He Pou a Rangi
Climate Change Commission

Ināia tonu nei: a low emissions future for Aotearoa

Advice to the New Zealand Government on its first three emissions budgets and direction for its emissions reduction plan 2022 – 2025

Te Kāwanatanga o Aotearoa New Zealand Government

Disclosure statement

As anticipated by the appointment criteria, the Climate Change Commissioners come from varying fields such as adaptation, agriculture, economics, te ao Māori and the Māori-Crown relationship.

While a number of board members continue to hold roles within these fields, our advice is independent and evidence-based.

You can read more about our board members on the Climate Change Commission website. The Commission regularly updates and publishes on its website a register of relevant board interests.

Ngā Kōrero Akiaki ki Te Kāwanatanga o Aotearoa: te tuatahi o ngā tahua tukunga hauwaro e toru me te ahunga o ngā whakahekenga hauwaro 2022 – 2025
Advice to the New Zealand Government on its first three emission budgets and direction for its emissions reduction plan 2022 – 2025

Ināia tonu nei: a low emissions future for Aotearoa
Date: 31 May 2021

He karakia

Poua ki runga, Poua ki raro
Ruia, tuia, kokiritia
Kia mau ki a ū
Kia ora ai
He pikinga ki te rangi, kia tu i taiao
He pou e hora, He Pou a Rangi
Kia hora a papa
Hui e Taiki e-e!

We acknowledge Trevor Moeke for composing this karakia.

Ināia tonu nei: the time is now

Tēnā koutou e nga mata waka o te motu. Kei ngā manawa tītī o te motu, ara He Pou a Rangi e mihi ana. E tangi kau tou ana ki a rātou ngā kuku o te manawa kua mene atu rā ki tua o te tatau pounamu. Koutou ngā mate, haere, haere, e oki e. Rātou ki a rātou, tātou te hunga ora ki a tātou, tēnā rā tātou katoa.

I ahau e kōrero atu nei mā He Pou a Rangi, e mihi ana ki tēnei pūrongo e waha ake ana i ngā kupu akiaki ki ngā tūtohinga e tika ana mā Aotearoa, e eke ai te karamatamata, e eke ai te āhuarangi pakari me te itinga o te tukunga hauwaro i Aotearoa nei.

I roto i o mātou kohikohinga kōrero, mai i te 1 o Pepuere ki te 28 o Maehe 2021, i whakaritea e mātou i te koni i te 200 huihuinga huri noa i te motu, ā, i te takiwā o te 4,000 tāngata i uiuitia. I whakarongo ake ki ngā Iwi me ngā mana whenua mō te whakarite noa he aha hoki hei aronga matua ki tēnei pūrongo.

He koni i te 15,000 tāngata i tuku kōrero mai mā tō mātou paetukutuku, mā tō mātou paepāpori-urupounamu ā Iwi a 100 Coastie Voices, mā te poutāpeta me te īmera hoki. E tūtohu mai ana tēnei i te hiahia nui o Aotearoa whānui kia tika mai te āhuarangi. Ko tāna anō, he aro ki ngā kohinga kōrero nei, ā, he rongo kau i te tini me te mano o Aotearoa, e hiahia mai nei kia matatika, kia urutika, ā, kia tautika hoki ki te katoa.

Kua whai te pūrongo nei i te ingoa 'Ināia Tonu Nei: Kia Whakahekea E Aotearoa Te Hauwaro'. Inā rā te taitara e kīia nei me manawanui, ā, me māia hoki i roto i ngā uauatanga ka tukitukia e Aotearoa ā ngā rā kei tua. Me whai rā anō e Aotearoa te tahua me ngā tukanga e taikaha ana, engari me toitū hoki. Nātemea, ko ngā mahi o nāia nei, ka whai pānga ki te oranga tonutanga o ēnei whakareanga, ā, haere ake nei.

Ko tā 'Ināia tonu nei' he karanga mai i a tātou katoa kia ākina te āhuarangi ināia nei hoki, ā, kia mutu rā te tatari mō āpōpō rā anō. Ka taea te āki tika mai i te āhurangi mehemea kua kotahi te ahunga.

I te ahunga mai o te kāhui whetū o Matariki me tāna e tohu mai nei ko te tīmatatanga o te tauhou Māori – koinei anō ko te aonga ake ngā tumanako nui kia houkura ngā rā ki tua. He wā whakahirahira tēnei te taunga mai o te pūrongo nei, ā, he tūtohu hirahira tēnei ki a mātou e whakatere ana i tō mātou whakawhitianga ki te ohanga-whakaheke hauwaro. Āpiti atu, ko tā te ahunga nei he anga ki te pae taurikura, me te mea nei, ka iti tonu te whakapōrearea i te oranga tonutanga o ngā uri.

Kua tae te wā, Ināia tonu nei, kia tika te arahi mai i tā tātou e hiahia nei, ā, kia pūmau i ngā tikanga e here nei i tō tātou ao – anō o te whanaungatanga, te kaitiakitanga me te manaakitanga. E mōhio ana rā he mana nui tō te mahi whakawhanaunga, te aroha tētahi ki tētahi me te whakamiha o te tangata rā anō ki te tiaki i ngā mea e tika ana ki a tātou me o tātou tamariki mokopuna.

Mā te Atua tātou e manaaki. Nō reira, tēnā koutou, tēnā koutou, tēnā koutou katoa.

Dr Rod Carr, Chair and Lisa Tumahai, Deputy Chair

He mihi

Tena I whiua!
Taku pohiri e rere atu ra
Ki te hiku o te ika
Te puku o te whenua
Te pane o te motu ki
Te whakawhititanga i Raukawa
Ki Te Waipounamu e!
Nei Ra, ināia tonu nei!
Hui e-e… Taiki e-e!

Hear now, my call goes out across the land and hails welcome and binds us.

Calling the tail of the fish (Taitokerau), calling the broad hinterland (the puku of the whenua) and everything between.

Calling to the head of the fish, and across the great Raukawa (Cook Strait), south to Te Waipounamu.

Hear then, the time is now, ināia tonu nei! There, it's done.

We acknowledge Ngāti Porou.

Ināia tonu nei: the time is now

Tēnā koutou e nga mata waka o te motu. Kei ngā manawa tītī o te motu, ara He Pou a Rangi e mihi ana. E tangi kau tou ana ki a rātou ngā kuku o te manawa kua mene atu rā ki tua o te tatau pounamu. Koutou ngā mate, haere, haere, e oki e. Rātou ki a rātou, tātou te hunga ora ki a tātou, tēnā rā tātou katoa.

On behalf of He Pou a Rangi or the Climate Change Commission, I am pleased to present this report which details our advice on transitioning to a thriving, climate-resilient and low emissions Aotearoa.

During our consultation phase, from 1 February to 28 March 2021, we held or attended around 200 meetings and events across Aotearoa and talked with an estimated 4,000 people. We also listened to tangata whenua, our Te Tiriti o Waitangi/The Treaty of Waitangi partners, to gather their perspectives.

Over 15,000 people made submissions through our website, through our Iwi/Māori 100 Coastie Voices survey platform, through the post and by email. This response highlights that New Zealanders care about climate change. It also reflects our efforts to consult with, listen to and consider the voices of many thousands of New Zealanders who want to see a fair, inclusive and equitable transition for all.

This report is named ***Ināia tonu nei: a low emissions future for Aotearoa***. It provides advice to the New Zealand Government on its first three emissions budgets and direction for its emissions reduction plan 2021 – 2024. As the title suggests, Aotearoa needs to be proactive and courageous as it tackles the challenges the country will face in the years ahead. Aotearoa will need to ensure budgets and policies are ambitious and achievable, the actions we take today will impact on the wellbeing of current and future generations.

Ināia tonu nei is a call to all of us to take climate action today, not the day after tomorrow. We believe this report sets us on the right path, but we acknowledge there is a long way to go. All levels of central and local government must come to the table with strong climate plans to get us on the right track. Bold climate action is possible when we work together.

As the dawn rising of Matariki approaches and heralds the start of the Māori New Year, so too does a renewed hope for a brighter and prosperous tomorrow.

The time is now, *Ināia tonu nei*, to lead the change we want to see and to remain steadfast to the values that underpin our nationhood—values like whanaungatanga, kaitiakitanga and manaakitanga. We recognise the power of being connected to each other, having an ethic of care, respect in the way we progress, and taking care of things for ourselves and our mokopuna.

Ma te Atua tatou e manaaki. No reira, tēnā koutou, tēnā koutou, tēnā koutou katoa.

Dr Rod Carr, Chair and Lisa Tumahai, Deputy Chair

He Reta nā Te Heamana

Ko tā tēnei rīpoata he rārangi ake i ētahi kohinga kōrero whānui e tautoko ana i tētahi rautaki kia tutuki ai ngā whāinga tukunga hauwaro mō Aotearoa. E kitea ana, he mea nui, ā, me kore hoki i ngā huringa pāhekoheko me ngā huringa ahungaroa, ā, kei te kitea atu hoki me wawe tonu te Kāwanatanga ki te whakarei ake i āna mahi āhuarangi.

Tōna tikanga, he ara whai hua, he ara whai utu, he ara hoki e tōmina ana e te nuinga, koia nei ngā ara ka whāia e Aotearoa kia toiora ai te āhuarangi, me ngā tukunga hauwaro hei ngā rā ki tua. Ahakoa te huhua o ngā whakaaro mō te huarahi tika hei whāinga mā Aotearoa, kei ngā mahi a He Pou a Rangi e whakaaturia ana te kotahi o te whakaaro ki te pae tawhiti, ki ngā hiahia, me te whitawhita hoki kia tutuki ai ēnei mahi.

Ināia tonu nei – a low emissions future for Aotearoa
Ināia tonu nei – Kia Whakahekea E Aotearoa Te Hauwaro

Mōku ake, ko tōku hiahia he tuku kōrero ki aku tamariki mokopuna; i wheeke nei e au, i ngana nei e au, i tōku mōhio noa he aha oti tāku ki tēnei ao o tātou. Kua tae te wā kia mahia ngā mahi i runga i te tika, me te pono.

He tuatahitanga tēnei ā te Komihana ki te hoatu kupu akiaki ki te Kāwanatanga, ā,haere ake nei ēnei akiakinga. E whai ana tēnei i ngā kupu āwhina hukihuki o te Pepuere 2021 me te tūtohu i tā te Komihana ngākau titikaha ki te mahi tahi me Aotearoa whānui. E mārama ana ki te eke ki ngā paeora me whakarongo, me whakautu, ka mutu, me panoni ki tā te manomano tāngata i kōrero mai ki a mātou.

Ki te tutuki i te tika, i te haumako, i te hauora me te toitūtanga ki anamata, ahakoa te iti me te nonoi o ngā mahi tukunga hauwaro, he painga tonu kei roto. Kei a tātou katoa te mahi nui ki te awhi, ā, mā tēnā, ma tēnā e ora ai te kaupapa. Ko tā te Kāwanatanga he whakamāmā ake i ngā aukatinga mā roto i tōna tautoko i ngā hangarau hou, me ngā whanonga e hauraro ai ngā tukunga i a tātou e noho nei, e ora nei i tēnei ao.

Ka kitea i ēnei kōrero akiaki, mā te ahunga hauwaro o ngā tukunga ki Aotearoa nei ka kitea ngā hua ki te ao ōhanga, me te Iwi whānui tonu. Ka ora ake ngā kāinga, ka whāia anō ētahi huarahi hou, ka whānui ake te urunga ki ngā mākete, ka rerekē te whakamahi i ō tātou whenua, me te oranga hoki o te hunga tamariki, me ngā whakareanga kei ngā rā ki tua.

He mahi e ārahina ana e te pūtaiao me tāna anō he whai whakaaro ki te pānga o te rautaki āhuarangi ki o mātou Iwi. Me tautoko rawa a Aotearoa i ēna ka pōkaikahatia me rātou hoki kua kore e rata mai ki ngā panonitanga. Ka taea e ngā tikanga Māori te whakakotahi mai me te ārahi mai i a Aotearoa ki ēnei whakawhitinga āhuarangi nei.

Kua mahi tahi atu me ngā Iwi Māori ki te whakawhanake i a mātou hiahia me te whakahāngai i te tirohanga ā te Māori ki o mātou mahi. He mea nui kia whai wāhi te Kāwanatanga ki ngā Iwi Māori ki te hanga, me te whakatinana i ngā mahere me ngā kaupapa here, mātua rā ko ngā pānga, me ngā āheinga ki te Iwi Māori.

I rongo mātou, mēnā ko te ahungaroa kei te whāia, me taharua ngā mahi ahunga tika, ahunga tōkeke. Mēnā ko ngā pakihi, ngā ahumahi, ngā kaunihera ā-rohe, me ngā hapori kei te mahi tahi me te Kāwanatanga ki te whakatauira i te pāhekotanga o Aotearoa, ko ōu wheako, me ōu hiahia ka kitea.

Ināianei, kua tuku i a mātou kupu āwhina, ā, mā o tātou rangatira anō te rangatiratanga e whakatinana noa, e whakatau noa. Me whakarite rautaki horahora, me whakaheke i te tūpono whakapōrearea, māna, me tū hirahira.

Kua arohaehaetia e mātou te taha pūtaiao me te ohaoha. Kua tirohia te hangarau, me ngā pānga ki te pāpori whānui. Kua rangona ā koutou kōrero mai. Kua whakaritea mai hoki te ara anga whakamua mō Aotearoa. E mārama ana tēnei ara anga whakamua – kua tae te wā kia whakaū i ngā mahi āhuarangi. Ko ā tātou tamariki, ko te ao kei te aro mai.

Dr Rod Carr
Chair

He Reta nā Te Heamana: Letter from the Chair

This report sets out a comprehensive body of evidence to support a strategy for Aotearoa to achieve its emissions reduction targets. It shows transformational and lasting change is both necessary and possible – and makes a clear case for immediate and decisive climate action from government.

There are technically achievable, economically affordable and socially acceptable pathways for Aotearoa to take to achieve a climate-resilient and low emissions future. While there are some differences in opinion on which of these paths Aotearoa should take, the work of He Pou a Rangi the Climate Change Commission shows there is consensus on the end goal, as well as the need, and the urgency, for action.

Ināia tonu nei: the time is now.

For my part, I want to be able to say to my children and grandchildren: I did as much as I could as soon as I understood the impact I was having on this world. It's time to be on the right side of history.

This is the Commission's first advice to Government, and it won't be the last. It follows our draft advice released in February 2021 and demonstrates the Commission's commitment to working with New Zealanders. We understand to achieve real change we need to listen and respond. We have made many changes based on what thousands of you told us during consultation on our draft advice.

To achieve a cleaner, greener, healthier and more sustainable future, no emission reduction is too small – or too soon. All of us have a part to play and a contribution to make, and everyone's contribution matters. We need Government to reduce the barriers we face by supporting new technologies and behaviours to reduce emissions from the way we earn our living and live our lives.

This advice shows that the transition to a low emissions Aotearoa will bring benefits across the economy and to the whole of society. It will lead to healthier homes, encourage new ways of moving around, open up new market opportunities, change how we use our land, and improve the lives and choices of young people and future generations.

This work is led by science and considers the impact that climate action will have on the people of Aotearoa. Aotearoa will need to offer support to those who are most adversely affected and least able to absorb the impact of change. Tikanga values can guide Aotearoa through a climate transition that is inclusive.

We have worked in partnership with Iwi/Māori to develop our advice and incorporate te ao Māori into our mahi. It is critical government work with Iwi/Māori to develop and implement plans and policies, especially where impacts on, and opportunities for, Iwi/Māori are likely.

We heard from you that an equitable and just transition must be co-designed if it is to be enduring. If business, industry, local government, and community design the transformation of Aotearoa alongside government, it will reflect your experience and needs.

Now we have delivered our advice, it's over to elected representatives to show leadership, make some tough decisions, develop a detailed strategy, reduce avoidable uncertainty and take action.

We analysed the science and the economics. We looked at technology and social impacts. We listened to what you told us. And we shaped the direction Aotearoa needs to take to get there. The way forward is clear – the time for climate action is now. Our children and the world are watching.

Dr Rod Carr
Chair

Contents

Part two: Emissions reduction plan advice

Part three: Advice on requests from the Minister of Climate Change

Part four: Supporting information

Introduction

Chapter 1

Te Whakarākei Matua
Executive summary

Ināia Tonu Nei: a low emissions future for Aotearoa
Ināia tonu nei – Kia Whakahekea E Aotearoa Te Hauwaro

1 Kua mana te whāinga a Aotearoa kia korekore te taumata tuku i ngā hauwaro-whakamahana hei te tau 2050, ā, kia whakaheke hoki ko ngā haumewaro mā te 24-47% hei te tau 2050.

2 Ko tā ngā kōrero akiaki e tuku nei, he whakaatu atu a He Pou a Rangi i ōna wawata nui, i ōna whāinga nui, ka mutu, ko ōna huarahi whakawhitinga ki te ora – e taea ai e Aotearoa te tutuki me te whakapau i ōna kaha ki te whakatika i te āhuarangi.

3 I takea mai a Ināia Tonu Nei i ngā whakataunga motuhake ā Te Komihana me te aromatawai pāpono i ngā mātauranga whai take. Kua whakaritea e mātou ētahi kupu akiaki mā roto mai i te rangahau, i te aromatawai, i te whakariterite tauira, i te kōrero whiriwhiri me te whai whakaaro nui. Kua āta whakarite i runga anō i tā Aotearoa i kōrerotia i ngā uiuitanga huri i te motu.

4 E whakaatu mai ana ō mātou whāinga ka taea te timata, me te pono hoki o ēnei kōrero. Kei tēnei whenua tonu ngā hangarau me ngā rauemi e tika ana – kāhore he take o tā Aotearoa tatari ki ngā hangarau kei anamata. Ko tā ngā taunakitanga he whakaatu mai i te pai o te utu, he āheinga atu anō, ā, ki tēnei whakawhitianga kua puare mai ai te nui atu anō o ngā āheinga ohaoha. I o mātou uiuitanga i kitea hoki i te tautoko nui ā ngā Iwi huri i Aotearoa.

5 I te tatunga o ā mātou whakataunga whakamutunga, kua ea tō mātou wawata nui, ā mō nāianei ka taea hoki i tā mātou e hiahia nei. E tautoko ana tēnei i te tūranga o Aotearoa, whai muri i te aronga kore i roto i ngā tau, me te mahi nui me tutuki nei e Aotearoa kia whenua ora, kia taiao ora, ā, kia whenua whakaheke hauwaro mā ngā whakareanga hou.

6 E toru ngā wahanga ki ō mātou kōrero akiaki.

1. Ko ngā reanga kei te tuatahi o ngā tahua tukuwaro e toru, e whakarārangi mai nei i te katoa o ngā tukunga hauwaro-whakamahana kua whakaaetia ki Aotearoa mō te roanga o ngā wahanga rima-tau ki te 2035, e anga atu ana ki ngā whāinga me tutuki mō te tau 2050.
2. Ko te aronga o ngā tukanga me ngā rautaki me whai nei e te Kāwanatanga tōna mahere whakahekenga tuku hauwaro, ā, e whakarite mai nei i ngā tohutohu kia eke ai te whāinga a te tahua tuku hauwaro tuatahi.
3. Ko ngā kōrero akiaki a Te Ahungaroa o Aotearoa me te whakahekenga o ngā hauwaro-whakamahana katoa, he hiahia ēnei nā te Minita Āhuarangi.

7 Ahakoa kei te Komihana te mahi kia hoatu kōrero akiaki ki te āhuarangi, kei te Kāwanatanga tonu te haepapa mō te whakarite i ngā tukanga matua e ahu ai te mahere whakaheke tuku hauwaro me te ahunga o tā Aotearoa e whai nei i te tuatahi o ōna tahua tuku hauwaro e toru ki te tau 2035.

8 I roto i ēnei kōrero akiaki, kua tutuki nei e te Komihana i tā te ture Whakatika Āhuarangi e kī mai nei. Ko tā te ture nei he whakarite i ngā whāinga me te huarahi whāia. Ko tā mātou he hoatu noa i ngā kōrero motuhake mā roto mai i ngā kōrero whai take hoki hei aruarunga tika mā Aotearoa, ā, kāhore hoki he utu.

