 gross emissions (all gases)	Net zero carbon dioxide by 2050	Net zero long-lived gases (LLGs) and reduced short-lived gases (SLGs) by 2050, with fungibility	Net zero LLGs and reduced SLGs by 2050, without fungibility	Net zero emissions by 2050 across all GHGs	Net zero greenhouse gases in the second half of the century, separate pathways for LLGs and SLGs: biogenic methane to [x] percent below 2016 levels by 2050 and all other GHGs to net zero by 2050	Domestic emissions target, separate pathways for LLGs and SLGs (Option 5), nested within an overall international target of net zero emissions by 2050 (conditional on the partial use of international units)
Modelled by NZIER?	Yes	Yes	Yes	Yes	Yes, with two levels of SLG reduction (50% and 75% of 2016 levels)	Yes	No, but this scenario is identical to Option 2 at 2050	No, but this target is identical to Option 5, with an additional international component
Assumption: innovation levels	Baseline	Moderate	Moderate	Moderate	Wide	Wide	N/A	N/A
Assumption: Forestry sequestration by 2050 ¹⁰⁹	9 MtCO ₂ -e	16 MtCO ₂ -e	16 MtCO ₂ -e	<ul style="list-style-type: none"> 22.6 MtCO₂-e for 50% SLG stabilisation 18.9 MtCO₂-e for 75% SLG stabilisation 	<ul style="list-style-type: none"> 16 MtCO₂-e for 50% SLG stabilisation 16 MtCO₂-e for 75% SLG stabilisation 	<ul style="list-style-type: none"> 30 MtCO₂-e (sensitivity to 40 MtCO₂-e also tested) 	Same as option 2 in 2050	Same as option 2 in 2050

¹⁰⁹ In specifying the scenario parameters there was an omission of residual emissions from household transport (ie emissions from fuel use in household-owned motor vehicles) which is computed outside the model. Offsetting these residual emissions would require an additional 2–3 MtCO₂e of forestry sequestration. For example, the scenario C-wide-(30Mt) would require 32 MtCO₂e sequestration (rather than 30 MtCO₂e) to meet the net zero emissions target with the stated economic impact.

IN CONFIDENCE – NOT GOVERNMENT POLICY

	Baseline	Status Quo	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Constraint: all gases by 2050		32.9 MtCO ₂ -e	No specific constraint	Emissions of all gases fall to a level of: <ul style="list-style-type: none"> 16.4 MtCO₂-e for 50% SLG stabilisation 24.6 MtCO₂-e for 75% SLG stabilisation 	CO ₂ -e emissions the same as option 2 but through separate constraints on LLGs and SLGs.	0 MtCO ₂ -e	N/A	N/A
Constraint: long-lived gases by 2050		No specific constraint	CO ₂ constrained to 0 MtCO ₂ -e but no constraint on N ₂ O	No specific constraint	CO ₂ constrained to 0 MtCO ₂ -e but no constraint on N ₂ O because the SLG constraint below will reduce N ₂ O emissions.	No specific constraint	N/A	N/A
Constraint: biogenic methane by 2050		No specific constraint	No specific constraint	No specific constraint	50% of 2016 levels (16.4 MtCO ₂ -e) or 75% of 2016 levels (24.6 MtCO ₂ -e)	No specific constraint	N/A	N/A
Is biogenic methane fungible? (= biogenic methane can be offset by net CO ₂ -e reductions)		Yes	n/a	Yes	No	Yes	Yes	N/A
Can international units be used?		No	No	No	No	No, but the sensitivity of this option to international units was tested	No	N/A

NZIER's assumptions on innovation and forestry sequestration

The scenario designs discussed above assume varying levels of innovation and forestry sequestration. Both these factors have potentially large impacts on the scenario results.

The innovation assumptions are outlined in the table below.

