Chapter 4

Ngā taunakitanga me ngā tauira
Evidence and models

Summary

Emissions budgets set a limit on the total emissions allowed in Aotearoa for five-year periods out to 2050.

This chapter explains the Commission's process for determining the levels of these emissions budgets, outlining what we have considered, where we have drawn our evidence from, and how we have used the models we have built.

The Commission's focus has been on developing advice that is achievable and ambitious and puts Aotearoa on track to meet its targets for long-lived greenhouse gases and biogenic methane in a way that is focused on the long term. We want Aotearoa to reach the 2050 targets and sustain them beyond 2050.

The stages the Commission went through in determining the emissions budgets are:

- **Pulling together evidence to help us understand the actions that reduce emissions.** We have drawn on international evidence and evidence from Aotearoa. We have tested our evidence and assumptions through our technical reference groups and through consultation, and have made amendments in light of this feedback. We have engaged widely with government agencies, NGOs, business, industry groups and other stakeholders and considered the 15,000 submissions we received during consultation.
- **Modelled long-term scenarios to 2050 and beyond, and multiple paths to 2035, and used the results to calculate draft emissions budgets.** This involved running a series of scenarios, looking at what impact current policy will have on emissions, a range of long-term scenarios to 2050 and beyond, and focusing in more detail on the paths to 2035. We modelled three different paths and tested how sensitive these paths are. This was to determine that our recommended emissions budgets would be achievable as well as ambitious.

- **Tested these draft emissions budgets and made adjustments to ensure that any impacts were manageable, that they were sufficiently ambitious, and that they were a sufficient contribution to the global 1.5°C effort.** This involved looking at the potential impacts on the economy, different sectors, regions, communities, households, different socioeconomic groups, Iwi/Māori and different generations. Where there were negative impacts, we considered whether these impacts were manageable or whether they could be reduced or changed through changes to government policy. We looked at the positive impacts and co-benefits, such as to health and equitable access to health, and considered how these could be maximised.

This chapter also sets out more detail on the key features of the models we have built to help with this analysis.

Changes in our final advice

During consultation, we received feedback from submitters about the need to explain in more detail the approach we took to determine our emissions budgets recommendations. We have written this chapter in response to that feedback.

Introduction

1 In 2019, Parliament committed to long-term and enduring action on climate change. The Act sets clear emissions reduction targets and lays out a process for meeting them. Emissions budgets are a key part of this process. They set a limit on the total emissions allowed in Aotearoa for five-year periods out to 2050.

2 Part one of our report lays out our advice on the levels of the first three emissions budgets. These budgets cover the periods 2022 to 2025, 2026 to 2030, and 2031 to 2035.

3 This chapter explains the process we went through to determine the levels of these emissions budgets. It specifically outlines what is different about our approach compared to the work done by others previously. It outlines how we have stepped through our work, where our evidence has come from, and the models we have used.

4.1 Our obligations under the Climate Change Response Act

4 We have looked at how to transition to a thriving, climate-resilient and low emissions Aotearoa in a way that takes into account the different nature of long-lived gases and biogenic methane, as well as the balance between reducing gross emissions and removing carbon from the atmosphere.

5 This approach takes account of our obligations under the Act. After amendments to the Act in 2019, Aotearoa now has split-gas targets. This means that there are separate targets for long-lived gases and biogenic methane. These targets are illustrated in Figure 4.1.

6 Emissions budgets need to set Aotearoa up to:

- reduce biogenic methane emissions by at least 10% by 2030 and 24-47% by 2050 and beyond, compared to 2017 levels.
- reduce emissions of greenhouse gases, other than biogenic methane, to net zero by 2050 and beyond.