9 Kei te Kāwanatanga ināianei te whakarite i ngā tahua tuku hauwaro me te whakahau i ngā tohutohu kei te rautaki whakaheke hauwaro.

Te tutuki i te wawata me te tika o te whakahau

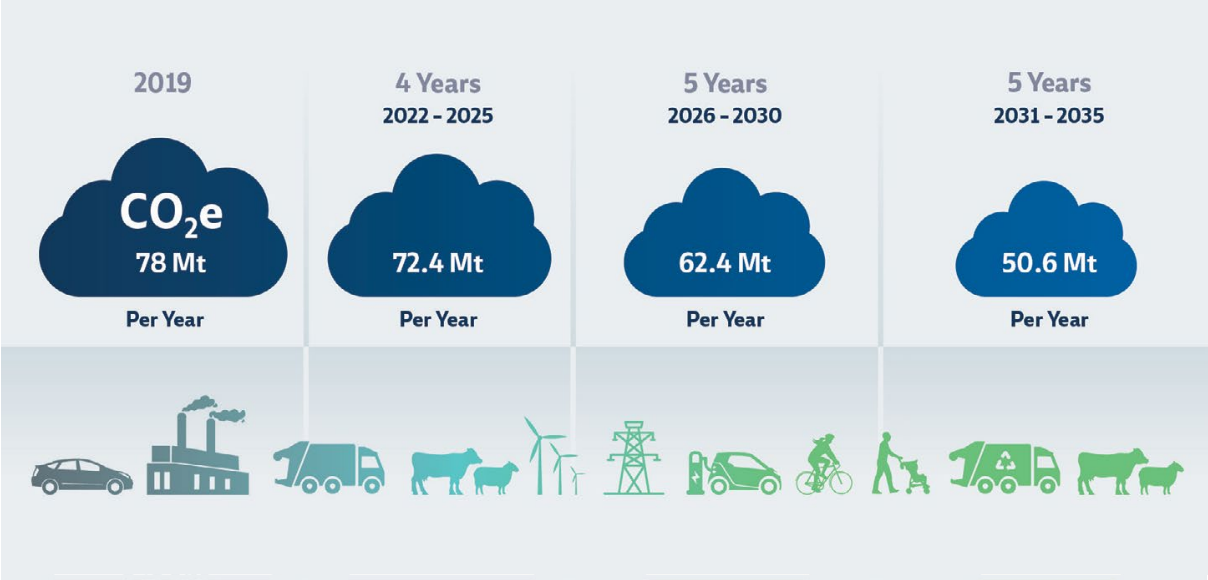
10 I whāia e mātou ngā tohutohu katoa i kitea ki te ture, anō o te whakawhanake i ngā tahua tuku hauwaro me te whakataurite atu ki ō mātou wawata mō te nāia tonu nei. Kua whakaritea kia whakaatu atu he aha oti ngā ahunga ka taea e Aotearoa, kia tutuki i ngā whāinga hauwaro-whakamahana me ngā haumewaro, ā, e hāngai ana ki te rautaki tauroa.

11 Kua whai nei e mātou i ngā huarahi maha kia tutuki i ngā whakahau a ngā tahua tuku hauwaro. Kua whakatauria e mātou ēnei huarahi mā te whakamahinga o ngā hangarau maha kia kite i te rerekē o te āhua ka kitea rāpea ā te tau 2035. Ko tā ēnei tahua he whakaatu mai i tōna pīngore me tōna pakari ki ngā whakarerekētanga ohorere.

12 Ko tā mātou hiahia nui kia whakahīhī te Kāwanatanga, kia nukutere i tōna anga whakamua, ā, e āhei ai pea te tutuki i ētahi whāinga tuku hauwaro nui, ā, kia tau hoki i te mōhio kua kore hoki e whakatāroa anō ēnei mahi whakatika i te āhuarangi.

13 Mai i te oroko kōrero kōhukihuki, kua homai a Greenhouse Gas Inventory ngā matapae tuku hauwaro mō Aotearoa. Kua piki ngā tuku hauwaro tawhito hei whakaatu i te mahi a ngā pūtaiao hou. Hei tapiri noa, ko tā te rōpū nei he whakaatu mai kei te piki tonu ngā tuku hauwaro a Aotearoa.

14 Ko tā ēnei kōrero hou ka uaua hoki tō mātou whai i ngā hiahia ki te tau 2050. Nātemea, kua āmenehia o mātou tahua tuku hauwaro, ā, kua piki ake ngā nama i kitea ki ngā kōrero kōhukihuki nā te rerekē hoki o te wāhi timata.



Emissions budgets 2022 – 2035 (AR5) annual average emissions

15 Kei ia tahua, ka kite atu i te whānui o ngā whakaheke tuku hauwaro. I whakatauira atu ētahi huarahi e tāea ai e ngā tahua. Ko ō mātou tauira he whakatauira hoki i ngā tahua e tika ana mā Aotearoa, ā, kia 65% te whakahekenga o ngā hauwaro whakamāhana me te 17% te whakahekenga o ngā haumewaro hei te tau 2035.

Change in emissions compared to 2019 from our modelling (AR4)			
	2025	2030	2035
Long-lived gases (net)	-15%	-38%	-63%
Biogenic methane	-8%	-12%	-17%
Total	-12%	-27%	-42%

Kāhore i te huarahi tika!

16 Nā te whakamana i ngā mahi e tika ana mā te āhuarangi, kua whakamana hoki e ngā kāwanatanga hou i te nunui o ngā tahua tuku hauwaro. Engari ahakoa te rerekē o ngā whāinga, he kotahi tonu te whai, anō o te whāinga paetata ki ngā whakatō rākau me te hoko i ngā hauhakenga o te moana, atu i te whai i ngā ahunga whakahekenga hauwaro ka kitea ki tōna mātāpuna.

17 Nā te kore hoki i whakatū tukanga e whakakore ai i ngā ohaoha hauwaro me te whakawhanake i ngā hangarau me ngā tikanga whakaheke tuku hauwaro, i whakamahia kētia e Aotearoa ngā ngahere i whakatō i ngā tau 1990 hei tūtohu tīmata i ōna mahi whakahekenga tuku hauwaro. Ko ngā hauhakenga o ngā hauwaro kei ēnei ngahere, ākuanei kua mutu. Ko ngā tahua whakahekenga tukuwaro nei kua piki ki te 26% mai i te tau 1990, ā, kua heke a Aotearoa ki tētahi tūnga uaua mēnā rā i moata te whakatū i ngā kaupapa, ngā rautaki me ngā mahere whakaheke tuku hauwaro.

18 E kite mai ana, kei ngā tukanga a te kāwanatanga o nāia nei kāhore oti i te tutuki i tā Aotearoa me whai nei, arā i tā te Komihana i ōna tahua whakahenga hauwaro, i ōna whāinga hoki mō te tau 2025. E tutuki ai ngā whakahau nei mō te tau 2050 me whai hoki ko ngā mema toa hei āki tere mai i tētahi rautaki aroā.

Te ahunga pae tawhiti hei āki i te toitūtanga o ngā whakahau

19 Ko tā ngā rautaki paetata kua tutuki i a Aotearoa, he mea whakatika i te āhuarangi o nāia nei. Ko te tahuaroa o te oranga he tauroa, ā, me matua mōhio ngā Iwi i te ahunga me te tere o tōna haere e utu tika ai i ngā mahi o ia rā, o ia rā. Me whakapau kaha ināianei, e kitea ai ngā hua o āpōpō.

20 Kua hoatu ki te Kāwanatanga o nāia nei te whakahau kia whai tautoko i ērā atu rōpū tōrangapū e mana ai ngā tahua nei, ā, kia tautohe hoki i tēnei take ki rō Pāremata. Me mana te tautoko me ngā kupu tautoko i te kaupapa toitū nei e ngā mema pāremata hei kōrero tūmatawhānui.

Te Takapauwharanui – te āhua tuku i ngā whakahekenga tuku hauwaro whānui

21 E pai ai, ā, e toitū ai ngā whakahekenga tuku hauwaro, me whakarite pūnaha e tika ana ki ēnei mahi tuku hauwaro.

22 E tutuki ai ngā tahua nei me whai tautoko nui. Ā, me tika te titiro ki ngā rōpū e taea te tautoko i te wawata kia whenua whakaheke tuku hauwaro a Aotearoa, rawa atu me whakahau i nāia tonu nei. Ko tā tēnei hoki, e ora ai tēnei kaupapa me eke ai te taha ki te hapori, ki ngā mahi tōrangapū, ki ngā manatū hoki. Nātemea, koinei tonu te herenga matua e kitea ai te toitūtanga o te ora.

23 Ka taea e te Kāwanatanga te ākina a Aotearoa mā te hoatu i te nunui o ngā whāinga hei whakaheke i te tuku hauwaro ā te wā, ā, kia whakarite hoki i ētahi kaupapa e tautoko ai te rangahau, te whanaketanga me te auaha mō te whakaheke tuku hauwaro anō te take.

24 Me tūpato, i roto i ō mātou hiahia kia whakaheke wawe i ngā tuku hauwaro, kua kore hoki e tika ai te taha ōhanga hei tautoko mai i ngā mahi whakahekenga tuku hauwaro ā ngā rā kei tua. Ko tō mātou whakahau he tohu i te iti o te whakaheke tuku hauwaro i te tuatahi, kātahi ka piki te tere o tōna tuku. He whakaatu atu tēnei i te roa o te wā hei tutukinga mā mātou.

25 He nui tonu ngā whakapōrearea mō te taha ki wā ka tau mai ētahi hangarau whakaheke tuku hauwaro ki tēnei whenua, ā, he aha hoki ētahi huarahi hei whāinga mā Aotearoa e tere ai tōna hangahanga.

26 Hei tōna tīmatatanga, ka roa te terenga, ā, ka roa hoki ngā hua ka kite ki ngā whakahaerenga matua katoa. Hei tauira, mō te taha ki ngā waka-hiko ka roa hoki, ā, ka roa hoki te whakarite i ngā toa hokohoko ki ngā hangarau hou nei, ko te tatunga hoki o ngā waka hio EV ki tēnei whenua, te whakarite huarahi hiko me te whakatō whare hiko, me te whakarite kia māma ai te utu ki te katoa.

Te Whakarite – kia toitū te kaupapa

27 Ko tētahi o ngā tino uauatanga ki ēnei kupu akiaki, ko te tau o te noho ki te ahunga o ngā mahi nā te iti o te whakapau kaha i roto i ngā tau me te whakarite kia toitū tōna haere. Me whakatere e Aotearoa, e tika ana hoki ki ngā Iwi ki te whakarite i a rātou anō, me te mea nei, kāhore oti e whakataimaha ana, ā, kāhore oti e whakapōikaha ana i te pani me te rawa kore.

28 Ki te pōturi te haere ka whakataha ko te mahi nui ki te whakatika i te āhuarangi, ā, ka noho ki o mātou rangatahi me ngā whakareanga e haere ake nei. Ko tā te nui o te rangatahi i kī mai, kua waiho kē mai e ngā kaumātua me ngā mātua i te haepapa nui ki a rātou, ā, i tō ngā tuākana koretake.

29 Ahakoa hoki, ki te hohoro te haere ka kino pea te pānga ki ngā Iwi. Kua ngaro pea i ētahi tūranga mahi, ā, kua kapi pea ētahi wāhi mahi, ētahi pakihi hoki – ahakoa rā ngā tukanga tika me te roa o te wā hoki. Kua whakaiti pea i te tautoko a ngā hapori me te whakatāroa i ngā mahi whakawhitiora nei. Mā te eke o te ohanga ki te karamatamata, mā te whakaratarata o te hapori ka eke hoki ngā whakareanga o nāianei me ngā whakareanga kei tua, ā, o roto i ngā tau ka kite i ngā hua o ngā mahi whakaheke tuku hauwaro nei.

30 E tutuki ai o mātou tahua tuku hauwaro, me eke ki te whāinga matatika, te whāinga tautika me te whāinga urutika. Hei whakamarama noa, me whakatika nei e te kāwanatanga te tūpono o te pānga kino me te āki hoki i ngā āheinga pai ka kitea e te whakaheke tuku hauwaro.

31 Ko te whakawhitianga ki tētahi ao whakaheke tuku hauwaro, he mea e tāea e te ohaoha me te whakaratarata hoki ā te tangata. E tutuki ai i tēnei kaupapa, me whakatere tika, me whakarite tika, me tohutohu tika, ā, me kotahi te whai ā ngā rōpū whai mana. Me whakarite tahi nei me ngā Iwi Māori, nātemea he Hoa-Tiriti tēnei ki te Karauna. Hei tēnei anō, he whakakotahi mai i ngā kaunihera ā rohe, ngā rōpū whakarite ōhanga ā rohe, ngā pakihi, ngā hungamahi, ngā uniana, ngā Iwi hauā me ngā rōpū hapori.

32 Engari, ko ētahi kei ngā hapori ka kino ake te pānga ki a rātou, ā, me eke te tukanga ki ngā oranga o ēnei hunga.

33 Mō te taha ki te Ahumahi, ka rerekē rawa atu i tō Aotearoa ahu ki te whakaheke tuku hauwaro. Mō te nui o ngā kaimahi me hoki ki te ako kia whiwhi pukenga hou, e taea ai te mahi ki tētahi ao e whai nei i ngā tikanga whakaheke tuku hauwaro. Heoi anō ko ētahi atu, ka uru ki ētahi atu tūranga kei te ao Ahumahi.

34 Me whakatō te Kāwanatanga ētahi tukanga hei tautoko i ērā e pōkaikaha nei, ā, me māmā hoki mā rātou. He mea nui tēnei, te whakaū i te matatika me te urutika a te whakawhiti tuku hauwaro nei, ā, me kaua rawa te kaupapa e tō mai anō i ngā raupatu ō mua me te whakatenatena i ngā nawe o nāianei. Me whai waahi mai e ngā rōpū kua pōkaikaha ki te kaupapa i tōna timatatanga, i tō te hangahanga-tukanga.

35 Ka rerekē te pānga a te whakahekenga tuku hauwaro ki tēnā Iwi, ki tēnā Iwi, ā, mō te taha ki te Kāwanatanga kei te āhua hoki o te hanga i te tukanga me te āhua o te wā ki ngā tukanga. Inā rā ngā kōrero akiaki he hoatu i te ahunga o te tukanga, kua whakawhāiti mai mātou ki te hanga punaha e tika ana, ā, e toitū ana.

36 I rangona hoki mō te taha ki ā mātou mahi ka nui kē te utu ki a Aotearoa. Ko tō mātou urupare, kua hoki ki te wetewete i te pōhēhē, kua whakamātau anō i ngā tauira, ā, kua whakamātau anō i te kaha o ngā whakaterenga. Kei tō mātou whakatau matua – e whakahī katoa ana i o mātou whāinga ka taea e Aotearoa te whakaheke tuku hauwaro me te whakatupu hoki i te ōhanga hei whakapiki hoki i te oranga.

37 Kua tirohia e mātou, ko te inenga Utu ki Ngā Hua ā Motu (GDP) ka heke mā te takiwā o te 1% ā te 2050, ā, kua kore e neke noa. Kei te rite hoki tēnei ine ki ngā taunakitanga kei tāwāhi. Inā rā te penapena pūtea ki ngā hangarau me ngā tikanga tuku hauwaro ka kitea ētahi āheinga hou me te whakaheke o te tūpono ki te mana o Aotearoa mō tōna korenga ki te whakatika i te āhuarangi. Heoi anō, ki te whakatāroa anō i ēnei whakahau matua, ā, pēnā i te whai waka-hiko me te whakauru tikanga ahuwhenua e tika ana ki te taiao, ka kite pū anō i te heke o te inenga GDP mā te 2.5% ā te 2050.

Te Toitūtanga – te whakarite tika i te ahu o te tukanga

38 Ko te rautaki whakaheke hauwaro ā te Kāwanatanga, me homai whakautu ki ēnei kōrero akiaki me te whakarite i tētahi rautaki whakahirahira, e tatu ai ētahi tukanga hou e tika ana ki te whakawhitianga ki te whakaheke tuku hauwaro.

39 Ko tōna tikanga ka eke te rautaki ki te waha i ngā āheinga ki te whakaheke i te tuku hauwaro i nāia tonu nei me te whakapakari ake i te motu mō te whakahoro i ngā mahi whakaheke hauwaro ā te wā. Me mōhio a Aotearoa i ngā ahunga tika ki te hautū waka, ā, me tika te taenga atu o aua tohutohu hoki. Me tau ngā whakaaro e tutuki ai ngā whakataunga e tika ana ki te āhua o tō rātou noho, tō rātou mahi, ka mutu, tō rātou ao.

Inā rā te ahunga o ngā tukanga, i kohikohi nei e mātou ētahi utu e tika ana ki tō nāianei me te utu e tika ana ki ngā hangarau maha. I whakamātauria e mātou ētahi huarahi, me te kohikohi kōrero ki te ahunga tika o te wā me te ahunga tika ki te taiao e eke ai ngā whāinga 2050.

40 I hōmiro hoki te titiro ki ngā tukanga āhuarangi o Aotearoa, kia kite hoki i ētahi wahanga, i ētahi uauatanga, māna anō ko ētahi āheinga. I whiriwhiria e mātou te utu kia toitū te kaupapa. Mō te taha ki ia rāngai me ngā rāngai tūmatanui katoa, i kitea rā ngā uauatanga mō te whakaheke hauwaro, ā, he aha hoki te rautaki e utu tika ai ētahi kaupapa mō te wā roa.

41 I ētahi wahanga, pērā i te hono mai a Te Mana Rauhī Taiao (NZ ETS), he mea nui te urunga mai a ngā mātauranga whai take hei ārahi noa i ngā tukanga. I ētahi atu wahanga, ā, pērā i ngā tukanga tē aro i ngā tukanga āhuarangi i roto i ngā tau, ko tā mātou he aro tika atu ki ngā kaupapa whai hua.

42 Kua whakarite i ngā whakahau kia kite atu i te kaha o te ahunga mākete e hauraro ai te utu me ngā tohutohu ki te whakahekenga hauwaro. He rauemi whai mana Te Mana Rauhī Taiao. Engari, mā te Kāwanatanga tonu te mahi nui kia whakauru i ngā tikanga hei oranga ki te tangata, hei oranga hoki ki te utu mākete.

43 Ko ngā rangahau me ngā kōrero tuku iho kei tāwāhi he tohutohu i tā te kaupapa whakaheke tika i te hauwaro, me te whakauru i tētahi pae-aroā e noho kotahi nei ngā tukanga taiao me ōna utu. Ko tā mātou hoki ki te Kāwanatanga, me mau nei e tōna mahere whakaheke hauwaro i ētahi tohutohu ki te kaupare i ngā uauatanga me te whakaū i ngā tikanga auaha me ngā tikanga whakarite kaupapa toitū.

44 Me aro i ngā mātāpono kei Te Tiriti o Waitangi. Ā, me aro hoki i ngā pānga ka whakawhiwhingia e ngā uri, e ngā hapori, e ngā kaimahi, e ngā pakihi me ngā whānau. Me aro ngā tukanga ki te whakapūmau i te matatika, i te tautika me te urutika a te katoa.

45 Hei whakamutu ake, kei ngā kupu akiaki (kei te wahanga tuarua o tēnei pūrongo) he takune iho i ētahi tino tohutohu. Kei raro ko ngā whakarāpopoto. Ko tā te Kawanatanga mahi he whiriwhiri he aha hoki te hanga me te urutanga o ngā tukanga, hei tā ēnei tohutohu nui.