Table 3: Innovations assumed within the innovation assumption sets

Innovation type	Wide innovation assumptions	Moderate innovation assumptions
Methane vaccine	Reduces dairy emissions by 15%; S&B by 10%; 70% adoption; spread over 20 years	No methane vaccine
Electric Vehicles (EVs)	95% of light vehicle fleet; 50% of heavy vehicle fleet by 2050	80% of light vehicle fleet; 25% of heavy vehicle fleet by 2050
Renewable electricity generation	98% renewables from 2035-2050; remainder from gas	92% renewables from 2035-2050; remainder from gas
Energy efficiency improvements	Double the rate of energy efficiency improvements assumed in the baseline	1.5 times the rate of energy efficiency improvements assumed in the baseline
Scenarios applied to:	Option 3 and Option 4	Status quo, Option 1 and Option 2

Selecting the appropriate level of sequestration for any given scenario and target is challenging. It requires consideration of the ambition of the target and the effect of other innovation assumptions, and hence the potential level of carbon prices and other government policies to incentivise afforestation.

Through an iterative process, NZIER determined that a sequestration level of 30 MtCO_{2e} in 2050 was appropriate as its 'core' scenario for the net zero emissions target (Option 4).¹¹⁰ The sequestration level was then pro-rated down across the other scenarios, broadly based on the size of the required gross emissions reduction to hit the specific target.¹¹¹

These assumed sequestration levels are significantly lower than in CMV's results, which had sequestration of 46–52 MtCO_{2e} in 2050 occurring under the three modelled pathways to net zero emissions. NZIER carried out a sensitivity analysis for the Net Zero all gases target scenario with a higher sequestration level of 40 MtCO_{2e}.

Note that in consultation with Ministry for the Environment officials, NZIER have assumed 9 MtCO_{2e} of sequestration in 2050 in the baseline. This is roughly the same as 2016 levels (using an approach consistent with that used in New Zealand's Paris Agreement Nationally Determined Contribution) and within the Ministry for Primary Industries' projected range of 4–17 MtCO_{2e} under current policies.

¹¹⁰ In specifying the scenario parameters there was an omission of residual emissions from household transport (ie emissions from fuel use in household-owned motor vehicles) which is computed outside the model. Offsetting these residual emissions would require an additional 2–3 MtCO_{2e} of forestry sequestration. For example, the scenario C-wide-(30Mt) would require 32 MtCO_{2e} sequestration (rather than 30 MtCO_{2e}) to meet the net zero emissions target with the stated economic impact.

¹¹¹ Note that sequestration assumptions for Option 3 are lower than for Option 2 because methane emissions cannot be offset with forestry under Option 3.

Options 1–4: Impact on emissions prices

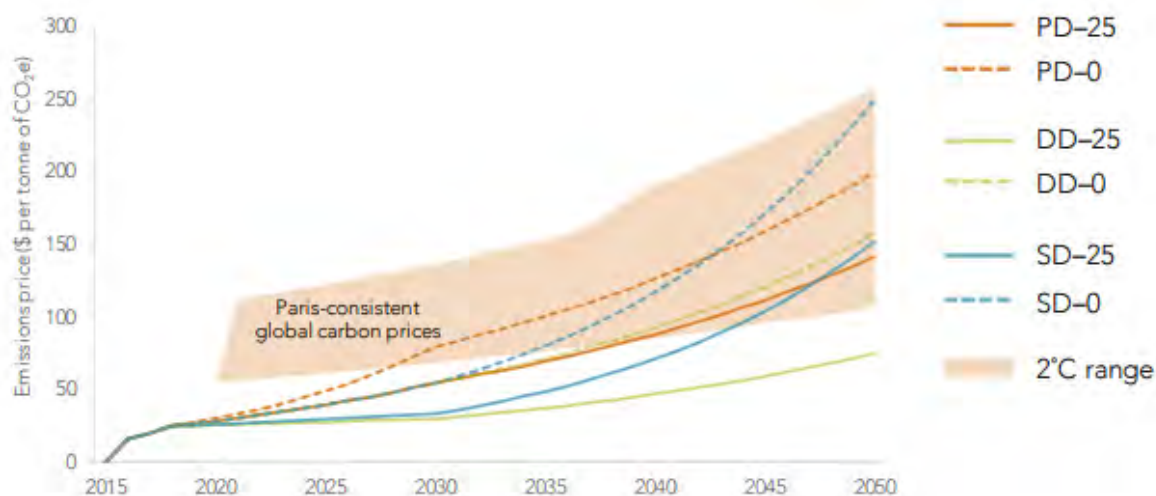
The modelling anticipates a substantial rise in emissions price: the stronger the target, the higher the price.