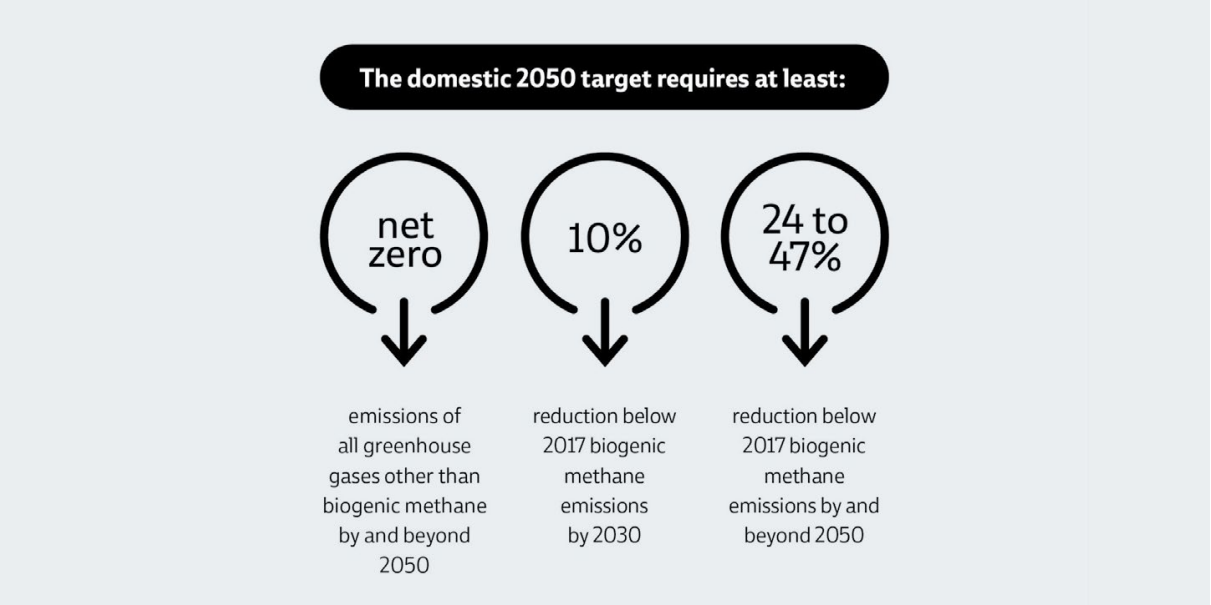

Figure 4.1: The domestic targets Aotearoa has set.

7 The greenhouse gases, other than biogenic methane, are carbon dioxide, nitrous oxide, F-gases and non-biogenic methane. For convenience, we refer to these gases as long-lived gases as the majority of these are long-lived.

8 The targets Aotearoa is working towards are domestic targets set to help the country deliver on the aims of the Paris Agreement.

9 The Act requires the Commission to advise on the levels of the emissions budgets that will help Aotearoa achieve the targets.

10 The Act also requires the Commission to advise on the proportion of emissions budgets that should be met by domestic emissions reductions and domestic emissions removals. In doing this we must consider a broad range of factors, including key risks and uncertainties, and the potential impact on communities from land use change (see *Chapter 3: The role of the Climate Change Commission*). This means we must carefully consider the role of forests in meeting our recommended emissions budgets.

11 This approach is different from previous exercises in Aotearoa that pre-dated the 2019 amendments to the Act. These earlier exercises looked at how Aotearoa could meet international responsibility targets, and so were focused on reducing overall net emissions, including through offshore mitigation.

12 In contrast, the framework for emissions budgets and 2050 targets in the Act is designed around driving a domestic low-emissions transition. The Commission's focus has been on developing a package of advice that not only puts Aotearoa on track to meet the targets for long-lived greenhouse gases and biogenic methane, but that does so in a way that is clearly focused on the long term.

Box 4.1: How we present emissions

Gross and net emissions

We present both gross and net emissions in this report. Gross emissions include emissions from:

- Transport
- Buildings
- Electricity
- Industry
- Heat
- Agriculture
- Waste
- F-gases

Net emissions refers to the overall balance of emissions and carbon dioxide removals. It is the sum of gross emissions combined with emissions and removals through land use and land-use change and forestry. In Aotearoa, emissions are mainly removed by forests, which take in carbon dioxide from the atmosphere as they grow and store it.

There are other ways to break down these emissions. For example, emissions from urban form, tourism, and construction fit across multiple sectors.

Split-gas approach

Throughout this report we present biogenic methane emissions in units of megatonnes of methane ($MtCH_4$) to take account of the short-lived nature of the gas and for consistency with the split-gas target.

Long-lived greenhouse gases, and our recommended all gases emissions budgets, are expressed in units of megatonnes of carbon dioxide equivalent ($MtCO_2e$).

Presenting emissions using Global Warming Potential over 100 years (GWP_{100})

When presenting emissions in $MtCO_2e$, these emissions are based on the GWP_{100} metric values from the Intergovernmental Panel on Climate Change's (IPCC) *Fourth Assessment Report* of the IPCC.