Key elements of our policy direction
Work in partnership with Iwi/Māori, and with local government, to ensure the transition to a low-emissions economy is firmly rooted in the principles of Te Tiriti o Waitangi/The Treaty of Waitangi.
Send clear and consistent signals about how Aotearoa will transition to low emissions and work together across political parties, government agencies and local government.
Improve the New Zealand Emissions Trading Scheme so that it provides stronger market incentives to drive low-emission choices.
Make sure all government policy and investment decisions support the transition to low emissions.
Drive system transformation by supporting innovation, mobilising finance for low-emissions investments and supporting behaviour change.
Increase the circularity of the economy and develop a thriving bioeconomy that delivers emissions reductions.
Take action to reduce emissions from existing and new urban areas and improve understanding of how changes to urban form and function can reduce emissions.
Provide affordable, reliable and convenient low-emissions alternatives to high-emission vehicles.
Introduce measures to make sure vehicles entering the fleet are efficient and to accelerate uptake of electric vehicles. Create options to decarbonise heavy transport and freight.
Develop a national energy strategy to decarbonise the energy system and introduce measures to make sure the electricity sector is ready to meet future needs.
Accelerate the switch to low-emissions fuels for process heat and drive energy efficiency improvements. Develop a plan to transform buildings to be low emissions.
Reduce emissions from waste, through measures that reduce the amount of waste generated and increase resource recovery.
Introduce policies, incentives and tools to speed-up emissions reductions from agriculture. Support farmers to identify changes and put them in place. Invest to open up more options for deeper emissions reductions.
Reduce reliance on forestry carbon removals and manage the impacts of afforestation.
Incentivise the reversion and planting of new native forests to create an enduring carbon sink.
Support a Māori-led approach to an equitable transition for Iwi/Māori and the Māori economy.
Design an equitable transitions strategy that results in a fair, inclusive and equitable transition.

Ngā panonitanga – me whānui tōna horapa

46 Inā rā te whakawhiti kia whakahekea e Aotearoa te hauwaro, ka panoni hoki te āhua ki te whakaputa ngao, te āhua ki te haere a te tangata, ki te āhua noho a ngā hapori me te ahunga o ngā pāmu. Ka kitea ētahi panoni ki te tangata me ngā tikanga whakahaere i ngā pakihi, ka rerekē hoki ētahi punaha tukanga, punaha hangarau hoki.

47 Kua tohutohu nei e mātou kia anga tika atu ngā mahi āhuarangi ki ngā rāngai kāwanatanga. Ko tāna, he tohutohu i ngā Minita me ngā ratonga, me tō haepapa nui, kia whakatinana i ngā tukanga me ngā rautaki whakaheke hauwaro, ā kāti, me tika hoki te noho ā ēnei haepapa ki runga i a rātou. Ko tā mātou anō, he whakahau i te kaupapa Vote Climate Change me te uru motuhake ki ngā ratonga whānui, e whakakotahi mai ai ngā rawa o nāianei rā anō ā te kāwanatanga ki te pūmautanga i ngā ture me ngā ahunga e tika ana ki te āhuarangi tika.

48 Kua aro tika atu o mātou whakahau ki tā te kawenata o Te Tiriti o Waitangi, ā, ka noho hei mataika i te rangamahi e whakawhiti atu ana ki te whai i te oranga toitū ki Aotearoa nei. Ko tā tēnei hoki e whakapūmau nei, ko te whakawhiti ora a te Iwi Māori, me te aronga kia whakaiti i ngā mamae ā ngā raupatu, māna he whakatika i te ahunga atu anō o ōna uri ki te karamatamata o te ora.

49 Kua rangona ngā hiahia a te Iwi Māori kia eke te kawanatanga ki te whakapūmau i te mana o tēnei whakahoahoa ā te Karauna ki te Māori. Mā roto mai i te āki nui kia noho a ngāi Māori ki ngā tūranga teitei, ka mutu, ngā tūru whai mana. Kua whakatinana Te Komihana i te tauira He Ara Waiora hei tohutohu mai i te ahunga o ngā tikanga mahi tahi ā te kāwanatanga ki te whakarauora i ngā tukanga kia whāia ko ngā tikanga Māori, hei oranga hoki mā te Iwi Māori.

50 He nui atu anō ngā painga a ngā mahi āhuarangi nei, pēnei i te taha hauora – nātemea ka mahana, ā, ka maroke pai nei ngā kāinga, ka piki te taha ki te hīkoi me te eke pahikara, ā, ka iti ake te haukino ki te āhuarangi. Ko tā enei painga hoki, he kite tika atu i ngā hua pai me te piki wawe mai o te ora a te tangata mō nāianei me ngā rā kei te heke mai.

51 Kāhore hoki te whakaheke hauwaro-whakamahana i te arotahi, kei te aronga o tana whakawhitianga ki te ora te mahi nui. Me takahi a Aotearoa i te huarahi e toitū ai te ora, ā, e pakari ai te tangata. He mātāpono nui ki te Iwi Māori.

52 Kei reira ngā aronga matua me whai nei e Aotearoa mēnā rā e hiahia ana ki te tutuki i ōna whāinga. Kua whakarite i ētahi huarahi e whakamātauria ana ā mātou tahua whakaheke hauwaro, e whakapūmau ana hoki i ngā aronga matua, me te whakamātau hoki mēnā ko te pōturi o te whanake hangarau, ko te whakarerekē waiaro rānei te take o te whakarerea i te kaupapa.

53 E ora mai ai tētahi kaupapa me titiro hoki i ōna pōhēhētanga. E whakawhiti atu ai kia whakahekea e Aotearoa te hauwaro me titiro hoki ki ētahi atu hangarau me te tokomaha hoki. Rawa atu i ngā mea kua whakatauira kētia, ā, ki tā te rere hoki a te ōhanga.

54 E whakaatu nei ō mātou tahua tuku hauwaro hoki i te momori me te maha o ngā huarahi ka taea e Aotearoa. He whakatau tēnei i te pono me whakaiti noa i ngā tūponotanga whakapōrearea, ā, kua kore e whakaroaroa hoki ngā mahi whakaheke tuku hauwaro.

Ko tā te ao e titiro nei i te whakapau kaha a Aotearoa

55 I ngā kohikohinga kōrero, ko ngā kupu me ngā urupounamu he aro ki te urunga o ngā tahua whakaheke hauwaro kōhukihuki e hāngai ana ki ngā whakapau kaha a te ao, ā, kia kaua e hipa atu i te whakamāhana i te 1.5°C, inā rā te whakatau a Te Ahungaroa o Aotearoa kāhore te whakataunga Parī i pērā noa.

56 E tutuki ai Te Ahungaroa, me whai i ētahi tukanga i tāwāhi. Ehara i te mea me iti rawa te mahi ā motu, engari me piki ake te whakapau kaha a Aotearoa ki tua atu o te wā kāinga.

57 Kei tā mātou e kite nei, kāhore hoki ngā whāinga a Te Ahungaroa e rite ana ki ngā whāinga o te whakaheke hauwaro-whakamāhana ki te 1.5°C.

58 Kua mana te ahunga o Aotearoa kia whakaheke i ngā hauwaro ki te 30% ki raro iho i tō ngā taumata 2005, tae noa rā ki ngā tau 2021-2030. E tika ai te mahi a Te Ahungaroa kia 1.5°C te whai, me eke ngā whakahekenga hauwaro mā te koni i te 36% ki raro iho mai i ngā taumata 2005, mō te tau 2030.

59 Heoi anō, kua kore te pūtaiao i tōna kotahi e tohu mai i ngā inenga e tika ana mā Aotearoa ki ngā whāinga a te ao. Me uru mai ngā kōrero a te hapori me ngā whakatau tōrangapū ki ngā tukanga ā te ao mō te mana taurite. Mā te Kāwanatanga o te wā te whakatau hoki.

60 Kua kitea i te ao whānui, i te mana nui o ngā whenua ki te tutuki i ngā whakahekenga hauwaro. Ahakoa he iti kē te mana o Aotearoa i tāwahi, he nui tonu te ōrau tāngata. Ko tā ngā whakahau nei he ahunga nui – engari ka eke rā anō Te Ahungaroa. Ko tā Aotearoa me ana mema tōrangapū mahi nui he āta whiriwhiri he aha kau te huarahi anga mua ki te urupare nui o te ao.

E pakari ake nei te hiahia

61 I te orokohanga mai o te komihana motuhake, o He Pou a Rangi i kite atu i te hiahia nui o Aotearoa kia pakari ōna whakariterite ki te whakaheke i te tuku hauwaro.

62 I whiriwhiria ngā whakaaro a te 15,0000 tāngata me ngā ratonga i tuku kōrero mai ki ō mātou kōrero kōhukihuki. He 4,000 tāngata hoki i haere mai ki ngā huihuinga a te Komihana me te tuku i o rātou wawata nui kia whakahekea e Aotearoa te hauwaro.

63 I roto i ēnei whakaritenga katoa, i rongo i tā Aotearoa whānui tautoko i te hiahia kia wawe te whakatika i te āhuarangi. Ahakoa hoki te rerekē o ngā hiahia, anō o te utu ki tēnei kaupapa, me te āhua o te noho o Aotearoa i te ao nei, ko tā mātou e whakapono nei e pakari ake ana te hiahia kia toitū ko te ora.

64 Ko te hiakai tēnā e rangona ana i te pānuitanga whakamutunga ki te ture Kore Hauwaro. Kua kite nei i roto i ngā marama e 18, kua kōrero ki a Aotearoa me te kite atu i tō rātou hiahia, me tō rātou urunga ki ngā tūranga teitei. E mārama ana te kite atu i tēnei ki ngā pakihi, ngā rōpū me te ao whakahiato ora, ngā hapori me ngā kairangahau.

65 Ko tā mātou hoki, me panoni e ngā mema tōrangapū ngā ture me ngā punaha kia māmā ai mā ngā Iwi me te ao ahumahi, kia pai ai ngā whiriwhiringa take whakaheke hauwaro.

66 I konei, ka tirohia te huarahi ki 2050. Ki te aromatawai i ngā mahi a te Kāwanatanga me te korenga o ngā tukanga te eke ki tā ngā tahua tuku hauwaro e kī nei, kua akiaki anō i a rātou me te whakahoki kōrero ki te katoa o Aotearoa.

67 Ki te kore te Kāwanatanga e aro mai ki ngā tahua tuku hauwaro me ngā whakahau ā tēnei pūrongo akiaki, me whakaputa tumatawhānui nei ō rātou urupare. Ahakoa aha, ko tā te Komihana he aromatawai i tā Aotearoa e tutuki nei.

68 Ko tāna anō, he wero i te Kāwanatanga mēnā rā kāhore hoki i te eke ki tā ngā whakahau whakaheke hauwaro e whai nei. Ki te kore e whakaae ki tā ngā tukanga e whai nei kua wero anō mātou, ā, kua tohea mō te ahunga o te ora te whai.

Te Whakarākei Matua
Executive summary

Ināia Tonu Nei: a low emissions future for Aotearoa

69 Aotearoa has committed to reaching net zero emissions of long-lived greenhouse gases by 2050, and to reducing biogenic methane emissions between 24-47% by 2050.

70 In delivering this advice, He Pou a Rangi the Climate Change Commission (the Commission) has presented ambitious, achievable and equitable paths that Aotearoa can take to meet these targets and contribute to global efforts to address climate change.

71 *Ināia tonu nei* is based on the Commission's independent judgement and impartial assessment of the evidence base. We have developed our advice through extensive research, analysis, modelling, engagement and deliberation. It has been refined based on what New Zealanders told us during a nationwide consultation.

72 Our analysis shows the transition can begin in earnest. The technology and tools the country needs to get there exist today – Aotearoa does not need to rely on future technologies. The evidence has shown the transition is affordable, brings many other benefits, and opens up new economic opportunities. Our consultation demonstrated that the transition has broad support from people across Aotearoa.

73 In reaching our conclusions we have balanced the need to be ambitious with what the evidence shows us is achievable now. This reflects the position Aotearoa is in after years of delayed action, and the work the country must do to pass on a thriving, climate-resilient, low emissions Aotearoa to the next generation.

74 There are three parts to our advice:

1. the levels of the first three emissions budgets, which step down the total amount of greenhouse gas emissions allowed in Aotearoa over five-year periods to 2035, charting a course towards meeting the 2050 emissions reduction targets (2050 targets).
2. direction on the policies and strategies needed in the Government's emissions reduction plan, which will detail actions for meeting the first emissions budget.
3. advice on the Nationally Determined Contribution (NDC) and the eventual reduction in biogenic methane, as requested by the Minister of Climate Change.

75 While it is the Commission's role is to provide advice on climate action, it is the Government's responsibility to determine the specific policies that will form the emissions reduction plan and to set the first three emissions budgets to 2035 for Aotearoa.

76 In presenting this advice, the Commission has carried out the role laid out for it in the Climate Change Response Act 2002 (the Act). The Act sets the targets and the process. We provide the independent, evidence-based advice on how to reach the targets in the best interests of Aotearoa, and do not come with vested interests.

77 It is now over to the Government to set emissions budgets and commit to the necessary action in its emissions reduction plan.

Balancing ambitious and achievable action

78 We have used all the considerations set out in the Act to develop emissions budgets that balance ambition with what is achievable now. We have worked to show how Aotearoa can meet its targets for long-lived greenhouse gases and biogenic methane in a way that is focused on the long term. This recognises that Aotearoa needs to reach the 2050 target and stay there.

79 We have demonstrated there are multiple ways to achieve our recommended emissions budgets. We have tested their sensitivity using a series of possible paths outlining different rates of technology and behaviour change to 2035. These show the budgets are flexible and resilient to unexpected change.

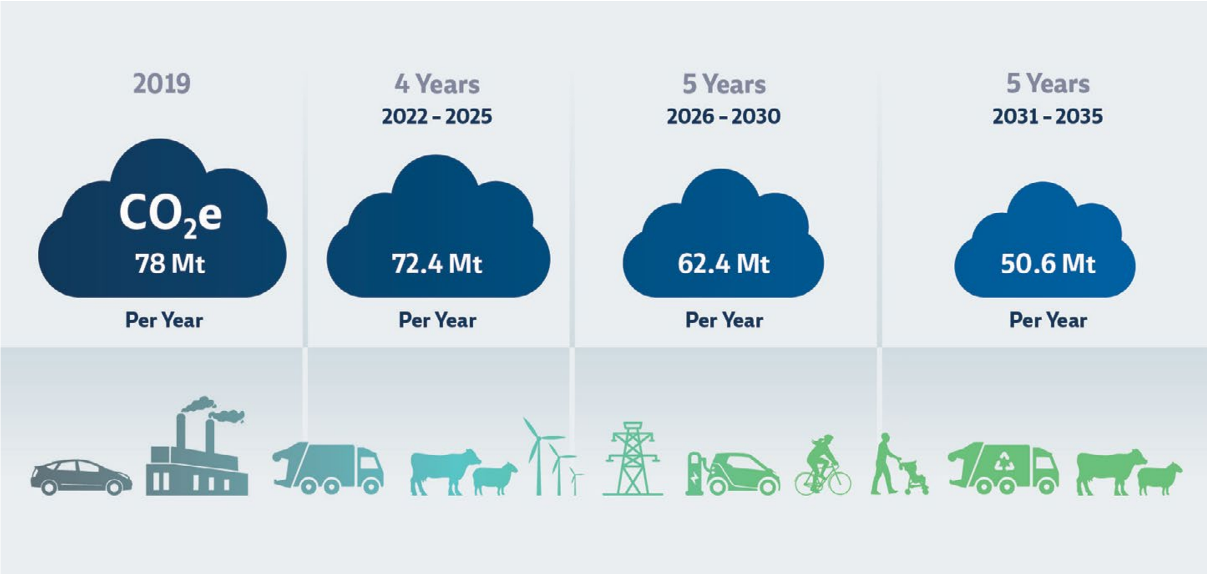
80 We want to give the Government confidence to move quickly to make the most of new opportunities that could lead to deeper emissions reductions, and ensure uncertainty about the future does not stall or delay climate action further.

81 Since our *2021 Draft Advice for Consultation, New Zealand's Greenhouse Gas Inventory 1990-2019* has provided updated estimates of emissions in Aotearoa. Historic emissions have been increased to reflect the latest science. In addition, the Inventory shows that the country's emissions are still increasing.

82 These updates mean that meeting the 2050 targets will be harder. Because of this, we have amended our emissions budgets, which are now slightly higher than they were in our *2021 Draft Advice for Consultation* because we have a tougher starting point.

83 We have made a change to the way we present our recommended budgets, that also contributes to budgets being higher than presented in our draft advice. In the table below we present final recommended emissions budgets applying a different rate for combining greenhouse gases into an overall figure.

84 For our recommended budgets, we have now applied the GWP_{100} values from the IPCC's ***Fifth Assessment Report*** (AR5) so that they will be consistent with the way government will report greenhouse gas emissions for the year 2021 onwards. In the rest of our advice we continue to present emissions using the IPCC's ***Fourth Assessment Report*** (AR4) GWP_{100} values. See ***Chapter 5: Recommended emissions budgets*** for more information.



Emissions budgets 2022 – 2035 (AR5) annual average emissions

85 Each budget would see progressively deeper emissions reductions. We modelled different paths that could deliver our recommended budgets. Our modelling shows that our recommended budgets could see Aotearoa reducing long-lived greenhouse gas emissions by 63% and biogenic methane emissions by 17% by 2035 (see table below).

Change in emissions compared to 2019 from our modelling (AR4)

	2025	2030	2035
Long-lived gases (net)	-15%	-38%	-63%
Biogenic methane	-8%	-12%	-17%
Total	-12%	-27%	-42%

We are not on track to meet our targets

86 Since acknowledging the need to act on climate change, successive governments have adopted a series of different emissions reduction targets. But while the targets changed, they all shared the same short-term focus on planting trees and purchasing offshore mitigation, rather than what was necessary to achieve actual emissions reductions at source.

87 Instead of putting policies in place to decarbonise the economy and develop low-emissions technologies, practices and behaviours, Aotearoa used forests planted in the 1990s to offset its emissions and meet its targets. The carbon removal benefits of these forests are now coming to an end. Gross emissions have increased by 26% since 1990 and Aotearoa is in a position that is more difficult than it might have been if it had started developing the structures, strategies and plans it needs to create a low emissions system earlier.

88 Our analysis shows that current government policies do not put Aotearoa on track to meet the Commission's recommended emissions budgets or the 2050 targets. Achieving the emissions reductions needed to get to 2050 will require our elected officials to move fast to implement a comprehensive plan.

Longer-term direction is needed to drive longer-term action

89 Short-term thinking has delivered Aotearoa to where we are now in addressing climate change. Transformational change takes time, and people need certainty around the speed and direction of travel to invest in changing how they live, work and operate. There needs to be some hard work done now that will pay dividends later.

90 We have recommended that the Government of the day seeks cross-party support on emissions budgets, and that they are debated in Parliament. The support and appetite for change of our elected officials needs to be a matter of public record.

Laying the foundations to deliver deeper emissions reductions

91 To achieve sustained and steady emissions reductions, Aotearoa must build a system that will support and drive these reductions.

92 Meeting the budgets will require an enabling environment. This means looking at the infrastructure we need to support a low emissions Aotearoa and making some big decisions now. It also means making sure social, political and institutional systems and structures are fit for purpose, because they create the conditions for behaviour and technological change.

93 The Government can help make sure Aotearoa will have more options for reducing its emissions in the future by putting in place measures to support and encourage research, development and innovation for low-emissions solutions.

94 We need to be careful that in our haste to achieve more immediate emissions reductions, we do not constrain the ability of the economy to support deeper reductions later. Our recommended budgets suggest smaller reductions to emissions at first that accelerate over time. This reflects the time it will take to fundamentally change the way we do things.

95 There are uncertainties around how quickly some low-emissions technologies will come into the country, how quickly solutions are developed and tailored for Aotearoa, and how quickly infrastructure is designed and built.

96 Once we start, it will take time to build momentum and make changes across systems. For example, for electric vehicles (EVs) it will take time to create supply chains for new technologies, ensure supply to bring EVs into the country, lay new electricity lines, install charging infrastructure, and make EVs an affordable and preferable choice.

Setting a sustainable pace for change

97 A key challenge in preparing this advice has been to find the balance between pushing hard to catch up after years of limited action and moving at a sustainable pace. Aotearoa needs to move at a pace that gives people time to plan and change in a way that does not threaten wellbeing, and further disenfranchise those already disadvantaged.

98 Moving too slowly will push the burden of addressing climate change onto young people and future generations. Many rangatahi told us that older generations had already left them with costs, and that delayed or weak action would add to those.

99 However, moving too fast will also impact people. Jobs could be lost unnecessarily and some industries and businesses forced to close even though there may have been solutions if they had more time. This could undermine public support for the transition and delay it even further. A thriving economy and society is vital for ensuring that both current and future generations can make continual and enduring emissions reductions over time.