CMV's pathways to net zero emissions (all gases, domestically) at 2050 produced an emissions price range of \$150–250/tCO₂e by 2050. As noted by the Productivity Commission, these prices are within the range of emissions prices estimated as necessary in other developed countries to deliver on the Paris Agreement goal of limiting global warming to under 2°C. Pathways to a less ambitious target of 25 MtCO₂e (comparable to Option 2 with methane reduced to 75% of 2016 levels) produced prices ranging from \$75–150/tCO₂e by 2050.

The price trajectories produced by CMV for both targets are shown in Figure 1, below.¹¹² The pathways modelled vary in the extent and type of technology changes that reduce emissions and the impact of those changes on the structure of the economy:

*The 'Policy Driven' scenario assumes that technologies are slow to develop and reductions in emissions must rely on strong policy such as high emissions prices. The 'Disruptive Decarbonisation' scenario assumes that technological change is fast, and it disrupts existing industries. The 'Stabilising Decarbonisation' scenario assumes that technological change is also fast, but it reduces emissions in existing industries.*¹¹³

Figure 1: Emissions price trajectories modelled by CMV



Source: Concept Consulting et al. (2018a).

NZIER's modelling finds substantially higher emissions prices: the main scenario for net zero emissions (all gases, domestically) at 2050 estimates an emissions price of around \$2,000/tCO₂e by 2050.

The wide range in emissions prices and macroeconomic impacts resulting from the models reflect the differences in their structure and the underlying assumptions as outlined

¹¹² Figure 3-21 on page 78 of the Productivity Commission, September 2018: *Low Emissions Economy: Final report*.

¹¹³ Ibid. Page 10.

previously. Notably, the range is much reduced when NZIER uses sequestration assumptions more closely aligned with CMV's results: for example, NZIER's net zero emissions scenario with 40 MtCO₂e of sequestration has an emissions price of under \$400 in 2050.

Dr Winchester's peer review of NZIER's study notes that CGE models tend to estimate higher costs compared with models with a reduced-form representation of the economy (such as CMV's model), due to realistic details of economies represented in CGE models. However, as previously mentioned, Dr Winchester concluded that NZIER's cost estimates are likely in the high end of the probable range.

Options 1–4: Impact on economic growth

Table 4 at the end of this appendix shows the macroeconomic impacts modelled by NZIER for each of the target options modelled. As stated earlier, CMV's model does not generate macroeconomic impacts, so results from CMV are not included in this table. However, we can reasonably assume the lower emissions prices estimated by CMV would give rise to a lower overall economic impact.

Modelled impacts are highly sensitive to assumed sequestration levels: more sequestration can dramatically reduce the impact

Target option	Forestry sequestration in 2050 (MtCO ₂ e) ¹¹⁴	Average 2020–50 emissions price (\$/tCO ₂ e)	Relative to the status quo:		
			Annual average GDP growth impact 2020–50 (percentage points)	Annual average GDP impact 2020–50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018–50 (\$ billion)
Option 4 (net zero emissions, 30Mt sequestration)	30	1,056	-0.35	-\$18.4	-\$148.1
Option 4 (net zero emissions, 40Mt sequestration)	40	406	-0.03	-\$0.9	-\$10.9

The table above compares results for NZIER's main net zero emissions scenario with its 'higher forestry sequestration' sensitivity run. The results demonstrate a high degree of sensitivity: here increasing the amount of sequestration assumed by one-third (10 MtCO₂e) reduces the modelled economic impacts by an order of magnitude. Under the main net zero emissions scenario, the annual average GDP growth rate is modelled to fall by 0.35 percentage points compared with the status quo, while in the higher forestry scenario this impact is reduced to 0.03 percentage points.

This suggests that forestry sequestration may be a vital factor in limiting the economic costs of the transition – particularly for more ambitious targets. Note that in CMV's modelling, forestry sequestration increases to even higher levels to achieve net zero emissions in 2050

¹¹⁴ See footnote 111. Error! Bookmark not defined..

(46–52 MtCO₂e). When sequestration is constrained to lower levels, this requires more gross emissions reductions, which can lead to steeply increasing marginal abatement costs.

Readers should note how sensitive the modelled macroeconomic impacts are to sequestration and other assumptions. The impacts presented here are intended to inform on the **relative impacts of different target options**, and the absolute values of the impacts of the various target options should be interpreted with caution.