Emissions generated from 2021 onwards will be reported in *New Zealand's Greenhouse Gas Inventory* using more up-to-date GWP_{100} values from the IPCC's *Fifth Assessment Report* (AR5). We have converted our recommended emissions budgets using the AR5 GWP_{100} values. We expect the Government will set emissions budgets using the GWP_{100} metric values from AR5 for consistency with the Inventory.

4.2 How we stepped through our work

13 Our task has been to recommend the levels of the first three emissions budgets. Key to this is working out how fast Aotearoa can reduce emissions, factoring the considerations within the Act. To do this, we divided our work up into different stages.

14 Figure 4.2 summarises the different stages of our work. We began by pulling together evidence to help us understand the actions that reduce emissions, and data to use as inputs into our models. We then modelled long-term scenarios to 2050 and beyond, and multiple paths to 2035, and used the results to calculate draft emissions budgets.

15 We tested these draft emissions budgets and made adjustments to ensure that they were sufficiently ambitious, they were a sufficient contribution to the global 1.5°C effort, and that any impacts were manageable. We discuss each of these stages in this section.

16 The way we stepped through our work shares many common features with how others have approached similar tasks, such as the Productivity Commission's Low Emissions Economy inquiry, the UK Committee on Climate Change's advice on carbon budgets, and the European Commission's analysis of decarbonisation pathways for the European Union.

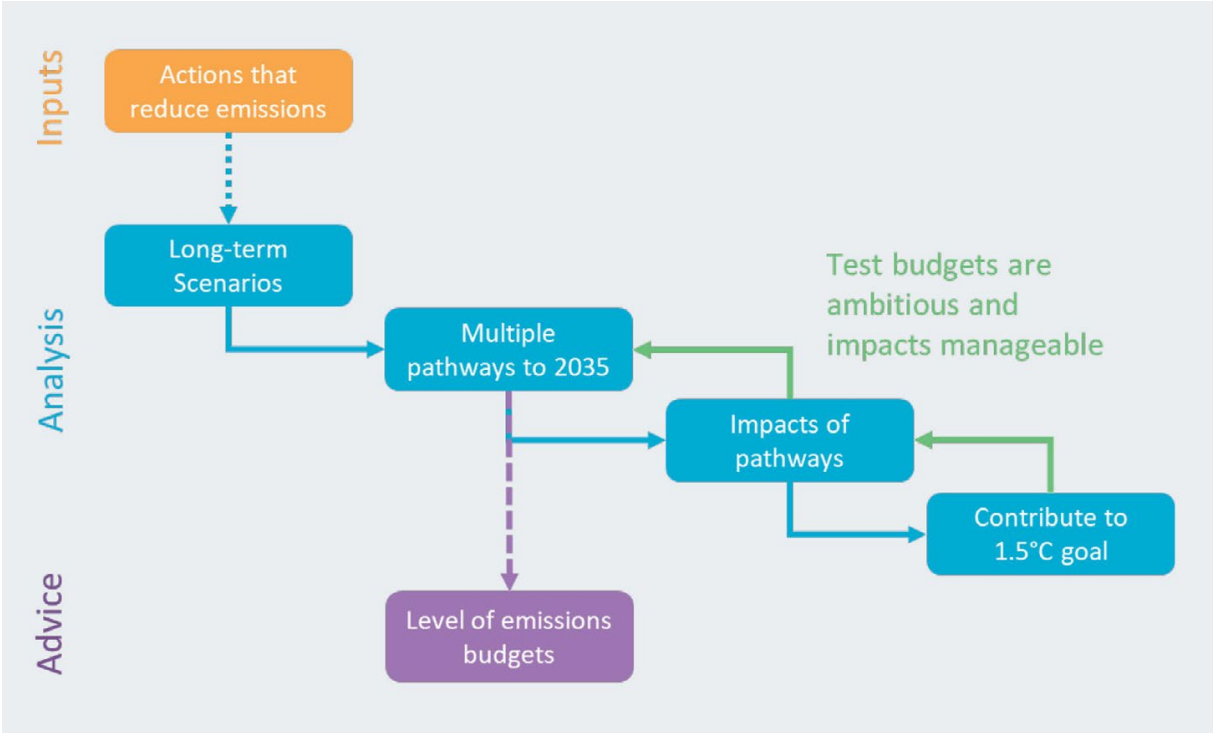

Figure 4.2: Stages of analysis for developing the Commission's advice.