100 For our budgets to be ambitious and achievable, they must be met in a way that is fair, equitable and inclusive. This means government must manage potential negative impacts and encourage positive benefits that come with climate action.

101 The transition to a low-emissions society can be economically affordable and socially acceptable. To achieve this, it must be well-paced, well-planned, well-signalled and co-designed. This means designing it alongside Iwi/Māori as the Crown's Treaty partner. It also means involving local government, regional economic development agencies, businesses, workers, unions, the disability community and community groups.

102 However, some groups of society will be more impacted than others. Policy will be needed to address this.

103 Employment and jobs will inevitably change as Aotearoa moves towards a low emissions society. Many workers will need to learn new skills to continue practising their profession in a low emissions environment. However, for some it will mean moving into jobs in other industries.

104 Government must put policies in place to support those who are most disadvantaged and least able to adjust. This will be important for ensuring an equitable and inclusive transition that does not compound existing inequities or historic grievances. Impacted groups must be included from the start in co-designing policy.

105 How the climate transition will impact different groups of society will depend on the exact design and timing of policies the Government chooses to put in place. In providing advice on the direction of policy, we have focused on building the systems so that this happens in a way that is proactive, well-planned and well-signalled.

106 We also heard from some that our ambition will cost Aotearoa too much. In response, we have re-examined our assumptions, rerun our models, and conducted further sensitivity analysis. Our main conclusion holds – we are confident in our assessment that Aotearoa can reduce emissions while continuing to grow the economy and improve wellbeing.

107 We have assessed that the level of GDP could be around 0.5% lower in 2035 and 1.2% lower in 2050 than it would be otherwise. This is consistent with findings overseas. Investing in low emissions technologies and practices now will open up new opportunities and reduce the risk of damaging the country's reputation due to a lack of credible climate action. However, delaying key actions like the move to EVs and embedding more efficient farm practices could result in the level of GDP in 2050 falling by around 2.3%.

Lasting change – setting the right policy direction

108 The emissions reduction plan the Government is required to develop in response to this advice needs to provide a comprehensive and cohesive strategy, setting new policies that lay the foundation for the transition.

109 The plan should make the most of opportunities to reduce emissions immediately and set the country up for accelerated emissions reductions down the track. New Zealanders must be given a predictable and stable direction of travel, with changes signalled well in advance. They need to feel supported to make decisions that will change the way they live, work and operate.

110 To inform our advice on policy direction, we gathered information about current and likely future costs for various technologies. We tested different paths, gaining insights about the nature and timing of the actions needed to meet the 2050 targets.

111 We also assessed the climate policy landscape in Aotearoa to identify the gaps, barriers and opportunities. We considered where emission pricing is likely to drive change. For each sector, and across the broader system, we identified where barriers currently deter low-emissions choices, and where strategic investment can help drive deeper change over the long term.

112 In some areas, such as in relation to the New Zealand Emissions Trading Scheme (NZ ETS), a strong evidence base supports relatively specific policy advice. In other areas, particularly ones that have not been the focus of climate policy in the past, our advice is more focused on outcomes.

113 We have made recommendations that include strengthening market incentives to drive low-emissions choices and investments. The NZ ETS is an important tool. However, the Government needs to make changes to ensure it is fit for purpose and sends a strong price signal.

114 International research and experience clearly show that the best approach to reducing emissions is to implement a comprehensive suite of climate policies alongside pricing schemes. We also recommend that the Government's emissions reduction plan includes action to address barriers and sustain focus on innovation and system transformation.

115 We must uphold the principles of Te Tiriti o Waitangi/The Treaty of Waitangi. We must also consider impacts on individuals, communities, workers, businesses and families. We need policies to ensure a fair, equitable, and inclusive transition.

116 Overall, our policy advice (laid out in part two of this report) is intended to provide strategic direction. This is summarised below. It is the Government's role to consider the detailed design and implementation of policies, guided by this direction.

Key elements of our policy direction
Work in partnership with Iwi/ Māori, and with local government, to ensure the transition to a low emissions economy is firmly rooted in the principles of Te Tiriti o Waitangi/The Treaty of Waitangi.
Send clear and consistent signals about how Aotearoa will transition to low emissions and work together across political parties, government agencies and local government.
Improve the New Zealand Emissions Trading Scheme so that it provides stronger market incentives to drive low emissions choices.
Make sure all government policy and investment decisions support the transition to low emissions.
Drive system transformation by supporting innovation, mobilising finance for low-emissions investments and supporting behaviour change.
Increase the circularity of the economy and develop a thriving bioeconomy that delivers emissions reductions.
Take action to reduce emissions from existing and new urban areas and improve understanding of how changes to urban form and function can reduce emissions.
Provide affordable, reliable and convenient low-emissions alternatives to high emissions vehicles.
Introduce measures to make sure vehicles entering the fleet are efficient and to accelerate uptake of electric vehicles. Create options to decarbonise heavy transport and freight.
Develop a national energy strategy to decarbonise the energy system and introduce measures to make sure the electricity sector is ready to meet future needs.
Accelerate the switch to low-emissions fuels for process heat and drive energy efficiency improvements. Develop a plan to transform buildings to be low emissions.
Reduce emissions from waste, through measures that reduce the amount of waste generated and increase resource recovery.
Introduce policies, incentives and tools to speed up emissions reductions from agriculture. Support farmers to identify changes and put them in place. Invest to open up more options for deeper emissions reductions.
Reduce reliance on forestry carbon removals and manage the impacts of afforestation.
Incentivise the reversion and planting of new native forests to create an enduring carbon sink.
Support a Māori-led approach to an equitable transition for Iwi/Māori and the Māori economy.
Design an equitable transitions strategy that results in a fair, inclusive and equitable transition.

The changes we will need are widespread

117 Transitioning to a low-emissions Aotearoa will mean changes to the way energy is produced, the way people travel, the communities they live in and the way land is used. It will involve changes to individual and corporate behaviours, changes to existing processes and ways of operating, and technological innovation.

118 We have recommended coordinating efforts to address climate change across government. This includes nominating specific Ministers and agencies with accountability for implementing policies and strategies in the emissions reduction plans to ensure there is clear ownership for actions. We also recommend establishing Vote Climate Change as a specific multi-agency appropriation which consolidates existing and future government funding for core climate change mitigation and adaptation activities.

119 We have also been clear in our recommendations that Te Tiriti o Waitangi/The Treaty of Waitangi must be at the forefront of the transition and core of the work to drive change in Aotearoa. This will ensure an equitable transition for Iwi/Māori, mitigate against compounding historic grievances and set Aotearoa up to achieve success for all its people.

120 We have heard very clearly that Iwi/Māori expect government to uphold the Crown-Māori partnership. This can be achieved through supporting Māori representation at all levels of decision-making. The Commission has applied the He Ara Waiora framework in developing our advice, which focuses on collaboration with government to improve awareness of how policy can achieve wellbeing outcomes for Iwi/Māori from a te ao Māori perspective.

121 There are many co-benefits from climate action, particularly to health because of warmer, drier homes, more walking and cycling, and less air pollution. These benefits are significant and immediate and can improve the quality of life for people now and in the future.

122 Reducing greenhouse gas emissions is not the only objective, the nature of the transition also matters. Aotearoa needs to transform in a way that maintains and builds wellbeing. This is particularly important to Iwi/Māori.

123 There are priority actions needed if Aotearoa is going to reach its targets. We have developed paths to test our emissions budgets that include all these actions and tested whether slower than anticipated technology development or behaviour change would put the country off this course.

124 To create any future path involves making assumptions about what will happen. The transition to a low-emissions Aotearoa may well involve different mixes of technologies than the ones we have modelled, depending on how the relative economics play out.

125 Our work shows the recommended budgets are resilient and there are multiple ways Aotearoa can achieve them. This provides certainty and makes sure uncertainty about the future does not stall or delay climate action.

Aotearoa in the global climate change effort

126 During consultation, we received feedback asking how we could conclude that our draft emissions budgets aligned with contributing to the global effort to limit warming to 1.5°C while also stating that the Nationally Determined Contribution (NDC) under the Paris Agreement did not.

127 To achieve the NDC, Aotearoa will need some offshore mitigation. This is not about doing less domestically – but about increasing the contribution Aotearoa makes beyond what is possible at home.

128 Our assessment is that the current NDC is not compatible with contributing to global efforts to limit global warming to 1.5°C.

129 Aotearoa has committed to reducing net emissions to 30% below 2005 gross emissions levels, over the 2021-2030 period. For the NDC to be compatible with the 1.5°C goal, it would need to reflect emissions reductions much more than 36% below 2005 levels by 2030.

130 However, science alone cannot determine the share Aotearoa should contribute to those global reductions. Reaching a conclusion on this also depends on social and political judgements about international equity. These should be made by the Government of the day.

131 Internationally, others have taken more ambitious action on climate change. While emissions from Aotearoa are small on a global scale, they are high per capita. The Commission's proposed emissions budgets are already ambitious – but the NDC goes further. New Zealanders and their elected officials need to decide how we want to contribute to the global response.

The momentum is growing

132 Establishing the independent Climate Change Commission was a commitment by Aotearoa to take strong and decisive action to address climate change.

133 We have considered the views of the approximately 15,000 people and organisations that submitted on our draft advice. Approximately 4,000 more came to events to hear from the Commission and share their vision of a low-emissions Aotearoa.

134 Throughout this process we have heard support across Aotearoa for decisive action on climate change. While views differ on what action should look like, how much the transition will cost, and what role Aotearoa has in the world, we believe there is growing momentum for change.

135 The appetite for change was seen with the passing of the Zero Carbon Act. We have seen it over the past 18 months as we have spoken to people across Aotearoa and seen people taking positive action and showing leadership in their sectors. This is evident across business, the NGO and social sector, communities and academic researchers.

136 Our analysis shows that elected officials need to make changes to legislation and structures to make it easier for people and industry to make low-emissions choices.

137 From here, the Commission will monitor progress toward 2050. If we assess the Government's actions and policies fall short of what is needed to achieve the emissions budgets, we will advise them of this and make our advice transparent to the public of Aotearoa.

138 If the Government chooses not to accept the budgets and the recommendations in this advice, it must publicly explain why not. Either way, the Commission will monitor the country's progress.

139 This means we will hold successive Governments to account for action to achieve long-term climate change goals. If we do not think that policies are doing enough, we will be asking for more ambitious action.

Chapter 2

Ngā Kohinga Kōrero: mō ngā kōrero akiaki kōhukihuki

Consultation and submissions: what we heard about our draft advice

1 The Climate Change Commission (the Commission) has consulted with, listened to, and learnt from thousands of people in preparing this advice.

2 Between January 2020 and January 2021, Commissioners and staff held over 700 meetings, workshops and hui. We met with different sectors, people, and organisations to introduce ourselves and our work, and to hear views on what needs to be considered in Aotearoa in responding to climate change.

3 During our consultation phase, from 1 February to 28 March 2021, our team held or attended around 200 events across Aotearoa and talked with an estimated 4,000 people. Consultation is comprised of all our engagement activity and the submissions we received.

4 We held a series of online events, including open Zoom sessions targeted at a general audience. Overall, we had over 3,000 people attend these. We attended events to speak with people from community groups, unions, NGOs, business, central and local government, parliamentary groups, and others.

5 We met kanohi kitea with Iwi/Māori where possible and engaged online where not. We ran a targeted consultation survey for Iwi/Māori – the 100 Coastie Voices campaign. The focus of this was to identify broad issues that Iwi/Māori would consider to be most significant.

6 We received more than 15,000 submissions through our website, the 100 Coastie Voices survey, the post and by email.

7 We heard from rangatahi/young people through our collaboration with The Hive, a programme that uses social media to encourage young people to have their say on public policy.

8 Much of what we heard in our engagement was echoed in the submissions we received. Central themes around the impact of our advice on New Zealanders, the pace of change, and the need to carefully manage the transition to a low-emissions Aotearoa emerged.

9 The key themes identified through the 100 Coastie Voices survey aligned with what we heard more broadly through consultation – that the Government must uphold its commitments and obligations to Te Tiriti o Waitangi/The Treaty of Waitangi and the Crown-Māori partnership in its response to climate change.

10 In this chapter we discuss some of the main themes and insights from our engagement and consultation in more detail, and share how they have shaped our first advice and will continue to shape our future research, analysis, and advice to government.

11 While the valuable information we received through consultation reflects the views of many New Zealanders, it cannot be taken to represent the views of all New Zealanders. We are conscious that those who chose to respond to our consultation are highly engaged, and may not represent society as a whole. We have not, therefore, emphasised statistical summaries of the submission findings in our final advice. Instead, we have reflected on the themes we heard most consistently, and some of the areas where people had very different perspectives. We have also considered new evidence that has been provided to us through consultation. We have then re-examined the evidence and our judgements in light of what we learnt to form our final advice.

How we received and processed submissions

12 The 15,404 submissions we received came to us through:

- **Haveyoursay.climatecommission.govt.nz** – our online consultation portal was used by 4,247 submitters
- **hello@climatecommission.govt.nz** – our public information email address was used to provide 11,118 submissions including the template submissions we received
- **Postal service** – 39 submitters posted their submissions to us in hard copy.

13 We received 14,463 individual submissions, 901 submissions from organisations, 40 submissions from Iwi/Māori.

14 The '100 Coastie Voices' campaign gathered an additional 167 responses from across Aotearoa.

15 As submissions were received, they were read and themes identified. Findings were summarised and recorded. Staff across the Commission discussed the information and themes coming through submissions. Staff also considered how these compared to the themes we heard through our engagement. Evidence we received through submissions and engagements was used to test and refine our modelling assumptions and inputs. Our judgements, conclusions and recommendations were also assessed and modified where appropriate in light of the material we received.

16 Submission themes, including how they changed and shaped our advice, were discussed with the Commission board and considered as part of making final judgements on our advice and recommendations.

17 In this chapter, and throughout the report, we have highlighted where we have changed our advice based on what New Zealanders have told us through our consultation process.

High level response to our draft advice

18 We heard through our engagements and through submissions that New Zealanders recognise the need to act on climate change. This came through from all the different groups we heard from. Where views diverged was what action we take and the speed with which we do so.

19 The number of submissions received, and the wide range of people that they come from, show that there is broad interest in how we transition to a thriving, climate-resilient, low-emissions future for Aotearoa – and there are wide-ranging views about the important things to consider.

20 We heard strongly that Te Tiriti o Waitangi/The Treaty of Waitangi and the Crown-Māori partnership should underpin the response to climate change in Aotearoa. The Commission has been clear about our commitment to ensuring an approach that upholds the Treaty, and this is addressed further throughout our report.

21 Overall our consultation demonstrated the need to act, and the potential magnitude of climate change impacts if we don't, are well understood. However, views differed around how Aotearoa should respond, its role in the world, and the part different communities, regions and businesses play in the transition.

22 We have reassessed and changed our draft advice in response to themes and new evidence that came through from consultation and the submissions we received. The chapters within the report cover the more detailed elements of what we heard, and we have noted in them the substantive changes made to our advice as a result.

The impact of change on the economy of Aotearoa, people's wellbeing, and the environment

23 Concern about the impact of the low-emissions transition on Aotearoa, the economy and the wellbeing of people, was evident in many submissions. This included the consequences of action, of inaction, and of different policy approaches.

24 Those who fully opposed the draft advice were predominantly concerned about the economic costs for Aotearoa and how those costs would be distributed. This includes approximately 6,000 template submissions from one organisation that were in opposition to the Commission's draft advice.

25 Other submitters who opposed action said this was because they believe action in Aotearoa will not make a difference to the global climate. Others supported climate action, but raised concerns about the potential economic impacts for certain people, communities, sectors or businesses.

26 There were divergent views on the cost of the transition across submitters. This – in general – saw either a preference for strong action regardless of cost, or a preference for only taking action if it would incur no or minimal costs.

27 There was commentary throughout consultation and through some submissions about the estimated impacts of emissions budgets on the level of GDP in our advice. Some submitters expressed surprise about this figure, asked questions about how credible it was, and whether the modelling we used to reach this estimate was fit for purpose.

28 When discussing the cost and impact of the transition to a low-emissions Aotearoa, a number of submitters pointed to the co-benefits of climate action and suggested these needed to be weighed against costs.

29 Improved public health and reduced healthcare costs from plant-based diets, active transport, more energy-efficient and warmer housing, and reduced air pollution were co-benefits commonly highlighted by submitters. Others stressed benefits to the environment including cleaner waterways and increased and protected biodiversity.

30 Some submitters mentioned the need to support workers impacted by the transition to re-train, especially people on low incomes and working in high-emitting industries. Some businesses also emphasised how critical the education system will be in setting workers up with the skills needed in emerging and growing low-emissions industries.

31 Some submitters argued for more focus on consumption-based emissions over production-based emissions, also known as 'whole-of-life' embodied carbon to include emissions from mining, production, transportation and disposal. This also came through strongly in submissions on buildings, with people saying buildings should be constructed using designs and products that lower emissions.

32 Through our engagements, we heard from some that we should be considering cross-cutting themes more closely and thinking more broadly than climate change. Some submitters expressed a strong preference for us to drive a more coordinated approach to big issues like tourism, biodiversity, or how we plan and build cities.

How we responded:

We have re-examined our cost assessments. We have rerun our models and carried out additional sensitivity analysis to further understand the modelled cost of GDP. We have increased the coverage and emphasis on the co-benefits of climate change action and emphasised that GDP does not measure all of these costs and benefits. We have included an additional chapter that provides more detail on the distributional impacts of the climate change transition, increasing our emphasis on the need for education and skills to help with a fair and equitable transition.

We have also increased our emphasis on the cross-cutting themes, elevating recommendations on urban form and function, the circular economy, and the bioeconomy to sit in a chapter focused on cross-cutting policy. Recommendations in these areas have been reconsidered and revised in light of new information.

Equity and fairness

33 A common thread through submissions was fairness – climate action or inaction should not entrench inequity or disadvantage some groups of society, or be at the expense of people's economic, social, and cultural wellbeing. We heard support for a just transition. This is a transition that is equitable, fair, and inclusive. People said that the cost of the transition should fall on industries most responsible and not harm low-income communities.

34 Submitters called for the Government to uphold its commitments and obligations under Te Tiriti o Waitangi/The Treaty of Waitangi in its response to climate change. Both Māori and non-Māori told us that all government action to address climate change should be underpinned by Te Tiriti o Waitangi/The Treaty of Waitangi and its principles of partnership, participation, protection, and equity.

35 We heard that if climate action fails to comply with Te Tiriti o Waitangi/The Treaty of Waitangi and te ao Māori perspectives, Iwi/Māori will be further disadvantaged, and Aotearoa will fail to achieve an equitable transition to a low-emissions economy.

36 Some submissions talked about global equity: the responsibility of richer countries such as Aotearoa towards poorer countries that are inequitably disadvantaged by climate change. Many said it was important for Aotearoa to show leadership for and support Pacific neighbours.

37 We heard often through engagement and submissions about intergenerational fairness. A theme that emerged was that it would not be fair to leave the costs of climate change to young people and future generations.

38 Submitters talked about socio-economic equity. Particular groups mentioned included Iwi/Māori, Pasifika, women, the elderly, people with disabilities, young people, and people on low incomes, living in poverty or in rural areas. We heard that we need to support people through the transition, particularly for affected workers and communities. Many noted that some groups would need extra support such as subsidies for EVs, public transport, sustainable housing materials and insulation; or different services for elderly and people with disabilities who cannot easily get around on public transport.

How have we responded:

We have carefully considered intergenerational equity, and surmise that the budgets we have proposed strike a fair intergenerational balance that would leave future generations with a country that is both low emissions and thriving.

We have added a chapter focused on policy direction for an equitable transition for Iwi/Māori. We have suggested in our final advice that transition planning is used more widely, particularly for different industries. This recognises how industry and regional economies are connected. We have strengthened our advice to reflect feedback on how important education and skills are in the transition to a low-emissions Aotearoa.

We heard often through consultation and submissions that we needed to recommend specific policies to address impact on people. We have been clearer that the Commission's role is to set the direction of policy, not develop specific policies themselves.

Ambition and pace of change

39 Through submissions, we heard frustration from people who felt the Commission had been too cautious in our draft advice and wanted quicker and stronger action.