The higher the target ambition, the higher the economic impact

Target option	Emissions remaining in 2050 (MtCO ₂ e)	Relative to the status quo:		
		Annual average GDP growth impact 2020-50 (percentage points)	Annual average GDP impact 2020-50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018-50 (\$ billion)
Option 4 (net zero emissions)	0.0	-0.35	-\$18.4	-\$148.1
Option 2 (fungible split gas target, 50% stabilisation level for short lived gases)	16.4	-0.18	-\$11.7	-\$94.8
Option 2 (fungible split gas target, 75% stabilisation level for short lived gases)	24.6	-0.07	-\$4.7	-\$38.9

The table above shows that as the ambition of the target increases, so does the target's economic impact. For a target of net zero emissions (all gases) by 2050 (Option 4), the average annual GDP growth rate is modelled to fall by 0.35 percentage points compared with the status quo scenario. Whereas for a fungible, split gases target (Option 2) average annual GDP growth slows by 0.07–0.18 percentage points (also relative to the status quo), depending on the SLG stabilisation level.

The impact of a given split gas target is expected to be lower if it allows for fungibility

Target option	Innovation assumption	Forestry sequestration in 2050 (MtCO ₂ e) ¹¹⁵	Relative to the status quo:		
			Annual average GDP growth impact 2020-50 (percentage points)	Annual average GDP impact 2020-50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018-50 (\$ billion)
Option 3 (non-fungible split gas target, 50% stabilisation level for short lived gases)	Wide	16.0	-0.33	-\$12.2	-\$75.6
Option 3 (non-fungible split gas target, 75% stabilisation level for short lived gases)	Wide	16.0	-0.31	-\$9.9	-\$52.7

¹¹⁵ See footnote 110.

target, 75% stabilisation level for short lived gases)					
Option 2 (fungible split gas target, 50% stabilisation level for short lived gases)	Moderate	22.6	-0.18	-\$11.7	-\$94.8
Option 2 (fungible split gas target, 75% stabilisation level for short lived gases)	Moderate	18.9	-0.07	-\$4.7	-\$38.9

Fungibility refers to the ability to substitute emissions of one type of gas with abatement or sequestration of another. Target options that do not allow fungibility place an absolute cap on SLG emissions, whereas target options that permit fungibility allow SLG emissions to exceed the specified stabilisation level if there is an equivalent amount of abatement and/or sequestration of LLGs (and vice versa).

NZIER modelled a set of scenarios that allowed fungibility and a set that did not. These scenarios reduced net emissions of LLGs to zero by 2050 and reduced SLG emissions to either 50 percent or 75 percent of 2016 levels. Collectively, these scenarios inform on the economic impacts of Options 2 and 3.

If fungibility is not permitted, the sectors that emit SLGs (mainly livestock agriculture) are constrained so that emissions are reduced to the specified level. In the model, this was done by reducing the economic output of these sectors, which has flow-on effects to other related sectors (eg, dairy product manufacturing and meat processing) and the wider economy. If fungibility is permitted, this is ultimately equivalent to an all-gases target and was modelled as such.

Allowing fungibility would be expected to lower the cost of meeting a given split gas target, as it would allow abatement or sequestration to occur wherever this is at least cost to the economy. The modelling results in the table above appear to largely support this.¹¹⁶ However, Dr Winchester notes in his peer review that the scenario designs **do not allow direct assessment of the impact of fungibility**, because they also used different input assumptions on sequestration and innovation. Isolating the impact of fungibility was very difficult due to model limitations.¹¹⁷ The results should hence be read with care.

The two stabilisation levels for SLGs within the split-gas target options (2 and 3) that were tested by NZIER indicate that – as we would expect – a higher stabilisation level leads to lower impact on the economy. For both the fungible case (Option 2) and the non-fungible

¹¹⁶ An exception is that the non-fungible option with a 50% SLG stabilisation level shows a smaller impact than the corresponding fungible option in NPV terms (but higher impact on other measures). This is because of a difference in the timing of the impacts, with the non-fungible scenario performing relatively better early on but significantly worse in the final decade of the simulation. This may be a consequence of the particular sets of assumptions used.