4.2.1 We assessed the actions that reduce emissions

17 For the first stage of our work, we carried out detailed assessments of the opportunities to reduce and remove emissions in each sector. These opportunities included behaviour or practice changes, and existing and anticipated technologies. For example, a behaviour change could be using public transport or walking or cycling rather than driving. Technologies in the transport space could include electric vehicles (EVs), biofuel or hydrogen powered vehicles and electric planes.

18 We assessed the potential emissions reductions of each opportunity. This included, where relevant, the costs, timeframes, constraints, risks, uncertainties, barriers, and co-benefits. Understanding barriers is particularly important for understanding what could slow widespread uptake and systems change, and what therefore needs to be addressed through policy (covered in *Part 2: Emissions reduction plan advice* of this report). We assessed barriers in line with the requirements under the Act to consider how emissions budgets may realistically be met.

19 One example is our assessment of EVs. We assessed the emissions reductions from replacing an internal combustion engine (ICE) vehicle with an EV, how the cost of purchasing an EV might change over time, how the running costs might change over time, the constraints with getting new and used EVs into the country, and barriers including issues around range and charging infrastructure. We also assessed how many vehicles would be on the road and how far people would drive their vehicles each year.

20 These assessments have been outlined in *Chapter 6: Reducing emissions from transport, buildings and urban form* of the *2021 Supporting Evidence.*

21 For these assessments, we used information from both within and outside of Aotearoa, evidence provided to us in our Call for Evidence, engagement and consultation, and information provided by technical reference groups of external experts on waste, land, transport, and energy.

22 There was not sufficient evidence to include some opportunities for reducing or removing emissions in our current analysis. However, further information may become available for our analysis of future emissions budgets. An example of this is storing carbon in the oceans and soil (Box 4.2).

Box 4.2: Storing carbon in the oceans and soil

There are opportunities to remove carbon dioxide from the atmosphere and store it in the oceans and soil. More work needs to be done on the scale and permanence of these emissions and removals and how they could be accounted for before considering them in future emissions budgets.

Blue carbon

Storing carbon in oceans and coastal marine habitats is known as 'blue carbon'. Human actions can impact blue carbon through climate feedback mechanisms (i.e. climate change impacting the amount of carbon the ocean can hold) and through more direct actions (such as bottom trawling releasing carbon from the sea floor).

Blue carbon could be stored, for example, by growing seaweed, mangroves or seagrasses, and released through practices such as bottom-trawling, or disturbance of marine habitats.

Understanding the quantity of carbon stored or released is most relevant for our emissions budgets and targets, although it is not yet included in domestic or international reporting or accounting frameworks. Long-term data as to how oceans store carbon is limited and requires further scientific research before it could be included in reporting and accounting frameworks, and in emissions budgets and targets.

Soil carbon

Storing carbon in soil is known as 'soil carbon'. How much carbon is stored in soils depends on the land use, climate and soil type. For example, more carbon is stored under pasture than is stored under arable crops. In Aotearoa, soils already contain relatively high levels of carbon.

The quantity of carbon stored in soils is not constant. Carbon from decomposing animal and plant organic matter is continually added to the soil while microbes continually decompose this organic matter and release some of it back to the atmosphere as carbon dioxide. Some carbon is also lost via leaching. It is the balance of these processes that determine if carbon stocks are changing.

If the soil carbon stock is increasing, then soils are a sink of carbon dioxide. Conversely, if the soil carbon stock is decreasing, the soils are a source of carbon dioxide.

Long-term data on whether Aotearoa soils are gaining or losing carbon is limited. Some soils are losing carbon. For example, it is well established that drained peatlands are losing soil carbon.

Other soils may be gaining carbon. Increases in soil carbon stocks are generally slow but circumstances outside of human control, such as drought, can lead to the rapid loss of soil carbon.

Modelling studies suggest that there is potential for some soils to increase the quantity of carbon they store. Exactly how to exploit this potential is unclear at present. Some farm practices (for example the use of biochar or deeper rooted pasture plants) have been advocated as ways to increase the amount of carbon stored in the soil. However, the evidence base for their cost and effectiveness in Aotearoa is still developing.

New Zealand researchers are further exploring how farm practices and climate can change soil carbon stocks and whether it is possible to accurately account for changes in stocks on individual farms.

In respect of carbon losses from peatlands, we are recommending that the Government develop methods to account for this in emissions budgets and take steps to prevent these losses. For more information, see *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets* and *Chapter 18: Policy direction for forests and other carbon stocks*.