40 Some submitters pointed out specific areas where they believed more ambition was achievable and affordable. This included:

- Increasing ambition for heavy freight
- Increasing ambition for low-emissions aircraft
- Being more ambitious around increasing walking, cycling, and public transport
- Higher rates of land use change and adoption of alternative agricultural production systems, like regenerative farming
- Reducing waste emissions through greater use of gas capture systems at landfills.

41 People suggested that starting now would save money later. They wanted immediate action to replace high-emissions infrastructure, shift towards low-emissions transport options, and plant and preserve native forests. They said inaction now would lead to higher costs later to deal with the same problem.

42 Many pointed out a responsibility to make changes now to lessen the burden on future generations. Equity for future generations came through in submissions from a broad range of groups. In addition, younger submitters expressed feelings that older generations had already burdened them with costs, and that these should not be added to in the future.

43 Even with ambitious action now, people pointed to debts – financial and otherwise – that unborn generations would carry because of climate change: more storms, floods and other extreme weather, impacts on food and water supplies, loss and damage to housing and community infrastructure. Many said those who had historically benefited from earth's resources and contributed to climate change should be the ones to pay for climate action.

44 We also heard from those who thought that the pace we were suggesting was too swift, and that the recommendations in our draft advice went too far, too fast. We heard concerns about the ability of existing infrastructure to support the changes we were suggesting – particularly in agriculture and transport.

45 Concern about the ability of the national grid to support rapid electrification came through in submissions. Concerns about our ability to import enough electric vehicles to meet the numbers suggested in our advice surfaced in our engagement with some stakeholders, and also appeared in submissions.

46 Regarding agriculture, we heard that while there was support for lowering emissions, the reduction in stock numbers combined with increases in efficiency noted in our draft advice were not possible, as the agricultural sector in Aotearoa is already highly efficient.

How we responded:

We relooked at the evidence around what pace is possible in terms of technological and behavioural change. In some cases, we reduced the ambition or pace of our assumptions, for example the number of used EVs available in the early years or efficiency improvements on sheep and beef farms. In other cases, we increased the pace, for example the use of low-emissions fuels in heavy freight and the increase in gas capture systems for landfills.

The details of how we changed our assumptions are laid out in Table 7.3 in Chapter 7. The real-world opportunities and constraints to change that were highlighted through the submissions process have been reflected in *Chapter 7: Demonstrating emissions budgets are achievable*.

We made sure we were as ambitious as possible in each sector, while still ensuring the options were technically feasible and economically affordable. We rechecked the paths that would deliver our budgets would also put us on track to meet the 2050 emissions reduction targets (2050 targets). Overall, this added up to a similar level of ambition to our *2021 Draft Advice for Consultation*.

The role of government

47 The coordination and effectiveness of the government approach to COVID-19 came through as a theme in submissions, with the response being seen as an example of what can be achieved when there is strong government leadership and investment. Submitters talked about the opportunity to take the same 'go hard and go early' approach to climate change.

48 We heard that any government action to address climate change should be underpinned by Te Tiriti o Waitangi/The Treaty of Waitangi and give effect to the principles of partnership, participation, protection, and equity. We also heard very clearly that business, industry, local government, and community expect to co-design a transition alongside government to ensure the transition reflects their lived experience and their needs.

49 People were clear that if they were part of designing the transformation to a low-emissions future, it would become something they can support. The business sector was particularly keen to partner with government and saw itself as a key player in the country's work to reduce emissions. The idea of a Citizen's Assembly was suggested as an option for bringing in diverse voices that represented the people of Aotearoa.

50 We heard concern that a lack of cross-party support in Parliament could derail emissions reductions, particularly if there was no agreement on the emissions budget numbers.

51 To be able to innovate and invest, respondents said they needed to know that decisions and legislation would not change with every election cycle. This was a strong theme that came through in our engagements with business and industry during consultation. These groups highlighted the need for certainty across the next decade so that they could plan accordingly, setting the foundation for further change and investing in the infrastructure needed.

52 Some submitters called for government to rely on the market to reduce emissions, meet the country's 2050 targets through a strengthened New Zealand Emissions Trading Scheme (NZ ETS) and avoid any further policy intervention. However, we heard from others that addressing pricing barriers, using emissions pricing to drive choices, and investing in innovation were important policy interventions.

How we responded:

We have strengthened our recommendation for climate considerations to be included in all government decision making. Many submitters said we need to move beyond just including climate considerations, and that we need to state this should be adequately resourced, as well as included. This has been included where appropriate. We have also emphasised the need for collaboration and partnership with business and industry in many of our recommendations. This recognises how crucial these groups are in the transition.

We more strongly emphasised the importance of the NZ ETS in driving gross emissions reductions. We included more of the rationale and economic thinking that builds the case for policies alongside the NZ ETS. There is a strong body of work internationally which demonstrates that policies to remove barriers and support innovation are needed alongside pricing schemes.

The policy recommendations in this advice are now more clearly targeted towards the policy direction for the emissions reduction plan, and the types of policies the government should commit to in that plan.

In our final advice we have explained more clearly the frameworks we have used to arrive at our policy direction for the Government and how we have applied them. We have also more clearly explained what problems in the market are hindering progress and the types of policies that are needed to fix them. Government will need to do the detailed work to put these types of policies in place.

We have included more detail around the purpose of progress indicators and how we anticipate them being created and used.

Perspectives of tangata whenua

53 In addition to meeting kanohi kitea with Iwi/Māori we received written submissions and surveys from Māori through our 100 Coastie Voices campaign.

54 While there was overall support for addressing climate change challenges, Iwi/Māori submitters raised concerns that Māori would be disproportionately impacted by climate action if the Government does not uphold its commitments and obligations to Te Tiriti o Waitangi/The Treaty of Waitangi and the Crown-Māori partnership in its response to climate change.

55 Māori and non-Māori were unified in their view that emissions reduction plans must be firmly rooted in the principles of partnership, participation, protection, and equity.

56 Submitters talked about the need to recognise legacy issues, the potential to compound impacts of managing Māori collectively-owned land, and the importance of ensuring Iwi/Māori are adequately resourced to participate in an equitable transition.

How we responded:

We have included a new chapter in our final advice that highlights and addresses the key concerns raised by Iwi/Māori submissions. This new chapter outlines the key concerns and issues raised by tangata whenua through the consultation process. We have also emphasised the role of government to uphold Te Tiriti o Waitangi/The Treaty of Waitangi in a way that addresses climate change throughout the report.

Our final recommendations, throughout the advice, have been strengthened to assist government to support the Crown-Māori relationship by working closely with Iwi/Māori, and to enable an equitable transition by upholding Te Tiriti o Waitangi/The Treaty of Waitangi.

The role of forests and carbon dioxide removals

57 Through our engagements during consultation, we heard broad acknowledgement that people do not want to continue using forests as the primary way to meet targets. We also heard about the wider benefits forests can deliver.

58 Through submissions, we received positive support for establishing new native forests, and a number of submitters wanted to see more effort to protect carbon stocks in existing native forests. Conversely, some submitters disagreed with our draft advice shifting away from a focus on forestry to achieve our targets, and thought that fast-growing exotic species and using pines as nurse crops for natives have an important role to play.

59 At the same time, we heard from submitters who were concerned about the potential impact on rural communities of new large-scale exotic forests, particularly those planted solely for carbon.

How we responded:

We maintained the principle that we need to decarbonise at source and to expand and protect native forests to create an enduring carbon sink.

While fast-growing exotic species have a role to play, we are clear that they cannot be used in place of reducing emissions. We looked more closely at our assumptions around native forests to make sure what we were proposing was feasible. We concluded it was, but that it would require a strong commitment, and policies, from the Government to support this happening. This includes a new recommendation for integrated pest control.

We also heard that submitters supported our advice on wetlands and peat soils, and we have strengthened our advice in this area.

We also increased our emphasis on the important role of the bioeconomy. We provided more detail on available biomass feedstocks and how this can best be used to reduce emissions across multiple sectors.

Agriculture

60 Submissions on agriculture were diverse. Some submitters said stronger action is needed to lower emissions in the sector and, at the other end of the spectrum, others said agriculture should not be part of the Commission's recommendations at all.

61 One of the most common themes in submissions on agriculture was that faster action and more ambition for reducing agricultural emissions is needed, but that providing adequate support for farmers to transition will be crucial.

62 We heard from people who wanted an end to land conversions to dairy farming, and controls on the use of synthetic nitrogen fertiliser and feed such as palm kernel extract.

63 We heard calls to support farmers to reduce on-farm emissions through management practices, and to help them shift to new farming technologies, more regenerative farming, organic farming and 'nature-based' solutions, including soil carbon sequestration. People wanted the Government to invest in rural digital connectivity, research and into technology that can reduce agricultural emissions.

64 Submissions on the role of the primary sector climate action partnership He Waka Eke Noa were divergent, with some people strongly supportive and others sceptical **of its voluntary nature.**

65 We heard strongly through engagements and submissions that our assumptions underpinning how much agricultural emissions could be reduced were overly optimistic.

66 We heard from people that agriculture underpins the country's export economy and that agricultural emissions in Aotearoa are low, compared to other nations producing the same products – if Aotearoa produces less meat and dairy, higher emitters may step into the gap to produce more, with a negative overall impact for climate.

How we responded:

After re-examining the evidence, we adjusted our assumptions around how much emissions can be reduced currently through on-farm improvements. We now assume that it will be harder to achieve agricultural emissions reductions. We also tested paths with higher rates of land-use change to horticulture. Details of these assumptions can be found in *Chapter 7: Demonstrating emissions budgets are achievable.*

We considered the options around input controls on fertilizer, stocking rates, feed and land conversion to remove barriers. We have emphasised that a suite of policies – including pricing, extension services, and research and development – will be required to reduce emissions as set out in the Act.

We also explained more clearly the Commission's upcoming role as set out in the Act in assessing the progress of the agricultural sector towards a pricing mechanism. The Commission can better assess what complementary policies might be needed, once it sees what that pricing mechanism could look like.

Waste

67 Submissions on waste expressed that the approach set out in our *2021 Draft Advice for Consultation* was broadly on the right track. Submitters were positive to see the Commission endorse strong action to tackle the waste problem in Aotearoa. There were some submissions that called for more specific, directive and ambitious policy measures, and a few that opposed any direct measures on waste and expressed a view that waste emissions are best reduced through the NZ ETS.

68 The Commission's recommendation to reduce waste generated at source was broadly supported. The recommendation to extend product stewardship was also well received, with suggestions made as to what additional waste streams could be placed under product stewardship. Some submitters also called for the timeframes for product stewardship to be accelerated.

69 There was less consensus on the issue of increasing waste recovery from landfill with some submitters wanting more aggressive targets to increase waste recovery and some submitters being concerned that more aggressive targets would create more transport emissions than it saved from landfill.

70 Some submitters wanted various waste recovery options prioritised, with calls for more emphasis on waste to energy through options such as anaerobic digestors and more emphasis on composting.

71 Many supported the Commission's call to extend and improve landfill gas capture, although some were concerned about the potential for the focus on improving landfill gas capture to distract from waste reduction and recovery.

How we responded:

We have increased and accelerated the ambition in our waste recommendations as a result of the themes and evidence gathered through consultation.

We have strengthened what we are recommending around reducing waste generation, increasing investment in resource recovery, and increasing landfill gas capture. The recommendations also have a focus around data collection in response to submissions feedback, which highlighted this gap.

We have also elevated the circular economy recommendation into a separate multi-sector recommendation. This is covered with more detail in *Chapter 8: Reducing emissions from waste* and *Chapter 19: Direction of policy across Aotearoa* of the *2021 Supporting Evidence*.

Energy, industry and buildings

72 Through consultation and submissions, we heard broad support for our recommendation that the Government develop a coordinated energy strategy, and that industry stakeholders are keen to be involved in designing this.

73 We heard from many submitters about the proposed recommendation to phase out new connections to fossil or natural gas and LPG in buildings after 2025 and phase out use of these fossil gasses in buildings by 2050.

74 We heard concerns about the need to maintain access to fossil gas for homes that are off-grid, or where it is used as a backup in emergencies. We also heard concern around the future of businesses that install fossil gas or rely heavily on it, especially restaurants – and for the people they employ. We heard that the impacts of large changes in fossil gas supply and demand need to be well thought out to ensure a low-emissions energy system is also reliable and affordable.

75 Many submitters supported the 2050 target for phasing out fossil gas in buildings but were concerned the 2025 timeline for ending new connections was too soon. Some submitters called for phasing out fossil gas in buildings as early as 2022.

76 Energy efficiency, particularly for buildings, was suggested as a quick win for reducing emissions and improving health outcomes. Submitters expressed a view that Aotearoa needs better, healthier homes and workplaces that are more energy efficient, and that buildings should be constructed using designs and products that lower emissions.

77 There was widespread support for ending the use of coal to generate electricity and fire boilers. Some submitters wanted an end to the use of coal as soon as possible. Some highlighted that our assumptions around the rate of switching out these boilers was ambitious but achievable.

78 Some were concerned that our modelled electricity prices were too low in the near term and did not reflect market conditions at the time of writing. There was also concern for the impact on electricity prices as a result of going to 100% renewable electricity, but widespread support for shifting to a renewable energy target.

How we responded:

We reiterated the importance of an energy strategy to decarbonise the energy system in a way that ensures access to affordable, secure, low-emissions electricity.

We re-ran our electricity model with new assumptions to check our electricity price results. We tested some additional scenarios and included these results in the report.

We re-checked our assumptions around the costs of new fossil gas connections. After reviewing the evidence, we still concluded that the continued expansion of the network for fossil gas was not warranted. We have acknowledged that low-emissions gases, such as hydrogen and biogas, may play a useful role in reducing emissions in the future. We have also recommended more work is needed to manage the diminishing role of fossil gas across the energy system and recognised that stakeholders want more input into how this will be achieved.

We further emphasised the importance of low-emissions buildings, both in terms of energy efficiency and embodied emissions.

We refined our assumptions around some of the larger industrial facilities and undertook sensitivity analysis as a robustness check. We call for a plan to decarbonise the industrial sector and have made clearer the need to identify and decarbonise industry that is strategically important to the Aotearoa economy.

Transport

79 A large number of submissions focused on transport. The relative merits of transitioning from internal combustion engine (ICE) vehicles to electric vehicles (EVs) was a dominant theme. This often came with a call to put more emphasis on public transport and active transport.

80 There was general support for the roll out of EVs, with some people wanting this to be accelerated, however, we also heard concerns that focusing on EVs creates new problems. This includes the need for charging infrastructure and the potential inability of the grid to meet EV demand, equity issues around the cost of EVs, and the social and environmental impacts of EVs and production of EV batteries. There were concerns around the short-term supply of EVs in a global market.

81 Some people thought emissions efficiency standards for ICE vehicles should be more demanding and introduced sooner while the supply of EVs increases. Others from the motor vehicle industry strongly supported the proposed emissions efficiency standard timing in our draft advice.

82 Early in our consultation, feedback from stakeholders identified concerns about the Commission's perceived lack of ambition for active transport. People indicated that more aspirational targets were being set through local government for regional public and active transport use.

83 Many submitters echoed this and wanted less focus on cars and roads in favour of more public transport, cycling, and walking. They pointed to the co-benefits of public transport and active transport, such as savings on infrastructure and improved physical and mental health.

84 We also heard from submitters about how important design and urban form are for driving changes in how, and how often, people travel. We have moved our recommendations around urban form and function to the multi-sector part of our final advice – recognising the importance urban form has at a system wide level.

85 We also heard submitters ask us to further consider the role of international aviation and shipping in our advice on reducing transport emissions.

How we responded:

Our final advice places more emphasis on shifting the way we travel and supporting better infrastructure for walking and cycling. It places less emphasis on private vehicle use, although accelerating EV uptake remains key to achieving our emissions budgets.

In response to what we heard through submissions, we rechecked our assumptions against the targets being set by local government, and found that they were largely consistent. We have disaggregated how we present the public and active transport assumptions so that the four largest regions, which include the largest cities, have tailored assumptions. Public and active transport assumptions were updated and aligned with regional plans, where possible. Cycling assumptions were made more ambitious. Public and active transport assumptions have been set out in *Chapter 7: Demonstrating emissions budgets are achievable.*

We revised the assumptions around EV uptake, to reflect information provided through submissions around the likelihood of a slower uptake in the short term, and included more ambitious assumptions around ICE vehicle efficiency, heavy transport, and low-emissions aircraft. We also undertook sensitivity analysis around the cost of new EVs.

We significantly increased the amount of biofuels we assumed, and have assumed electrification of some short distance flights. We have taken a more holistic approach to heavy transport and freight that also considers efficiency and shifting to lower-emissions modes such as shipping and rail, rather than solely focusing on increasing the uptake of low-carbon fuels.

NDC and compatibility with the global 1.5°C effort

86 There was broad support for recognising in our *2021 Draft Advice for Consultation*, that the Nationally Determined Contribution (NDC) is not compatible with the global efforts to limit warming to 1.5°C above pre-industrial temperatures (the global 1.5°C effort). A recurrent theme from submitters was the need for the NDC to be a 'fair share' target and represent the obligation Aotearoa has as a developed country to do more.

87 Some submitters wanted us to go further and provide recommendations on what the revised NDC should look like.

88 Many were opposed to the use of offshore mitigation, either wanting none to be included or for its use to be minimised, because of concerns around it delaying action within Aotearoa and doubts about its legitimacy.

89 A small number of submitters engaged on the approach taken to assess compatibility with contributing to the global effort. Some submitters also thought that the approach used to account for forests in targets is misleading.

How we responded:

We have added a chapter in our final advice that looks specifically at the questions that were raised during consultation about the contribution Aotearoa makes to the global 1.5°C effort. We have re-examined the rules for accounting for targets and forests, and still conclude that they are appropriate for Aotearoa.

We have looked at the implications of meeting the NDC with domestic action alone, with no offshore purchasing, and concluded that the pace of change required to do so would have substantial impacts on many people.

After considering the feedback from submitters on the need for us to provide recommendations on what a revised NDC should look like, we still maintained our view that this is a political and ethical question. Elected representatives need to weigh up the relative importance of factors beyond compatibility with contributing global efforts to limit warming to 1.5°C. These include the cost Aotearoa is willing to bear, social and economic impacts, international expectations and reputation, relative comfort with climate risk, and the balance of how much is done in Aotearoa versus how much is done internationally.

Changing behaviour

90 Submitters discussed the changes to individual, collective and business behaviour that will be needed, and the role of government in enabling behaviour change. They stressed it was not up to individuals to drive the transition, and government needed to create an environment where the low-emissions choice is the easiest and default choice.

91 Again, submitters brought up the way the 'team of five million' responded to the COVID-19 pandemic. Many people said they wanted to see the same sort of political leadership, community education, and cooperation for climate action.

92 We heard calls for community education and engagement in schools and across all sectors to increase understanding of climate science, the impacts of climate change, and what people can do. People wanted to see climate change education made compulsory.

93 Others said education alone is not enough, and highlighted the importance of investing in infrastructure to support behaviour change. The message was to create better infrastructure for things like EV charging and public transport, recycling and composting, then help people understand how important it is.

How we responded:

As a result of what we have heard through consultation, we have been more specific in our recommendation on behaviour change. It has been amended to state that Government should establish a dedicated fund for behaviour change initiatives and nominate a lead agency.

Lack of clarity in some of our recommendations

94 A number of submissions included feedback on recommendations that were not contained in our draft advice, or misinterpreted our recommendations. In particular, the following misconceptions have come through consistently in consultation:

- **Commission setting emissions targets:** some submitters called for the Commission to strengthen emissions reduction targets. Parliament set the 2050 targets in 2019 by passing the Climate Change Response (Zero Carbon) Amendment Act – which also led to the Commission's establishment. Our current role is not to advise on the 2050 targets, but to advise on how to achieve the 2050 targets that have been legislated.
- **Our advice as policy, or a central plan:** some submitters confused the Commission's advice with specific policies or plans. Some thought our advice was a 'central plan'. The Commission does not set policy, develop law, or draft the emissions reduction plan, but advises on policy direction.
- **Recommending a ban on fossil gas:** while our draft advice proposed a ban on new fossil gas connections for buildings, some submitters interpreted this as a 'ban' on fossil gas and LPG. Many submitters were concerned the advice would mean a 'ban on gas barbecues' and strongly opposed that. No recommendations were made about banning fossil gas barbecues.
- **For agriculture, mandatory livestock rate reduction targets/individual targets:** some submitters were concerned that discussion of reducing livestock rates was a mandatory target being recommended in our advice, or that it was a target that would be applied to individual farms. No recommendations were made about individual farms or animal numbers.
- **'Our path':** some submitters read our path as either the only trajectory for reducing emissions in Aotearoa, or as a way of setting sector targets or budgets. As there are many potential paths to reach budgets and targets, we have renamed the path as the 'demonstration path' and included alternative paths.