¹¹⁷ The sequestration assumptions were set at different levels on the basis that the non-fungible target option does not allow sequestration to offset SLGs – however, it is difficult to determine what levels would be appropriate. The logic behind differing innovation assumptions for these scenarios was that achieving the non-fungible targets (option 3) would require a high level of innovation, particularly through a methane vaccine for livestock agriculture, whereas a fungible target (option 2) may give less incentive for this as it allows forestry to offset biogenic methane emissions.

case (Option 3), the 75 percent stabilisation scenarios had a lower impact on average annual GDP growth rate than for the 50 percent stabilisation scenarios.

Allowing the purchase of international units could reduce the target's economic impact

Target option	Relative to the status quo:			
	Average 2020–50 emissions price (\$/tCO ₂ e)	Annual average GDP growth impact 2020-50 (percentage points)	Annual average GDP impact 2020-50 (\$ billion per year)	Cumulative NPV in 2018 of GDP impact over 2018-50 (\$ billion)
Option 4 (net zero emissions, domestic only)	1,056	-0.35	-\$18.4	-\$148.1
Option 4 (net zero emissions, 80% domestic, 20% international units, \$150/tCO ₂ e) ¹¹⁸	567	-0.11	-\$5.7	-\$48.4

Allowing the purchase of high-integrity international units could reduce the economic impact of achieving a net zero emissions target (Option 4). NZIER modelled a scenario where a net zero emissions target is met 80% domestically, with the remaining 20% of emissions offset through the purchase of international units. Compared to the main domestic net zero emissions scenario (where GDP growth slows by 0.35 percentage points relative to the status quo), this international units scenario sees a lower GDP growth impact of 0.11 percentage points (also relative to the status quo).¹¹⁹

Readers should note that scenarios that allow purchases of international units are complex to model. In particular, in the scenario where 80% of the abatement must be met domestically, NZIER could not model offsetting the remaining 20% of emissions through a CGE framework. NZIER estimate that offsetting these emissions through purchasing international units at \$150/tCO₂e would cost \$67.1 million per year over the period 2020–50. Therefore the macroeconomic impacts in the table above underestimate the economic impact this target poses.

Further, the international unit scenario gives a higher economic impact than the higher forestry sequestration scenario presented earlier. This suggests that if more sequestration is feasible, this would be more economically beneficial than purchasing international units. However, the scenarios were not designed to allow a direct comparison.

While the availability of international units has potential to reduce the economic impact of meeting the target, this could dilute the signal for transition set by the target. This could limit the extent to which the domestic economy transitions and would risk New Zealand not

¹¹⁸ Note that the macroeconomic impacts stated for this scenario represent the economic costs of meeting an 80% reduction target in 2050. These impacts do not consider the costs of purchasing international units to account for the remaining 20% of emissions. There was not sufficient time in which to model this in a CGE framework. The purchase of the international units would pose a cost to NZ of \$67.1 million per year between 2020 and 2050. These figures therefore underestimate the macroeconomic impact of this scenario.

¹¹⁹ See 53 above. GDP impacts of this scenario are underestimated by at least \$67.1 million per year (the direct cost of purchasing units to offset the remaining 20% of emissions).

realising the potential co-benefits of a domestic transition. Readers should also note that there is huge uncertainty in the emissions price in the future — as a result, it would be risky to rely on international units to meet potential emissions targets.

Option 5: Impact on economic growth compared to Option 2

Option 5 is identical to Option 2 in that it sets a split-gas target, by 2050, of reaching net zero emissions for LLGs and reducing emissions of biogenic methane by [x] percent on 2016 levels. However, it adds the requirement for reaching overall GHG neutrality in the second half of the century (ie, by 2100).

Although the economic impact of Option 5 has not been specifically modelled by NZIER, at 2050 this option has the same economic impact as Option 2. After 2050, the impact of these options diverges: in Option 2, the level of SLG emissions stabilises at [x] percent of 2016 levels; whereas in Option 5, SLG emissions continue to reduce (through abatement, sequestration or international units) to reach net zero in the second half of the century. Modelling out to 2050 is already stretching the dynamic CGE model to its limits — therefore, it was not used to model past this point.

Option 6: Not modelled

Option 6 was developed after modelling was commissioned; there has not been time to model this.