4.2.2 We used modelling to understand the scale of the transformation possible

23 We modelled a range of scenarios to understand how Aotearoa could meet emissions budgets and targets. Our modelling is different from conventional scenario analysis. Conventional scenario analysis sets up assumptions about the world and uses modelling to show where you'd end up. In this case, the targets in the Act tell us where Aotearoa needs to end up. We have used scenario modelling to understand what types of actions and what budget levels could get us to those targets.

24 We used our assessment of the opportunities for reducing emissions to develop assumptions as inputs into the models. Each scenario has different input assumptions, and therefore gives different outputs or results. These outputs are interpreted and compared to outputs from other models to ensure they make sense. Figure 4.3 shows how the inputs feed into a model, which makes a series of calculations based on those inputs, and produces results.

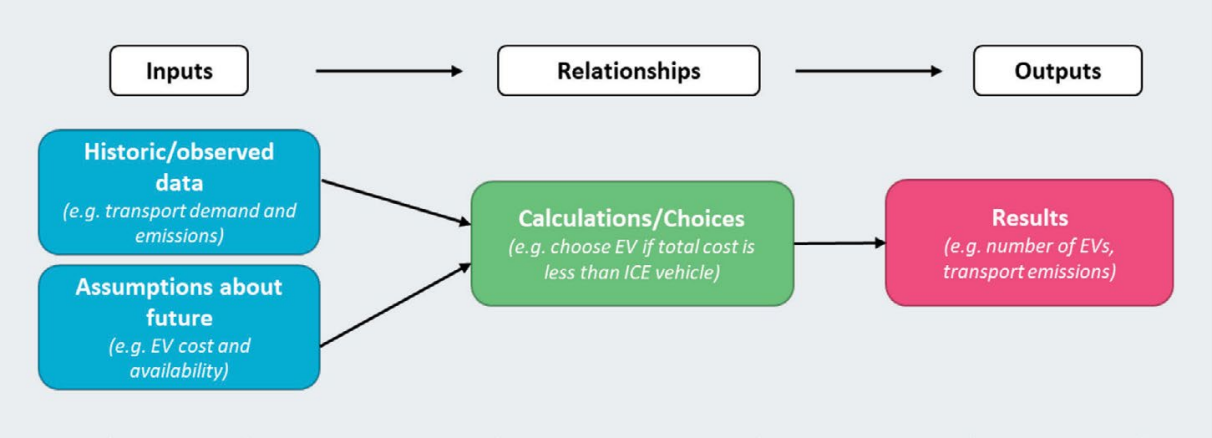

Figure 4.3: The key components of modelling.

25 We ran a series of scenarios in the ENZ model:

- **Current policy reference scenario**. We modelled a current policy reference scenario to understand the impact that current policies would have on emissions in Aotearoa over time. This allowed us to assess whether current policies put us on track to meeting the targets. To make sure the results were reasonable, we compared the results of this scenario to the Government's projections released in January 2021 (see *Chapter 6: Long term scenarios to 2050*).
- **Long-term scenarios.** We modelled a series of long-term scenarios that would deliver the 2050 targets. These scenarios helped us to understand what additional effort might be needed to meet these targets, under a range of different future conditions. This showed us how Aotearoa could meet these targets and the actions that would be critical to deliver them (see *Chapter 6: Long term scenarios to 2050).*
- **Paths to 2035 scenarios.** We looked in more detail at possible paths to 2035 so that we could calculate emissions budget levels. These pathway scenarios included the critical actions needed to achieve the long-term targets, determined from the long-term scenarios. We modelled three different paths and we also modelled how sensitive these paths were to key input assumptions. This was to determine that our recommended emissions budgets would be achievable as well as ambitious (see *Chapter 7: Demonstrating emissions budgets are achievable).*

26 Our models factor in interactions within sectors and across the economy. For example, we consider the increased electricity demand from charging EVs, and the need for land to grow the biomass needed to power industry differently.

How we dealt with uncertainty

27 While we have modelled a range of scenarios, and tested different assumptions, it is not possible for any form of modelling to precisely predict the future. Changes in how people live their lives are not always easy to predict, and new technologies are continually developing. We have modelled multiple scenarios to test that there are multiple ways to achieve our recommended emissions budgets and the long-term targets.

28 Uncertainty about what will happen is a normal part of any analysis that looks at the future. There are a number of uncertainties we have factored into our advice – for example where we don't know what the future cost of technology could be, how people's behaviour will change over time, and what will happen internationally.