Feedback on what was missing

95 Through our conversations during consultation and submissions received, people identified areas where they would like the Commission to put more attention.

96 Themes included the emissions sources and sinks associated with oceans, wetlands, and biodiversity. There was also strong interest in consumption-based emissions accounting, particularly for buildings and EVs, and reducing consumption as a way to reduce emissions. People wanted to see more investment in innovation through supporting research and development that is specific to Aotearoa.

How we responded:

We have increased our emphasis on the importance of innovation and now have a specific recommendation.

We were clearer in our recommendation on low-emissions buildings around the importance of reducing embodied emissions. We undertook further analysis and added additional information on the environmental costs and benefits of EVs and their supply chains. We have added recommendations on avoiding further degradation of wetlands and peatlands to stop their loss of carbon.

We note the increasing discussion on oceans. However, as the evidence base is still developing, robust accounting for ocean sinks is not yet possible.

While we have not been in a position to expand our advice to include all of these areas, some of them have been addressed in our supporting evidence, and others provide a useful context for us as we consider our future work programme.

The Commission's role

97 We acknowledge that sometimes the wide range of views we have received are in conflict with one another. Our independent advice, while supported by evidence, must always involve judgement by our Commissioners trading off the different things the Act requires us to have regard to.

98 The relationship between the Crown and Iwi/Māori, the impact on current and future generations, land-use change, and the cost of transition are just some of the many things that must all be taken into account.

99 Some submissions showed people have interpreted the role of the Commission and our advice in different ways. This is understandable as the Government established the Commission relatively recently, in November 2019. In the coming months we will do more work to explain our role.

100 Independent of government, the Commission's role is to provide impartial advice, and to monitor and hold the Government to account on climate action. Government's role is to make decisions and put the policies in place on the back of those recommendations.

101 This report provides our final advice on the emissions budgets for Aotearoa out to 2035, and provides guidance on the direction of the emissions reduction plan – which includes recommendations on the types of policies the Government could develop to achieve the emissions budgets they will set.

102 Our independence means we are responsible for exercising judgement in making trade-offs when developing our advice, on the basis of the sound information we have.

103 The Government's role is to make decisions on the recommendations we make and determine the emissions budgets to give effect to those recommendations. There is much more work to be done by the elected leaders of Aotearoa and by government agencies.

104 By the end of this year, the Government is required to adopt emissions budgets and an emissions reduction plan.

105 Once the emissions budgets and emissions reduction plan have been set by the Government, the Commission has responsibility for monitoring the Government's progress and reporting on that progress to all New Zealanders.

Chapter 3

He Pou a Rangi – Tōna Aronga Matua
The role of the Climate Change Commission

1 The Climate Change Commission's (the Commission) role is to provide independent, evidence-based advice on the actions the Government needs to take to address climate change and transition to a low emissions and climate-resilient Aotearoa. The Commission was created by amendments to the *Climate Change Response Act 2002* (the Act), passed in 2019.

2 These amendments created a new framework for the Government's domestic climate change policies. This framework is designed to support Aotearoa to join global efforts to address climate change and to provide more certainty and stability around climate action.

3 Key elements of this framework include:

- Long-term emissions reduction targets for 2050
- A system of emissions budgets to step Aotearoa towards the 2050 emissions reductions targets (2050 targets)
- National Climate Change Risks Assessments and National Adaptation Plans
- A Climate Change Commission to give independent, expert advice on reducing emissions and adapting to climate change, and to monitor the Government's progress towards meeting emissions reduction and adaptation goals.

3.1 The Commission provides impartial advice

4 The Commission is an independent Crown entity set up to provide impartial advice to the Government, based on evidence and expert judgement. Our independence is key. It means we can provide impartial advice at arm's-length to Ministers and hold successive governments to account for action to achieve long-term climate change goals.

5 Our focus on the long term means we have an important role helping to insulate climate change policy in Aotearoa from short-term political pressures. Our advice will support greater stability and predictability. It will also improve transparency of, and accountability on, climate action. Better transparency around climate action allows more effective public scrutiny of government approaches, giving the public the opportunity to hold governments to account through elections.

6 The Act requires the Commission to draw from the best available evidence and analysis in carrying out our role. In developing our advice, we have drawn on a wide range of research and analysis from both in Aotearoa and overseas.

7 The Act also requires the Commission to give effect to the Crown-Māori relationship, te ao Māori, and specific effects on Iwi/Māori in all the advice it gives to the Government

8 Our roles under the Act are varied, and we are required to perform a wide range of tasks and deliver over different timeframes. Our responsibilities under the Act, and the timeframes for delivering on them, are summarised in Figure 3.1 below.

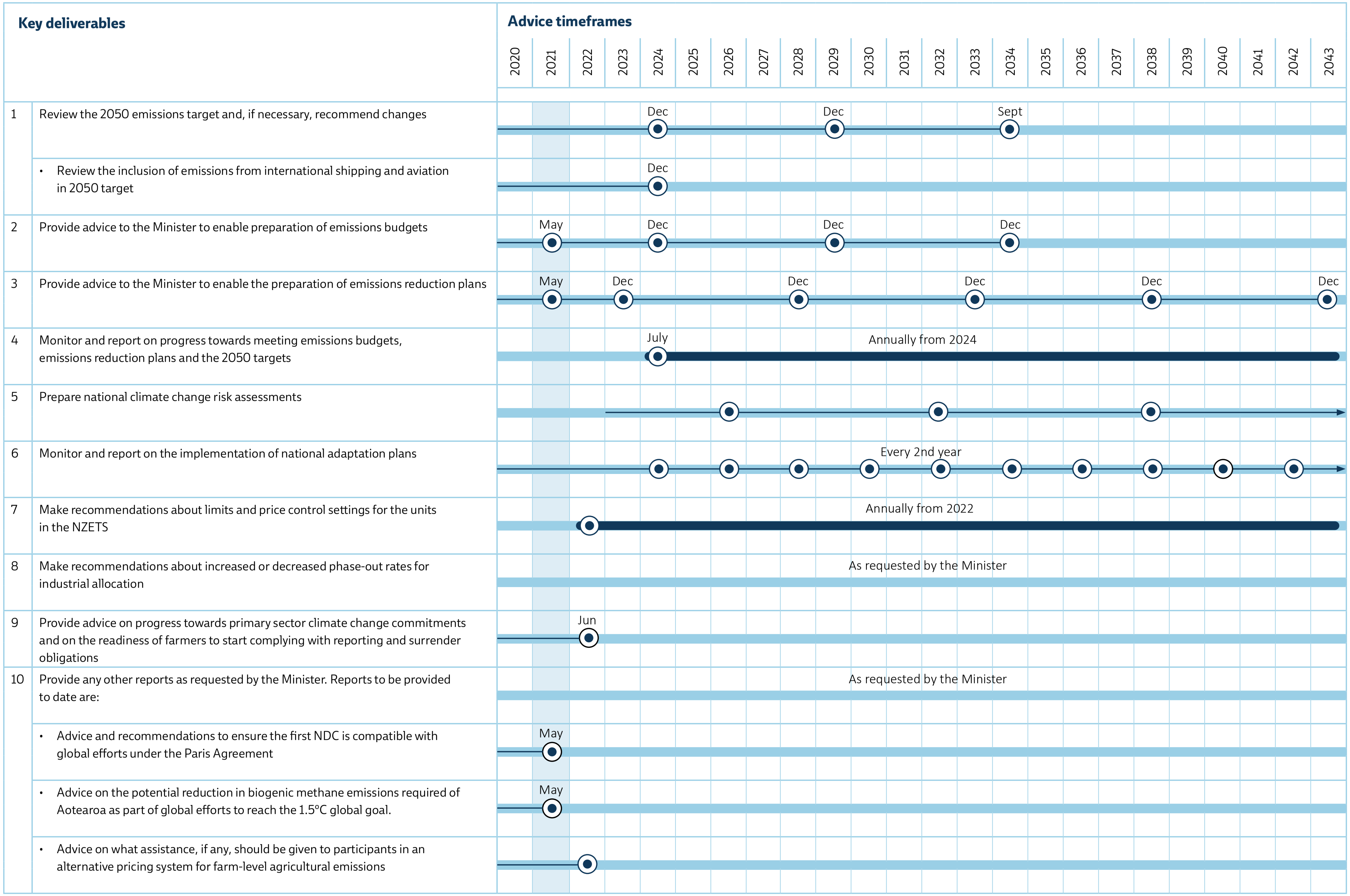


Figure 3.1: Our responsibilities under the Act, and the timeframes for delivery on them

3.2 The Commission is part of a broader policy landscape

9 The Commission is an Independent Crown Entity, with an advisory role within the wider system for climate change policy in Aotearoa (Figure 3.2).

10 The democratically elected Government holds the power to make decisions about our country's response to climate change. These decisions will be based on its own priorities and will be informed by the Commission's advice, as well as advice from officials in Policy agencies, such as Ministries. Government action on climate change will be subject to the important checks and balances of the parliamentary process.

11 The Commission has an ongoing role to monitor progress towards emissions budgets and targets. As part of this, we will assess the adequacy of government action and share our conclusions publicly.

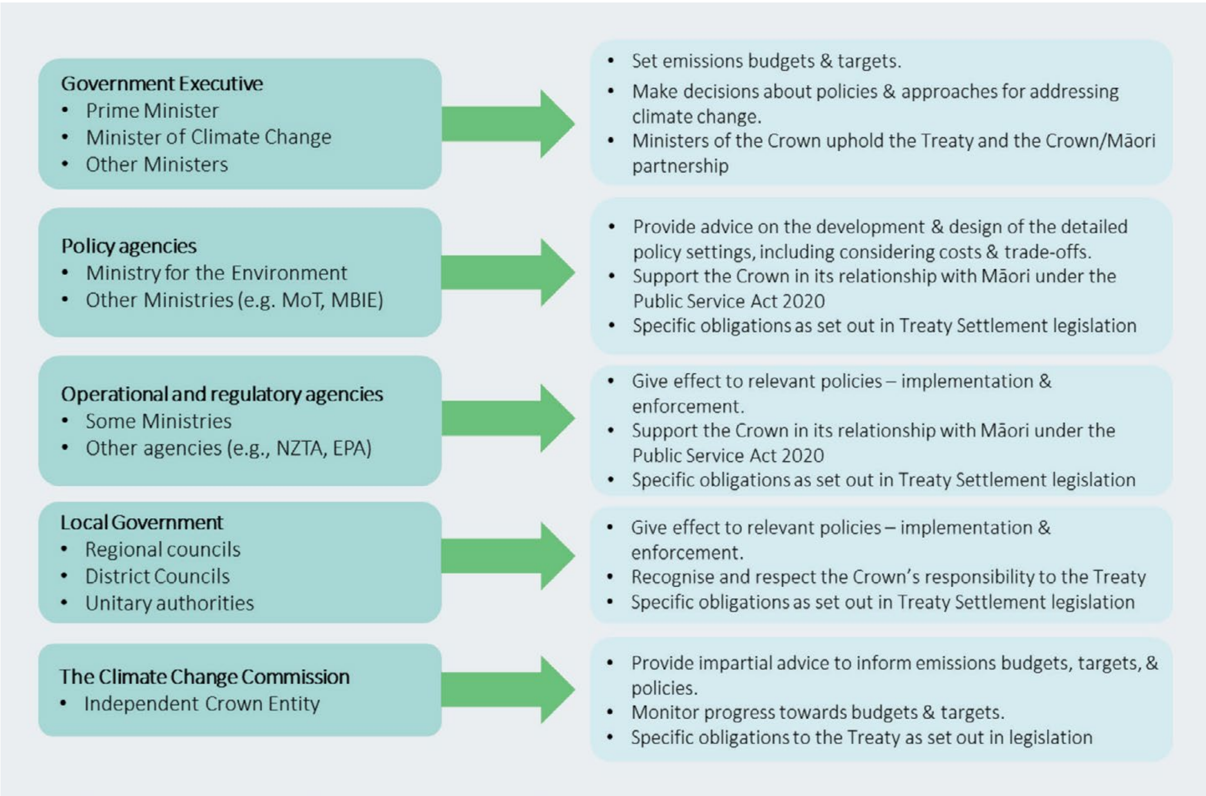


Figure 3.2: Summary of different roles in relation to climate policy

3.2.1 Our role on emissions budgets

12 An emissions budget is the total amount of all greenhouse gases that Aotearoa can emit over a certain period. Emissions budgets must step emissions down to meet the targets in the Act.

13 The Commission is responsible for advising on the level of emissions budgets, as well as several other matters related to the nature of emissions budgets. Once we hand our advice to the Minister of Climate Change, it is up to the Government to act.

14 Emissions budgets will be set by the Government, and if its budgets differ from our advice it will need to explain the reason for these differences.

3.2.2 Our role on the emissions reduction plan

15 Each emissions budget must be accompanied by an emissions reduction plan, setting out policies and strategies for meeting the budget. The Government is responsible for drafting and implementing the emissions reduction plan. In this way, the Government of the day remains accountable to the electorate for the policy choices it makes.

16 We provide high-level advice about the direction of policy needed to meet emissions budgets. This advice must be considered by the Government when it prepares its emissions reduction plan.

17 It will be government agencies that develop detailed policy advice and implement specific policies. This means it will be government agencies that do the detailed policy design, including examining the trade-offs, risks and benefits associated with different policies and approaches.

3.3 This document contains impartial advice on eight matters

18 Under the Act, there are six specific matters that we must include in our first package of advice to the Government. These centre around recommending emissions budgets that step emissions down to meet our 2050 targets. They include details around what those budgets should look like, and how we think they could be met.

19 We have also been asked by the Minister of Climate Change to provide advice on two additional issues: the eventual reductions needed in biogenic methane emissions, and on the country's Nationally Determined Contribution (NDC). Table 3.1 below outlines where these different pieces of advice can be found in the report.

Table 3.1: Pieces of advice contained in this report

Advice	Where you can find it
The recommended quantity of emissions permitted in each emissions budget period	Chapter 5
The proportions of an emissions budget that will be met by domestic emissions reductions and domestic removals, and the amount by which emissions of each greenhouse gas should be reduced to meet emissions budgets and targets	Chapter 5
The appropriate limit on offshore mitigation that may be used to meet an emissions budget, and an explanation of the circumstances that justify the use of offshore mitigation	Chapter 5
The rules that will apply for measuring progress towards meeting emissions budgets and the 2050 target	Chapter 10
How the emissions budgets, and ultimately the 2050 target, may realistically be met, including by pricing and policy methods	Chapters 5-7, Chapter 11
The direction of the policy required in the emissions reduction plan for that emissions budget period	Chapters 12 – 20
The compatibility of the country's NDC with global efforts to limit warming to 1.5°C	Chapters 21 -22
Eventual reductions needed in biogenic methane emissions	Chapter 23

20 Providing the analysis and advice contained in this document represents a significant amount of work. However, this is only our first package of advice. We have a long-term role and have an important role in the future monitoring progress and providing advice on future emissions budgets and emissions reduction plans.

21 There are some important things that are not included in this first package of advice, but which we received a lot of feedback on during public consultation. For example, some submitters called for the Commission to recommend changes to the 2050 emissions reduction targets.

22 However, the Act does not permit us to do this unless there has been a significant change in circumstances that would justify changing these targets since they were set in November 2019.

23 Although these are not areas covered in this document, they are important areas we will look at in future advice.

3.3.1 We have considered a range of matters in developing our advice

24 The Act requires us to consider a range of matters in carrying out our analysis and developing our advice. These are listed in Table 3.2, along with the main chapters where they are addressed – noting that some matters are also touched on, to a lesser extent, in other chapters.

25 The matters outlined in section 5M of the Act apply, where relevant, to all the Commission's work – including any advice requested by the Minister.

26 Section 5ZC of the Act outlines considerations specific to emissions budgets. This section must also be applied to the Commission's advice on the direction of policy for the emissions reduction plan. In some cases, consideration of these matters for emissions budgets flows through to inform advice on policy direction generally. In other cases, we have considered these matters specifically in relation to particular policy issues.

27 The list of considerations is long. Our advice cannot be based on a single matter or perspective, it must consider and/or have regard to the whole range of matters contained in the Act, where they are relevant. This has required us to make judgements. How we have gone about making those judgements is outlined in *Chapter 5: Recommended emissions budgets*.

Table 3.2: Matters we are required to consider or have regard to in developing our advice

What we are required to consider	Main areas where you can find it
Section 5M: Matters the Commission must consider, where relevant	
Current available scientific knowledge	*Advice Part One*: *Chapter 9* and throughout *Advice Part Two*: throughout *2021 Supporting Evidence*: Chapter 1 and throughout. *Technical Report*: *Climate science considerations of global mitigation pathways and implications for Aotearoa*.
Existing technology and anticipated technological developments, including the costs and benefits of early adoption of these in New Zealand	*Advice Part One*: Chapters 6- 8 and throughout *Advice Part Two:* Chapters 13-19 and throughout *2021 Supporting Evidence:* Chapters 5-9 and throughout
Likely economic effects	*Advice Part One*: Chapter 8 *Advice Part Two:* Chapter 20 *Advice Part Three:* Chapter 22 *Supporting Evidence:* Chapters 15 -16
Social, cultural, environmental, and ecological circumstances, including differences between sectors and regions	*Advice Part One:* Chapter 8 *Advice Part Two:* Chapters 19-20 and throughout *2021 Supporting Evidence*: Chapters 16-17
Distribution of benefits, costs, and risks between generations	*Advice Part One:* Chapter 8 *Advice Part Two:* Chapters 19-20 *2021 Supporting Evidence:* Chapters 15 and 16

The Crown-Māori relationship, te ao Māori, and specific effects on Iwi/Māori	*Advice Part One:* Chapter 8 and throughout *Advice Part Two:* Chapter 19 and throughout *2021 Supporting Evidence:* Chapter 10 and Chapters 15-16
Responses to climate change taken or planned by parties to the Paris Agreement or to the Convention	*Advice Part One:* Chapter 9 *Advice Part Three:* Chapters 21-23 *2021 Supporting Evidence:* Chapter 2
Section 5ZC: Matters relevant to advising on, and setting, emissions budgets (note: this section must also be applied when advising on the emissions reduction plan). **When preparing advice for the Minister the Commission must:**	
5ZC(2)(a): have particular regard to how the emissions budget and 2050 target may realistically be met, including consideration of:	
The key opportunities for emissions reductions and removals in Aotearoa	*Advice Part One:* Chapters 6-7 *Advice Part Two:* Chapters 13-19 *2021 Supporting Evidence*: Chapters 4-9
The principal risks and uncertainties associated with emissions reductions and removals	*Advice Part One:* Chapters 5-7 *Advice Part Two*: Throughout *2021 Supporting Evidence:* Chapters 4-9
5ZC(2)(b): have regard to:	
The emissions and removals of greenhouse gases projected for the emissions budget period	*Advice Part One:* Chapter 6 *2021 Supporting Evidence*: Chapter 11
A broad range of domestic and international scientific advice	*Advice Part One*: Chapter 9 and throughout *Advice Part Two***:** Throughout *2021 Supporting Evidence*: Chapter 1 and throughout *Technical Report***:** Climate science considerations of global mitigation pathways and implications for Aotearoa
Existing technology and anticipated technological developments, including the costs and benefits of early adoption of these in Aotearoa	*Advice Part One:* Chapters 6-8 and throughout *Advice Part Two:* Chapters 13-19 and throughout *2021 Supporting Evidence*: throughout
The need for emissions budgets that are ambitious but likely to be technically and economically achievable	*Advice Part One:* Chapters 5 -8 *2021 Supporting Evidence*: Chapters 4-9, Chapters 11-12 and Chapters 15-16

The results of public consultation on an emissions budget	*Advice Part One:* Chapter 2 and throughout *Advice Part Two:* Throughout *2021 Supporting Evidence:* Consultation front-piece for each part
The likely impact of actions taken to achieve an emissions budget and the 2050 targets, including on the ability to adapt to climate change	*Advice Part One:* Chapter 8 *Advice Part Two:* Chapters 19-20 and throughout *2021 Supporting Evidence:* Chapters 15-17
The distribution of those impacts across the regions and communities of Aotearoa, and from generation to generation	*Advice Part One:* Chapter 8 *Advice Part Two:* Chapters 19-20 and throughout *2021 Supporting Evidence:* Chapters 15-16
Economic circumstances and the likely impact of the Minister's decision on taxation, public spending, and public borrowing	*Advice Part One:* Chapter 8 *Advice Part Two:* Throughout *2021 Supporting Evidence:* Chapter 15
The implications, or potential implications, of land-use change for communities	*Advice Part One:* Chapter 8 *Advice Part Two:* Chapter 13 and Chapters 18-20 *2021 Supporting Evidence*: Chapter 16
Responses to climate change taken or planned by parties to the Paris Agreement or to the Convention	*Advice Part One:* Chapter 9 *2021 Supporting Evidence:* Chapter 2
The relevant obligations under international agreements for Aotearoa	*Advice Part One*: Chapter 9 *Supporting Evidence:* Chapter 13

28 We have captured these considerations at a high level in the framework in Figure 3.3. This makes explicit the lens we have approached our work through, highlights the key components of the system that we consider in our analysis, and the dimensions across which we consider distributional impacts. See ***Chapter 11: Approach to developing advice on policy direction*** and ***Chapter 12: Policy direction to create an enabling environment for change*** for more about our approach to developing our policy advice, and Te Tiriti o Waitangi/The Treaty of Waitangi considerations.