This Option pulls various elements from Options 1 to 4, which have been modelled. Some simple logic provides insights on the potential impact of Option 6. This option has a similar impact as Option 5 in the period 2021-2050. Allowing the use of overseas reductions means this option will also be less expensive than option 4. While these relative differences are more certain, the absolute values and the scale of the impacts is not certain. This assumes fungibility of biogenic methane emissions.

Summary of modelling results

Table 4, over the page, presents the modelled macroeconomic impacts of Options 1–4 compared with the ‘do-nothing’ baseline and status quo 2050 target. It also expresses GDP impacts in their cumulative net present value (NPV) in 2018 (also relative to the baseline, and the status quo scenario).

Table 4: Full economic modelling results for baseline, current domestic target and target options 1–4

Target option	Scenario description	Emissions price - annual average 2020-50 (\$/tCO ₂ -e)	Emissions price at 2040 (\$/tCO ₂ -e)	Emissions price at 2050 (\$/tCO ₂ -e)	Annual average GDP Growth 2020-50 (% pa)	Annual average GDP 2020-50 (\$ million per year)	Absolute GDP at 2040 (\$ million per year)	Absolute GDP at 2050 (\$ million per year)	Annual average GNDI 2020-50 (\$ thousand per household per year)	Cumulative 2018 NPV of GDP impacts over 2018-2050 (\$ billion) ¹²⁰
NZIER CGE scenario and sensitivity results										
Baseline: do nothing further scenario		N/A	N/A	N/A	2.15%	\$397,893	\$433,537	\$536,108	\$238	
Status quo: New Zealand meets its current domestic 2050 emissions target		\$115	\$39	-\$192	2.06%	\$387,606	\$418,688	\$521,619	\$232	
Option 1	Net zero carbon dioxide	\$1,125	\$1,444	\$2,933	1.58%	\$368,852	\$395,484	\$452,989	\$220	
Option 2	Fungible: Net zero LLGs, SLGs stabilised at 50% of 2016 levels	\$518	\$552	\$693	1.87%	\$375,938	\$403,379	\$494,009	\$225	
	Fungible: Net zero LLGs, SLGs stabilised at 75% of 2016 levels	\$271	\$243	\$141	1.99%	\$382,908	\$412,326	\$511,338	\$229	
Option 3	Non-fungible: Net zero LLGs, SLGs stabilised at 50% of 2016 levels	\$978	\$1,273	\$2,458	1.72%	\$375,368	\$405,571	\$472,590	\$224	
	Non-fungible: Net zero LLGs, SLGs stabilised at 75% of 2016 levels	\$1,039	\$1,349	\$2,629	1.75%	\$377,739	\$408,672	\$476,204	\$226	
Option 4	Net zero emissions (all gases), 30 MtCO ₂ e forestry sequestration	\$1,056	\$1,211	\$2,012	1.71%	\$369,231	\$397,656	\$470,341	\$220	
	Net zero emissions (all gases), 40 MtCO ₂ e forestry sequestration	\$406	\$409	\$383	2.03%	\$386,693	\$419,666	\$517,119	\$231	
	Net zero emissions (all gases), 80% domestic, 20% international with international units at \$150/tCO ₂ e ¹²¹	\$567	\$611	\$753	1.95%	\$381,949	\$413,623	\$504,916	\$228	
Calculated differences relative to the baseline (do nothing) scenario										
Status quo: New Zealand meets its current domestic 2050 emissions target		\$115	\$39	-\$192	-0.09%	-\$10,286	-\$14,849	-\$14,489	-\$6.5	-\$99.3
Option 1	Net zero carbon dioxide	\$1,125	\$1,444	\$2,933	-0.57%	-\$29,041	-\$38,053	-\$83,119	-\$17.9	-\$215.9
Option 2	Fungible: Net zero LLGs, SLGs stabilised at 50% of 2016 levels	\$518	\$552	\$693	-0.27%	-\$21,955	-\$30,159	-\$42,099	-\$13.7	-\$194.1
	Fungible: Net zero LLGs, SLGs stabilised at 75% of 2016 levels	\$271	\$243	\$141	-0.16%	-\$14,985	-\$21,212	-\$24,769	-\$9.4	-\$138.3
Option 3	Non-fungible: Net zero LLGs, SLGs stabilised at 50% of 2016 levels	\$978	\$1,273	\$2,458	-0.42%	-\$22,525	-\$27,966	-\$63,518	-\$14.0	-\$175.0
	Non-fungible: Net zero LLGs, SLGs stabilised at 75% of 2016 levels	\$1,039	\$1,349	\$2,629	-0.40%	-\$20,154	-\$24,865	-\$59,904	-\$12.5	-\$152.1
Option 4	Net zero emissions (all gases), 30 MtCO ₂ e forestry sequestration	\$1,056	\$1,211	\$2,012	-0.44%	-\$28,662	-\$35,881	-\$65,767	-\$17.8	-\$247.5