29 In developing our advice, we have dealt with these uncertainties in several ways:

- By considering a **range of different potential paths** Aotearoa could take to reach our recommended emissions budgets and targets. Each path contains different mixtures of technologies and different assumptions about how people's behaviour may change, which helps to manage uncertainty by showing there are multiple ways the emissions budgets can be met.
- Through **sensitivity analysis** in our modelling. By systematically varying one parameter (or group of linked parameters) at a time, we can see what impact this has on the model output. In this way we can determine which input parameters have the biggest impact, and therefore where the biggest potential risks are.

30 Many things will change and evolve between now and 2035. The budgets and our suggested actions to achieve them do not describe an exact future. However, budgets outline the speed and level of emissions reductions required. This provides government, industry and communities with predictability to invest in building the infrastructure needed, design regulatory settings that work for new technologies and practices, allow markets to develop and mature, and develop our low-emissions know-how and supply chains.

4.2.3 We tested what impacts our emissions budgets could have

31 We looked at what our recommended emissions budget levels would mean for people, the environment, the land, and the economy, both now and into the future. This involved looking at the potential positive and negative impacts of our recommended emissions budgets.

32 We carried out analysis looking at the potential impacts on the economy, different sectors, regions, communities, households, different socioeconomic groups, Iwi/Māori, and different generations. This analysis considered economic, social, cultural, environmental, and ecological impacts.

33 Where there were negative impacts, we considered whether these impacts were manageable or whether they could be reduced or changed through changes to government policy. We looked at the positive impacts and co-benefits, such as to health and equitable access to healthcare, and considered how these could be maximised.

34 In setting our modelling assumptions, we considered the broader 'cost' to maximise benefits and minimise negative impacts. We factored in the lifetime of assets and assumed that assets will be replaced at the end of their useful life to reduce unnecessary cost. We considered emissions reduction opportunities that would:

- Benefit those on lower incomes, such as energy efficiency
- Bring significant benefits to health and health equity, such as walking and cycling
- Reduce congestion, such as increased use of public transport and working from home
- Bring environmental benefits, such as to biodiversity from native forests

4.2.4 We tested how our emissions budgets contributed to the global 1.5°C effort

35 To assess how our recommended emissions budgets would contribute to the global 1.5°C effort, we looked at how paths that would deliver our budgets compared to the IPCC's global 1.5°C pathways.

36 We could not apply these global pathways directly to Aotearoa. Instead we drew out the key lessons and features from the global pathways and considered how these applied in the Aotearoa context.

4.3 The evidence and models that have underpinned our work

4.3.1 Our evidence base

37 A requirement in the Act is to consider how emissions budgets may realistically be met. There is a vast amount of evidence available from within Aotearoa and internationally that has underpinned our analysis.

38 We reviewed a wide range of literature, and engaged widely with government agencies, NGOs, businesses, industry groups and other stakeholders. The more than 15,000 submissions we received during consultation have been invaluable for informing our analysis and advice.

39 We have drawn on international evidence from the likes of the IPCC, OECD, International Energy Agency, International Renewable Energy Agency, Bloomberg New Energy Finance, and the Energy Transitions Commission. We have drawn on domestic evidence such as from the Biological Emissions Reference Group, government entities, private companies, universities, research organisations, and Crown research institutes.

40 We have had to make judgements on what evidence to use and where to set the assumptions in our analysis. We have tested our evidence and assumptions through our technical reference groups and through consultation, and have made amendments in light of this feedback.

41 We have described the evidence we have drawn on in detail in *Chapter 2: What are other countries doing?* of the *2021 Supporting Evidence,* and lay out the amendments we have made to our assumptions in *Chapter 7: Demonstrating emissions budgets are achievable.*

4.3.2 Our models

42 Models are useful tools that can help to quantify the effects of different drivers of a system, and what can affect those drivers and alter outcomes. Models also require us to explicitly state our assumptions and to consider the interactions between different parts of the system.

43 All models are necessarily a simplification of a more complex system and are not intended to represent all aspects of that system in detail. Therefore, it is not possible or appropriate to rely solely on models to guide our advice.

44 We used four models to support our work, three of which were specifically designed for informing us on the transition to a thriving, climate-resilient, low emissions Aotearoa. These models allowed us to understand the scale and pace of the transformation that is possible across all sectors.