Figure 3.3: The Commission's framework

29 We also included values in our framework to help us to think about the impact of our recommendations on collective wellbeing. We have drawn from He Ara Waiora and tikanga Māori to apply values, which we believe resonate with New Zealanders. In applying these values, we have used the following guidance:

- **Manaakitanga** – approaching our work with a deep ethic of care towards the people and systems involved.
- **Tikanga** – ensuring the right decision makers are involved, and the right decision-making process is implemented.
- To support **Whanaungatanga**, we must be mindful of the relationship between all things, our connections to each other and how we connect to our whenua.
- **Kotahitanga** – taking an inclusive approach and working collaboratively with other agencies/ organisations, to have access to the best information, and to do the best work we can, collectively.

3.4 We have gone through a robust and inclusive process to develop our advice

30 Overall, our approach has been to engage and consult as widely as possible as we have developed our advice. This is central to our role as an independent advisor. It has also been critical to developing our understanding of different views, and for considering the needs, perspectives and concerns of individuals, businesses, industry, communities and others.

31 The feedback and perspectives we have received during our consultation have been enormously valuable. We received more than 15,000 submissions during consultation from a wide range of individual New Zealanders, community groups, non-governmental organisations, businesses, industry groups, public agencies, local governments, and others.

32 We also engaged widely with Iwi/Māori across the motu through consultation hui and submission feedback, including our 100 Coastie Voices campaign. We applied a range of methods to reach out and connect with Iwi/Māori to gather a broad range of insights for our advice, including engaging with Māori thought leaders, developing case studies with representatives of Māori-collectives, and assessing Iwi Management Plans. See *Chapter 19: Policy direction for an equitable transition for Iwi/Māori*. See also *Chapter 10: Perspectives from Tangata Whenua: Considering emissions reductions and removals Te Ao Māori view* from *2021 Supporting Evidence* for more information.

33 We have also gathered and analysed data and weighed up evidence from a wide range of credible sources. We have used both quantitative and qualitative tools to guide our analysis, and have tested the quality of our evidence, and refined it along the way.

34 The specific approach we have taken to develop the different parts of this advice has been described in each of the relevant parts of this report.

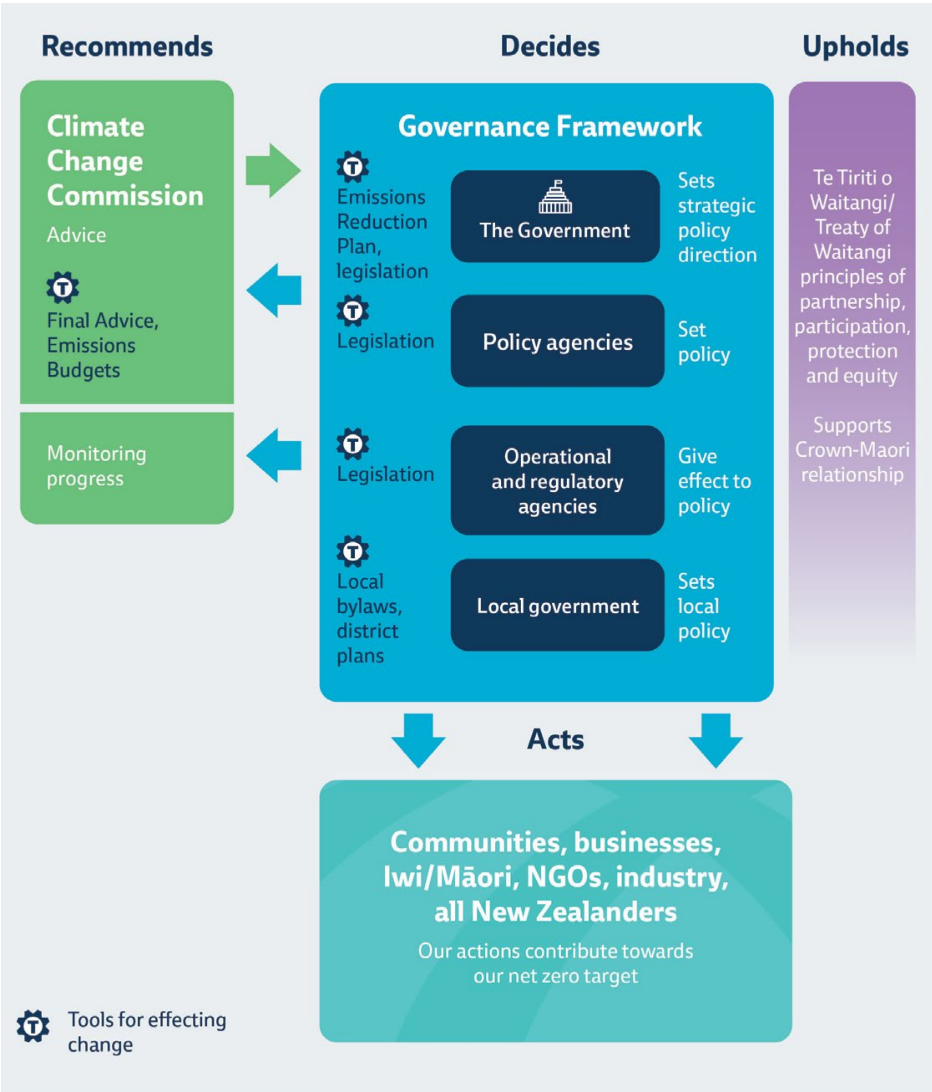


Figure 3.4: The Commission's role in advising government

Part 1

Emissions budgets advice

Emissions budgets

The Government's role:

Under the Climate Change Response Act (the Act), the Minister of Climate Change must set emissions budgets and ensure they are met. Emissions budgets must outline the total level of all greenhouse gas emissions permitted in a particular emissions budget period.

Before setting emissions budgets, the Minister must consider advice received from the Climate Change Commission (the Commission), that there has been adequate consultation on the emissions budgets, and consult the appropriate representative of each of the political parties in Parliament.

On setting emissions budgets, the Minister must notify the emissions budget, present the emissions budget to Parliament, make the emissions budget publicly available, provide a written response to the advice received from the Commission, and explain any reasons for departing from the Commission's advice.

The Climate Change Commission's role:

The Commission is required to provide the Minister of Climate Change with advice on:

- the recommended quantity of emissions that will be permitted in each emissions budget period;
- the rules that will apply for measuring progress towards emissions budgets;
- how emissions budgets may realistically be met, including by pricing and policy methods;
- the proportions of an emissions budget that will be met by domestic emissions reductions and domestic removals, and the amount by which emissions of each greenhouse gas should be reduced to meet the emissions budget; and
- the appropriate limit on offshore mitigation that may be used to meet an emissions budget, and an explanation of the circumstances that justify its use.

In developing this advice, the Commission must consider a wide range of matters, including how Aotearoa could realistically meet the recommended emissions budgets, the likely economic effects, distributional impacts, and latest scientific advice. The full list of considerations is included in *Chapter 3: The role of the Climate Change Commission.*

As part of its ongoing monitoring role, the Commission must regularly monitor and report on progress towards meeting emissions budgets and the 2050 emissions reductions targets (2050 targets). This includes assessing the adequacy of the Government's emissions reduction plan.

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.

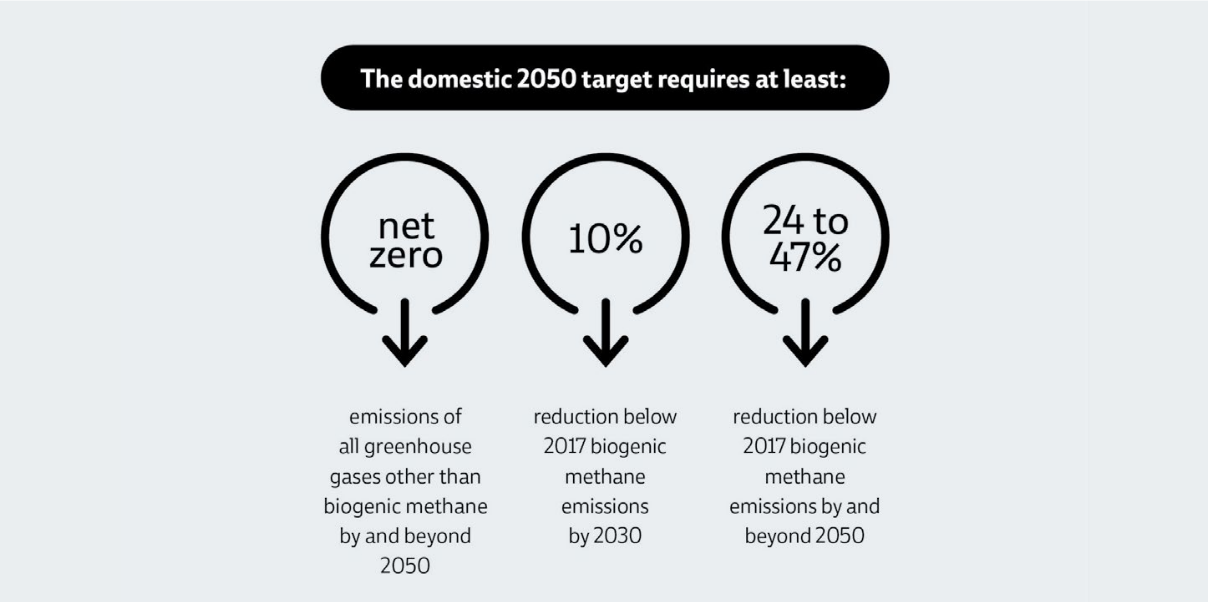


Figure 4.1: The domestic targets Aotearoa has set.

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.

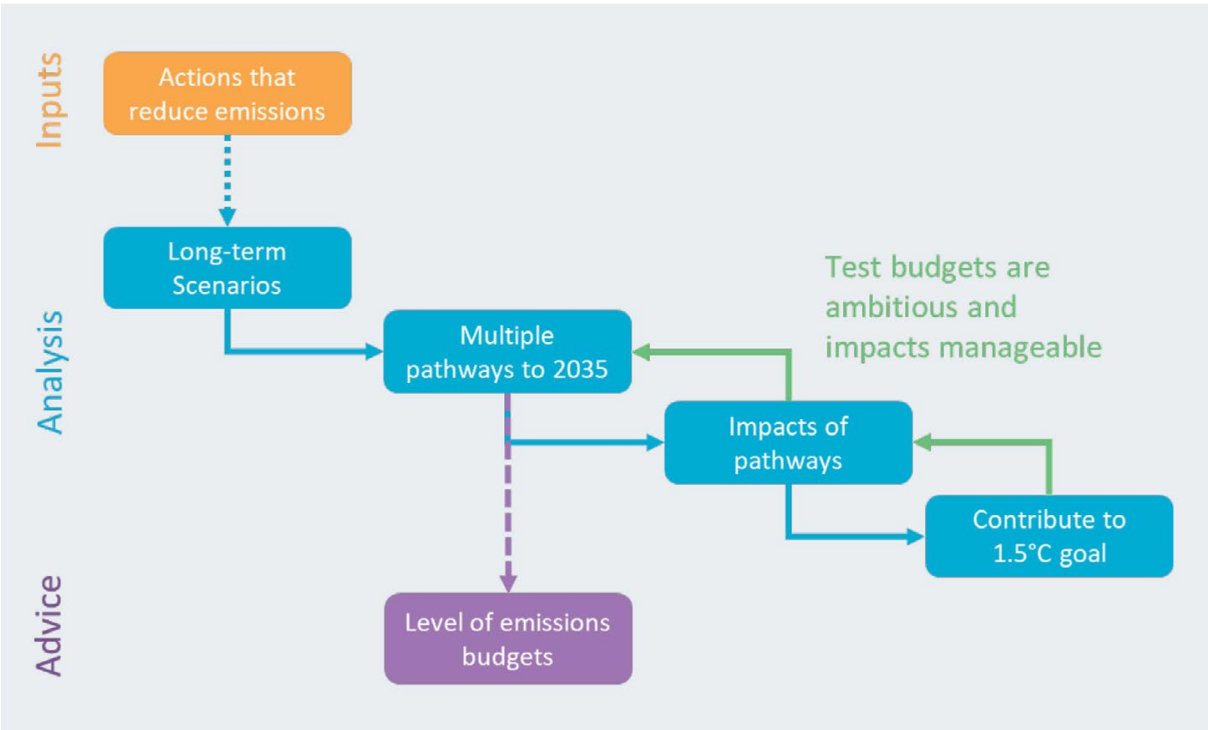


Figure 4.2: Stages of analysis for developing the Commission's advice.

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.

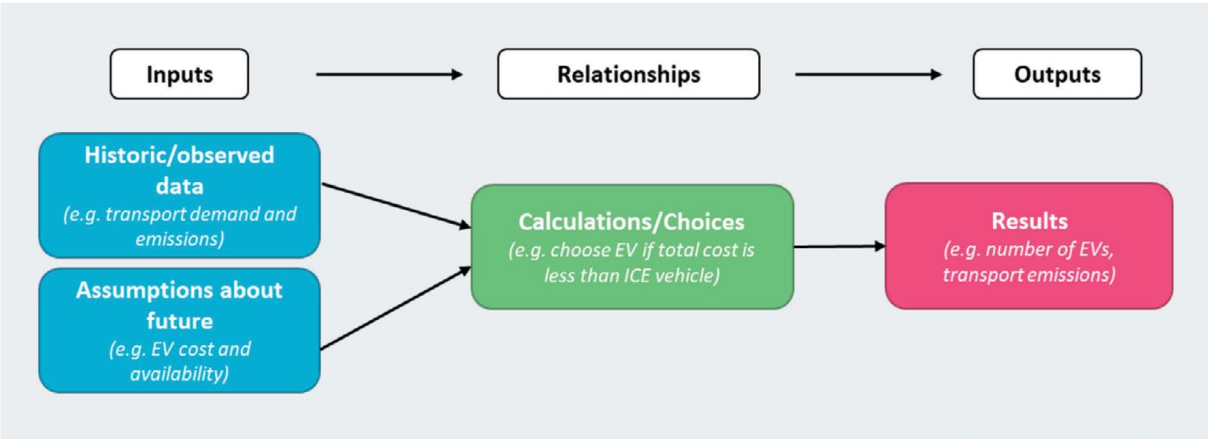


Figure 4.3: The key components of modelling.

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.

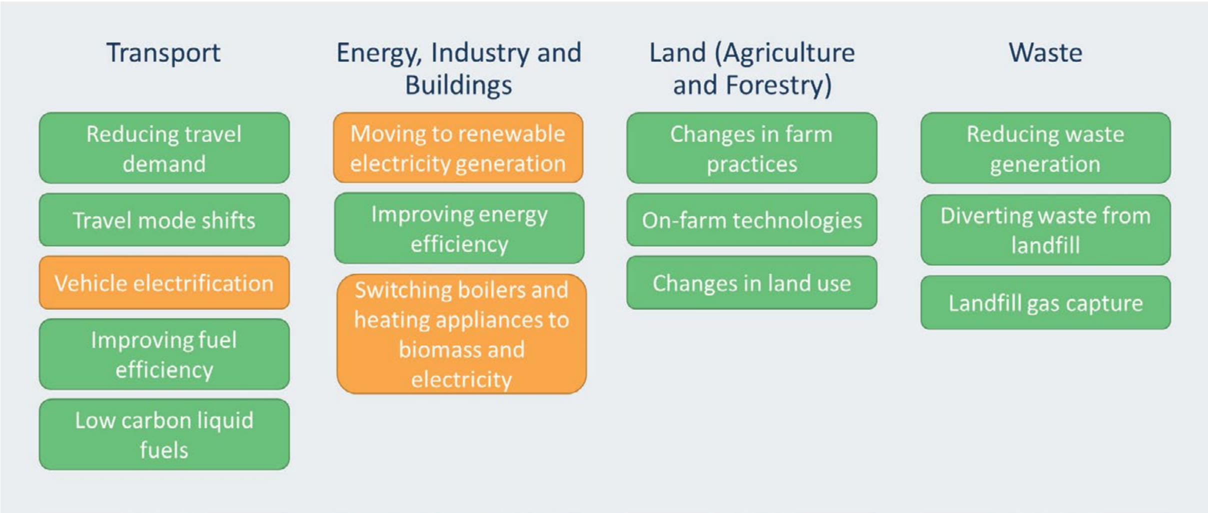


Figure 4.4: Key emissions reduction options represented in the ENZ model. For the options in orange boxes, the model simulates their uptake in each year based on costs, available resources, and other factors. For the options in green boxes, we specify their uptake as an input assumption in each scenario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

Chapter 5

Ngā tūtohunga mō ngā tahua tukunga hauwaro Recommended emissions budgets

Summary

Emissions budgets chart the course for stepping down greenhouse gas emissions over time to meet the emissions reduction targets are set out in the Climate Change Response Act (the Act). The Act requires us to provide advice to the Minister of Climate Change on the level of the first three emissions budgets, setting a path to achieving those targets.

The first emissions budget covers the 4-year period from 2022 – 2025, while the second and third budgets are five years, covering 2026 – 2030 and 2031 – 2035.

Our key decision in recommending the level of these budgets is how quickly Aotearoa should act to deliver emissions reductions. Acting too slowly pushes the burden of addressing climate change on to young people and future generations. Acting too quickly increases the transition cost, for example for infrastructure and asset replacement, and can have unintended consequences for people, society and the economy.

We have been guided by the requirements and considerations under the Act, which are grouped around achieving three key outcomes:

1. **Fair, inclusive and equitable** – emissions budgets that can be achieved in a way that is in line with Te Tiriti o Waitangi/The Treaty of Waitangi, that are affordable, manage negative impacts and support those most affected and least able to adjust, maximise broader opportunities to improve health and environmental outcomes, and ensure intergenerational equity.
2. **Ambitious** – emissions budgets that are ambitious and put Aotearoa on track to meet its emissions reduction targets, sustain those targets and contribute to the global effort of limiting warming to within 1.5°C of pre-industrial levels.
3. **Achievable** – emissions budgets that are technically achievable and economically affordable in light of uncertainty and real-world constraints. This recognises the time it takes people to build supply chains, install new infrastructure, develop markets, and develop skills.

Our recommended emissions budgets are fair, inclusive, equitable, ambitious and achievable. It is possible to meet them with solutions that are available to us today. If new technologies come on the market in the next few years, it may be possible and sensible to overachieve on these budgets.