¹²⁰ Note that net present value (NPV) was calculated using a 6% discount rate. Negative NPV values represent an economic cost, whereas positive NPV values indicate an economic benefit. These calculations were performed by MfE based on NZIER GDP modelling results — NPV of the GDP impacts are presented relative to the specified base scenario (baseline or status quo).

¹²¹ Note that the macroeconomic impacts stated for this scenario represent the economic costs of meeting an 80% reduction target in 2050. These impacts do not consider the costs of purchasing international units to account for the remaining 20% of emissions. There was not sufficient time in which to model this in a CGE framework. The purchase of the international units would pose a cost to NZ of \$67.1 million per year between 2020 and 2050. These figures therefore underestimate the macroeconomic impact of this scenario.

Target option	Scenario description	Emissions price - annual average 2020-50 (\$/tCO ₂ -e)	Emissions price at 2040 (\$/tCO ₂ -e)	Emissions price at 2050 (\$/tCO ₂ -e)	Annual average GDP Growth 2020-50 (% pa)	Annual average GDP 2020-50 (\$ million per year)	Absolute GDP at 2040 (\$ million per year)	Absolute GDP at 2050 (\$ million per year)	Annual average GNDI 2020-50 (\$ thousand per household per year)	Cumulative 2018 NPV of GDP impacts over 2018-2050 (\$ billion) ¹²⁰
	Net zero emissions (all gases), 40 MtCO ₂ e forestry sequestration	\$406	\$409	\$383	-0.12%	-\$11,199	-\$13,871	-\$18,989	-\$7.1	-\$110.2
	Net zero emissions (all gases), 80% domestic, 20% international with international units at \$150/tCO ₂ e ¹²¹	\$567	\$611	\$753	-0.20%	-\$15,944	-\$19,914	-\$31,192	-\$10.0	-\$147.7
Calculated differences relative to the status quo scenario										
Option 1	Net zero carbon dioxide	\$1,010	\$1,405	\$3,125	-0.48%	-\$18,755	-\$23,204	-\$68,630	-\$11.5	-\$116.6
Option 2	Fungible: Net zero LLGs, SLGs stabilised at 50% of 2016 levels	\$403	\$513	\$885	-0.18%	-\$11,668	-\$15,309	-\$27,610	-\$7.2	-\$94.8
	Fungible: Net zero LLGs, SLGs stabilised at 75% of 2016 levels	\$156	\$204	\$334	-0.07%	-\$4,699	-\$6,362	-\$10,281	-\$2.9	-\$38.9
Option 3	Non-fungible: Net zero LLGs, SLGs stabilised at 50% of 2016 levels	\$863	\$1,234	\$2,651	-0.33%	-\$12,238	-\$13,117	-\$49,029	-\$7.5	-\$75.6
	Non-fungible: Net zero LLGs, SLGs stabilised at 75% of 2016 levels	\$924	\$1,310	\$2,821	-0.31%	-\$9,868	-\$10,016	-\$45,415	-\$6.0	-\$52.7
Option 4	Net zero emissions (all gases), 30 MtCO ₂ e forestry sequestration	\$940	\$1,172	\$2,205	-0.35%	-\$18,375	-\$21,032	-\$51,278	-\$11.4	-\$148.1
	Net zero emissions (all gases), 40 MtCO ₂ e forestry sequestration	\$290	\$370	\$576	-0.03%	-\$913	\$978	-\$4,500	-\$0.6	-\$10.9
	Net zero emissions (all gases), 80% domestic, 20% international with international units at \$150/tCO ₂ e ¹²¹	\$452	\$572	\$945	-0.11%	-\$5,657	-\$5,065	-\$16,703	-\$3.6	-\$48.4