- We used **ENZ** to give us the scale of the emissions reductions that are achievable in each sector when factoring in specific technologies and mitigation options. ENZ is an economy-wide model that covers all the main emitting sectors in Aotearoa – energy, industry, transport, agriculture, forestry, product use and waste. ENZ captures the major interactions within the energy system and between different sectors.

  ENZ was developed by Concept Consulting, initially as an energy system model. The Commission purchased ENZ and has worked with Concept Consulting to further develop the model for our needs. Earlier versions of this model have been used by the Productivity Commission, Parliamentary Commissioner for the Environment and Ministry for the Environment. ENZ is described in more detail in the Appendix of *Chapter 11: Where are we currently headed* in *2021 Supporting Evidence*.
- We used the **Climate Policy Analysis (C-PLAN)** model to understand the overall impact of our recommended emissions budgets on GDP and how different sectors could expand and contract. C-PLAN is a global Computable General Equilibrium (CGE) model that takes data on the interactions between various economic actors and introduces a shock to understand how the structure of the economy is affected.

  The C-PLAN model has been built for the Commission and draws on international best practice modelling by Vivid Economics, the Massachusetts Institute of Technology and the European Commission's Joint Research Centre. C-PLAN is described in more detail in *Chapter 15: How we earn our way in the world* in *2021 Supporting Evidence*.
- We used the **Distributional Impacts Microsimulation for Employment (DIM-E)** to understand effects on employment across different sectors, regions, demographic groups and socioeconomic groups. DIM-E is a microsimulation model that takes the economy-wide outputs of C-PLAN and combines them with more granular data from Stats NZ.

  The DIM-E has been built for the Commission by Motu Economic and Public Policy Research. DIM-E is described in more detail in *Chapter 15: How we earn our way in the world* in *2021 Supporting Evidence*.
- We used the **EMarket and I-Gen** models to validate the electricity price results from the coarser electricity modelling approach used in ENZ. EMarket and I-Gen are models built by EnergyLink that together provide insights on how electricity prices change over time across Aotearoa under different scenarios. Under a particular scenario, they consider what power plants would be built and how these power plants would be used throughout the year.

4.3.3 How we model emissions reduction paths

45 The **ENZ** model chooses emissions reduction options over time in one of two ways (Figure 4.4).

46 ENZ models choices around the main electricity, transport, and heating technologies based on their cost. ENZ chooses to adopt a low emissions technology when it is cost-effective to do so. It calculates cost-effectiveness using information on changing costs (such as capital costs and energy prices) and a specified 'emissions value' path, which allows ENZ to factor in the associated emissions cost. Model choices are also limited by resource constraints, such as available biomass supply, and other important factors related to feasibility.

57 For other technologies, we specify the uptake as an input assumption. We do this for choices that ENZ is not designed to model (such as choice of travel mode) and where costs are highly uncertain or may not be a primary driver of adoption (such as energy efficiency). Our assumptions are built from available evidence on the likely costs and benefits of different options, and on achievable rates of change under supportive policies.

48 We develop emissions reduction paths or 'scenarios' by combining a set of assumptions around technology costs, emissions values, and adoption of the various emissions reduction options across sectors.

49 In **C-PLAN**, the model works out the cheapest ways to reduce emissions in each year in order to meet a specified cap on overall emissions. C-PLAN has separate emissions caps for long-lived greenhouse gases and biogenic methane. C-PLAN explicitly models key technologies such as electric vehicles and methane inhibitors for ruminant livestock. C-PLAN also models efficiency changes and fuel switching options.

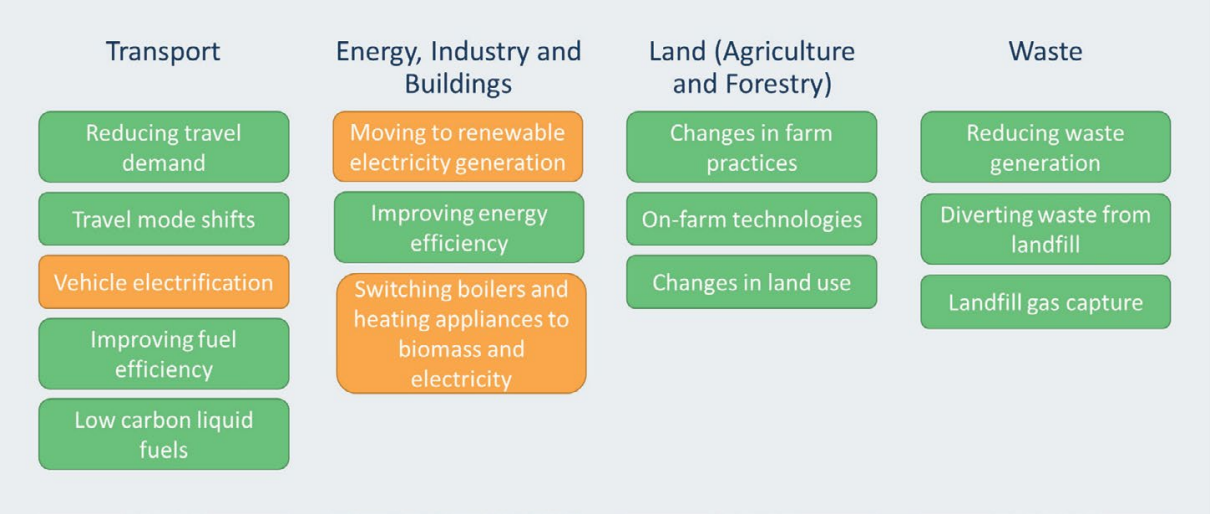

Figure 4.4: Key emissions reduction options represented in the ENZ model. For the options in orange boxes, the model simulates their uptake in each year based on costs, available resources, and other factors. For the options in green boxes, we specify their uptake as an input assumption in each scenario we run.

4.3.4 How we capture opportunities, benefits, costs and risks

50 Under the Act, there are a number of considerations that we must factor in when advising on emissions budgets. These requirements mean that we must take a wider view that looks at the opportunities, benefits, costs, and risks to society. We have not done cost-benefit analysis.

51 In general, we have prioritised actions that reduce emissions at the lowest cost per tonne first. However, this has not been our sole consideration. We have considered broader implications such as the health benefits from more walking and cycling, or the benefits to congestion from more public transport. We have considered the opportunities to develop new markets in low-emissions goods and the risks of losing market access.

52 We have considered future risks related to different levels of climate change and different emissions paths. For example, the amount of carbon stored in our forests could be affected by increasingly extreme weather events, increasing fire danger, and increased incidence of pests and diseases.

53 We also looked at the flexibility and options that could be created, or removed, by making different choices, and how benefits, costs, and risks could change over time. For example, whether the cost of a technology might reduce as it becomes widely adopted, either in Aotearoa or globally.

Box 4.3: Why we have not taken a 'least cost' approach

During consultation, some submitters expressed the view that we should be focusing on reducing emissions at 'least cost'. However, taking a 'least cost' approach is not one of the considerations laid out in the Act. Further, taking an approach that focuses solely on the 'least cost' now does not align with the requirements in the Act.

A solely 'least cost' approach does not align with the split-gas target, which factors in the different nature of biogenic methane. It does not consider the distributional impacts and who the costs fall on. It does not consider the potential impacts on communities, particularly rural communities and the broader food and fibre sector, from the significant amount of forest that would be needed beyond 2050 to sustain net zero long-lived gases.

A 'least cost' approach does not appropriately consider intergenerational equity. For example, using forests to offset gross emissions means there will be an ongoing burden in future to reduce those gross emissions. This will also lock land into forestry over the long term and limit future generations' choices about land use.

4.4 What is covered in the following Chapters?

54 The following chapters outline our advice on the first three emissions budgets.

- *Chapter 5: Recommended emissions budgets* outlines how we have balanced the criteria in the Act, what judgements we have made, and our recommendations on the first three emissions budgets.
- *Chapter 6: Long term scenarios to 2050* outlines long-term scenarios to show how Aotearoa could meet its emissions reduction targets and the actions that would be critical to deliver them.
- *Chapter 7: Demonstrating emissions budgets are achievable* demonstrates possible paths that could deliver our recommended emissions budgets, showing that these budgets would be technically achievable.
- *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable* looks at the potential impacts of emissions budgets on and across the economy and society. It tests whether any negative impacts are manageable, and how positive impacts and co-benefits can be maximised. It shows that our recommended emissions budgets are economically affordable.
- *Chapter 9: Contributing to limiting warming to 1.5°C* looks at how our recommended emissions budgets contribute to the global effort of limiting warming to within 1.5°C of pre-industrial levels.
- *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets* lays out the rules for measuring progress towards meeting emissions budgets and targets.