Changes in our final advice

We relooked at the evidence around what pace is possible in terms of technological and behavioural change. In some cases, we reduced the ambition or pace of our assumptions, for example the number of used EV available in the early years or efficiency improvements on sheep and beef farms. In other cases, we increased the pace, for example the use of low emissions fuels in heavy freight and the increase in gas capture systems for landfills.

The recommended emissions budgets in our final advice have been updated to reflect the new evidence which we received through consultation, and our updated modelling. The budget numbers also reflect the latest National Greenhouse Gas Inventory published by the Ministry for the Environment (MfE). This update provided estimates of emissions in Aotearoa for 2019, as well as improving estimates for past years. This has lifted the baseline for emissions – meaning Aotearoa has a slightly harder job ahead to meet the targets set under the Act.

Introduction

1 Emissions budgets sit at the core of the transition to a thriving, climate-resilient and low-emissions Aotearoa. They chart the course for stepping down emissions to meet the emissions reduction targets.

2 The key judgement we had to make in recommending emissions budget levels is how quickly Aotearoa should act to reduce emissions. In making this judgement, we have been guided by the requirements in the Climate Change Response Act 2002 (the Act) that are outlined in more detail in *Chapter 3: The role of the Climate Change Commission.*

3 During consultation on our *2021 Draft Advice for Consultation* we asked for submitters' views on the levels of the first three emissions budgets and whether they were ambitious enough. Some people submitted that our proposed emissions budgets needed to be more transformational. Some submitted that our proposed emissions budgets were too ambitious and would be costly to meet. Others agreed with the balance we had struck, and in particular agreed with the focus on technology that is commercially available now and replacing assets on as natural a cycle as possible.

4 The path forward for Aotearoa must be different from our past approach. Until recently, the growth of forests planted in the 1990s contributed significantly to meeting targets, but the carbon removal benefits of these forests are now coming to an end. Re-planting after harvest maintains but does not add to the average carbon stock. This focus on net emissions meant that gross emissions in Aotearoa continued to increase. As a country, we are now in a position that is much more difficult than it might have been, if we had acted with more regard to the future.

5 A key challenge for the Climate Change Commission (the Commission) in preparing this advice has been to strike a balance between pushing hard to 'catch up' after years of delay, while also acknowledging that adjusting course after years of minimal action requires hard work.

6 This chapter sets out how we have balanced the different considerations set out in the Act to make a judgement on the pace of the transition and the level of the first three emissions budgets. It also lays out our emissions budget recommendations. These budgets will set Aotearoa up to achieve the targets and fulfil other requirements of the Act.

5.1 Emissions budgets that are equitable, ambitious and achievable

7 The Act outlines a series of requirements and considerations for the Commission when advising on emissions budgets. These requirements and considerations can be grouped around achieving three key outcomes:

- **Fair, inclusive and equitable** – emissions budgets that can be achieved in a way that is in line with Te Tiriti o Waitangi/The Treaty of Waitangi, affordable, manages negative impacts and supports those most affected and least able to adjust, maximises broader opportunities to improve health and environmental outcomes, and ensures intergenerational equity.
- **Ambitious** – emissions budgets that are ambitious and put Aotearoa on track to meet its emissions reduction targets, sustain those targets and contribute to the global effort of limiting warming to within 1.5°C of pre-industrial levels.
- **Achievable** – emissions budgets that are technically achievable and economically affordable in light of uncertainty.

8 Balancing the three outcomes is not simple. The world, including Aotearoa, needs to reduce emissions as quickly as possible to limit warming to 1.5°C and reduce the severity of climate change impacts such as sea level rise and drought. However, there are constraints as to how quickly low-emissions technologies will come into the country, solutions can be tailored to the Aotearoa context, and infrastructure put in place.

9 Acting too slowly pushes the burden of addressing climate change on to future generations. Acting too quickly increases the cost as it takes time to develop supply chains, markets and infrastructure. We must strike a balance that looks for equity across generations so that future generations inherit a thriving, climate-resilient and low-emissions Aotearoa.

10 There are actions that we can take to reduce emissions now, and there are many more actions that we can take now that will set us up for deeper emissions reductions in later emissions budget periods.

11 The following sections outline the judgements we have made to balance these three outcomes. Figure 5.1 illustrates how these judgements relate to the considerations in the Act.

What the Act requires of us Below are paraphrased	Outcomes we are seeking	Judgements in budgets
• Consider Crown-Māori relationship, te ao Māori, and specific effects on Iwi/Māori • Consider the likely impacts of actions taken to meet emissions budgets including: – On the ability to adapt to climate change – Economic circumstances and effects – Distribution of benefits, costs and risks across regions, communities, and generations – Implications of land-use change on communities – Environmental and ecological circumstances	**Fair, Equitable, Inclusive** Emissions budgets that can be achieved in a way that is affordable, manages negative impacts and supports those most affected and least able to adjust, maximises broader opportunities to improve health and environmental outcomes, and ensures intergenerational equity	• A well-signalled transition allows time to plan a in a fair, inclusive and equitable way
• To meet and sustain targets • Consider the latest science • Consider international action on climate change and obligations under international agreements • The need for budgets that are ambitious but technically and economically achievable	**Ambitious** Emissions budgets that are ambitious and put Aotearoa on track to meet its emissions reduction targets, sustain those targets and contribute to the global goal of limiting warming to within 1.5°C of pre-industrial levels	• Decarbonise where possible • Build a long-tem carbon sink • Contribute to the global 1.5°C goal • Move as fast as real world constraints allow
• Consider key opportunities for reducing or removing emissions, and their principal risks and uncertainties • Consider existing technology and anticipated technological developments	**Achievable** Emissions budgets that are technically and economically achievable in light of uncertainty	• Develop emissions budgets that can be delivered in light of uncertainty

Figure 5.1: The outcomes we are seeking to achieve in recommending emissions budgets, the requirements in the Act that inform these outcomes, and the judgements we have made to achieve these outcomes.

5.1.1 A well-signalled transition allows time to plan in a fair, inclusive and equitable way

12 A well-signalled transition allows individuals, businesses and communities time to plan, and implement solutions for managing negative impacts and supporting those most affected and least able to adjust through the transition. Managed well, transitioning to a low-emissions Aotearoa offers broader opportunities to contribute to improving health, freshwater quality, biodiversity, reducing existing inequities, and addressing historic grievances.

13 A transition that is fair, inclusive and equitable for people is crucial so that it is acceptable to New Zealanders. Putting the values of manaakitanga, tikanga, whanaungatanga and kotahitanga at the forefront means having a deep ethic of care for people and the land. It means acknowledging people's role, being mindful of people's connections to each other and the land, working collaboratively and ensuring the right decision makers are involved. Having support and buy-in from New Zealanders is vital for meeting and sustaining emissions reduction targets.

14 Signalling a plan early provides people a level of predictability about the transition ahead. Having this time helps to avoid unnecessary costs. It means that families, businesses and public entities can replace assets – like coal boilers, fossil gas appliances and internal combustion engine (ICE) cars – with low-emissions alternatives when they reach the end of their useful life.

15 This planning is crucial as the decisions people make now have flow-on effects. This is not a reason for delay. Given lead times, the decisions people make now will set Aotearoa up for deep emissions reductions in future emissions budget periods.

16 A key part of an equitable transition is ensuring intergenerational equity and sustainable prosperity over the long term. In addition to passing on to future generations an Aotearoa that is low emissions, it is also important to pass on an Aotearoa with a productive economy where people are healthy and have jobs that are environmentally and socially sustainable. This will be vital for ensuring that future generations have the resilience and ability to make continual and lasting emissions reductions.

17 The risk of acting too quickly is that we make quick emissions reductions, but not in a way that follows a tikanga process. This could result in outcomes that are not socially, environmentally or economically sustainable, and may not get the buy-in for the deep decarbonisation Aotearoa needs in the long run.

18 The risk of moving too slowly is that Aotearoa misses the opportunity to put in place the changes needed now to deliver emissions reductions in the longer term, and the time Aotearoa has to act is further condensed.

5.1.2 Decarbonise where possible

19 The Act outlines emissions reduction targets for biogenic methane and long-lived greenhouse gases. These targets were set in 2019, after public consultation. The Act does not permit the Commission to recommend changes to these targets at this stage.

20 Aotearoa must not only meet these targets but must sustain them beyond 2050.

21 For long-lived greenhouse gases, there is the option of meeting the target by removing carbon from the atmosphere and storing it – primarily through forestry. Forestry is a lower-cost emissions removal option in the short term.

22 Relying heavily on forestry might help Aotearoa meet its 2050 emissions reduction targets (2050 targets) but it would make maintaining net zero long-lived emissions beyond that date more difficult. It would delay people taking actions that reduce gross emissions, lead to higher cumulative emissions and push the burden of addressing gross emissions on to future generations.

23 Climate change exacerbates forest fires, strong winds, storms, droughts, pests and pathogens – so there are also risks associated with the permanence of using forestry to remove emissions from the atmosphere, as these emissions are released if the forest degrades or is destroyed.

24 Many other countries are planning to rely on carbon capture, utilisation and storage (CCUS) in the long term. This is where carbon dioxide is captured from large emitters and transported to a site where it can either be used or stored in an underground reservoir. We have not relied on this in our analysis as CCUS is an expensive, emerging technology that has not progressed beyond the concept and research stage in Aotearoa.

25 We have designed emissions budgets to have a balance of gross emissions reductions and emissions removals to 'lock in net zero' beyond 2050. The different paths in *Chapter 6: Long term scenarios to 2050* show the kinds of actions that will be needed to reduce gross emissions in line with this balance.

26 Meeting targets in a way that locks in net zero requires rapid and sustained action to 2050. This means people need to decarbonise the sources of long-lived greenhouse gas emissions wherever possible, and only use carbon removals to offset emissions from hard-to-abate sectors.

27 We have set emissions budgets that would require near-complete decarbonisation in areas where it is technically and economically possible. There are already technologies that can be widely used to reduce emissions from low- and medium-temperature heat used in industry, electricity generation, energy use in buildings and land transport.

5.1.3 Build a long-term carbon sink

28 Achieving full decarbonisation will be very challenging in some sectors, so Aotearoa will need to build a long-term carbon sink (i.e. ongoing carbon removals) that is large enough to offset residual long-lived greenhouse gas emissions without the need for ongoing land use conversion.

29 A carbon sink removes carbon from the atmosphere and stores it.

30 **New exotic production forests** (particularly pine) absorb carbon quickly, but reach their average carbon stock (i.e. volume of standing carbon) after around 20 years. To keep adding to the amount of carbon stored in forestry, new land will need to be converted to forestry. We consider that the primary role of exotic production forests should be to support net emissions reductions prior to 2050. However, these should not be at the expense of progress to reduce gross emissions of long-lived greenhouse gases in those sectors where there are already clear routes for decarbonisation. Exotic forestry will also play an important role in providing construction materials and biomass feedstock for the bioeconomy, allowing biomass to be used as a replacement for fossil fuels. Some exotic forests have been established for carbon revenue, with no intention to harvest. If well managed, some of these could transition to native forests, but there are concerns that they may degrade and create environmental risks over the long term if not well managed.

31 **New permanent native forests** absorb carbon more slowly but will continue to do so for centuries until they reach maturity. Because of this, we consider that carbon removals from new permanent native forests have a role to offset the remaining long-lived greenhouse gas emissions in sectors with limited opportunities to reduce emissions from 2050. For instance, this could include offsetting residual nitrous oxide emissions from agriculture and residual industrial process emissions.

32 Aotearoa will need to start now to grow new native forests so that carbon removals can be used to offset the remaining long-lived greenhouse gas emissions from 2050 onwards. Establishing new native forests on less productive land offers a way for Aotearoa to build up an enduring carbon sink that supports intergenerational equity while minimising any loss to agricultural production and delivering wider benefits for erosion, soil health, water quality and biodiversity.

5.1.4 Contribute to the global 1.5°C effort

33 Aotearoa has a strong focus on getting to net zero – the support for the Climate Change Response (Zero Carbon) Amendment Act in 2019 shows that this is a collective goal. At the same time, the Commission also has to consider how Aotearoa is contributing to the global effort of keeping warming to 1.5°C.

34 There is no one prescriptive path of emissions reductions for Aotearoa or any other nation that will guarantee the world limits warming to within 1.5°C. This also means there is no single prescribed way to determine whether our recommended emissions budgets are compatible with contributing to the global 1.5°C effort.

35 The targets in the Act were set at a level that the Government viewed to be in line with the effort of limiting warming to 1.5°C above pre-industrial levels. In setting these targets, the Government drew on the Intergovernmental Panel on Climate Change (IPCC) *Special Report on Global Warming of 1.5°C* released in 2018. At a high level, this means that any emissions budgets set to meet our domestic targets are also consistent with what Aotearoa needs to do to meet international obligations.

36 We have also considered how emissions of the different gases would change under these budgets compared to the IPCC's assessment of global 1.5°C pathways. These global pathways provide useful insights for considering how our recommended emissions budgets contribute to limiting warming to 1.5°C. However, the pathways represent global averages and do not set out prescriptive pathways for individual nations. There is no 'right way' to reduce emissions.

37 As a result, we looked at the relative reductions and global trajectories for the different gases, drew out the key lessons and features, and then applied these in the Aotearoa context.

38 Our recommended budgets would put Aotearoa on track to meet the targets in the Act. The demonstration path would deliver net carbon dioxide emissions from Aotearoa at zero by 2038. It would also deliver combined emissions of nitrous oxide and carbon dioxide at net zero by 2050.

39 The reductions in biogenic methane in our recommended emissions budgets would put Aotearoa on track to meeting the biogenic methane target of reductions of at least 24%-47% by 2050. If some of the more uncertain methane reducing technologies come to fruition, biogenic methane emissions could reduce further.

40 The total contribution Aotearoa makes to the global 1.5°C effort is not limited to what can be done domestically. We have recommended emissions budgets that are ambitious and can be achieved solely through domestic actions. The Government can choose to increase the country's total contribution by reducing emissions offshore. This is discussed in more detail in *Chapter 21: The global 1.5°C effort and Nationally Determined Contribution for Aotearoa.*

5.1.5 Move as fast as real-world constraints allow

41 During consultation, some submitters requested we recommend more ambitious emissions budgets, and in particular a more ambitious first emissions budget.

42 Even with swift and decisive action, there are real-world constraints that mean it takes time to build momentum to make significant emissions reductions. For example, the time it takes people to build supply chains for new technologies, get electric vehicles (EVs) into the country, build up infrastructure such as electricity lines and EV charging infrastructure, develop supply chains and markets for horticultural products, and upskill farm advisors to support practice changes on farm.

43 We're recommending emissions budgets that we judge will enable Aotearoa to move as fast as these real-world constraints allow. This helps us to recommend budgets that are ambitious. At the same time, emissions budgets need to be achievable and sustainable so we are not recommending moving faster than these real-word constraints allow.

44 Some of these real-world constraints mean that we do not see deep reductions within the first emissions budget period. However, the actions we take within that time will be critical for setting Aotearoa up to deliver deep reductions in subsequent emissions budget periods.

45 Going beyond these real-world constraints would limit the options for reducing emissions. This could force businesses to reduce production or even close – having detrimental flow on effects to society – when there may have been solutions for reducing emissions if a different course was taken. A thriving economy and society is vital for ensuring that both current and future generations can make continual and enduring emissions reductions over time.

46 There could also be unintended consequences, where moving too quickly could increase global emissions or make future emissions reductions within Aotearoa more challenging. For example, this might happen if production moves offshore to other countries in a way that increases global emissions, or if electricity prices increase as fossil gas use is reduced too quickly and therefore slow emissions reductions from electrifying transport and heat.

47 Boxes 5.1, 5.2 and 5.3 outline the real-world situation for three key opportunities for reducing emissions – the shift to EVs, reduction in the use of fossil gas, and changing farm management practices.

Box 5.1: The shift to electric vehicles

EVs will be a key technology for decarbonising transport. To meet our recommended emissions budgets, Aotearoa would need to stop importing ICE vehicles between 2030 and 2035. This is in line with decisions by other developed countries and with the latest modelling by the International Energy Agency.

In considering what is technically achievable, we must consider the constraints around the supply of EVs. About 50% of vehicles imported into Aotearoa are used and about 90% of these used vehicles come from Japan. The speed with which Japan rolls out EVs will affect how quickly we can roll out EVs here in Aotearoa in the short term. Historically EV uptake in Japan has been low. However, Japan is aiming for all vehicles entering their fleet from the mid-2030s to be low-emissions vehicles. We have reflected these constraints in our recommended emissions budgets.

We heard from some submitters during consultation that our assumptions for EV uptake were too ambitious given these supply constraints. In our final advice, we have amended our assumptions and have highlighted different paths that could achieve our recommended emissions budgets (see *Chapter 7: Demonstrating emissions budgets are achievable* for more detail).

If EV supply was to be lower, we could still achieve emissions budgets by rolling out more conventional hybrids, by importing more new EVs as opposed to used EVs, and through more behaviour change in how, and how much, we travel.

It is also possible that EV supply could be higher than we have assumed, particularly in the second and third emissions budget periods, given how rapidly the EV market is developing. EV uptake in Europe has rapidly increased in response to policy, and despite the COVID-19 pandemic new EV markets are emerging in other countries. Several vehicle manufacturers announced plans in early 2021 to produce only EVs (see *Chapter 6: Reducing emissions from transport, buildings and urban form* in the *2021 Supporting Evidence*).

Policy will play an important role in speeding up EV uptake. The Act requires us to recommend emissions budgets that are achievable. At this point in time, we cannot be confident that EV uptake will be faster than we assume. However, we would welcome faster uptake if it was possible, and could revise future emissions budgets if circumstances change and new information comes to hand.

More detail on how policy can help speed up the shift to EVs is discussed in *Chapter 14: Policy direction for transport.*

Box 5.2: Reducing the use of fossil gas

The transition away from fossil gas and other fossil fuels is important for achieving the 2050 targets. Much of the fossil gas is used for producing chemicals, generating electricity, process heat, and heating and cooking in buildings.

One factor in the transition away from fossil gas is the company Methanex. Methanex produces methanol from fossil gas and consumes around 40% of the total domestic fossil gas supply. As a large user of fossil gas, Methanex's demand incentivises fossil gas producers to continue production to supply all users. Methanex can also provide flexibility by reducing its demand and methanol production when there is an interruption in supply or in dry years when the hydro lakes are low.

The supply of fossil gas could reduce over time. Current fossil gas fields are likely to reach the end of their economic life. This would reduce the amount of fossil gas available for all users. In the long term, it may become uneconomic for Methanex to continue operating in Aotearoa in its current form.

The speed with which Aotearoa reduces fossil gas use for generating electricity needs to be carefully managed to ensure electricity remains reliable and affordable. Fossil gas currently plays an important role in maintaining this reliability and affordability by backing up renewable generation, particularly at peak times in winter and in dry years.

Removing fossil gas too quickly from the system could increase electricity prices and reduce reliability. This could have significant consequences for the electrification of transport and low- to medium-temperature process heat – two big opportunities for reducing emissions in Aotearoa. Access to reliable and affordable electricity will also support homeowners and businesses as they gradually transition away from fossil gas for heating and cooking.

There are options for reducing the use of fossil gas for electricity generation. However, these options are currently expensive and therefore also need to be carefully assessed against the size of the potential emissions reductions while balancing electricity system reliability and affordability.

There are currently fewer options for moving away from fossil gas for industries that need high-temperature process heat and rely on fossil gas as a feedstock for products like urea. Alternative technologies are in the early stages of development and are expensive.

There are solutions for moving away from using fossil gas in heating and cooking, such as heat pumps and induction stove tops. Biogas and hydrogen may also offer opportunities. There is an upfront cost to replacing fossil gas appliances, boilers and infrastructure. This cost can be minimised by replacing appliances with low-emissions alternatives when they reach the end of their useful life.

As the use of fossil fuels is phased down, the diminishing role of fossil gas across the energy system will need to be carefully managed and sequenced as there may be consequences for network infrastructure and the workforce.

More detail on how policy can help manage the phase out of fossil gas is discussed in *Chapter 15: Policy direction for energy, industry and buildings.*

Box 5.3: Changing farm management practices

Widespread changes to farm management practices will play a key role in reducing emissions from the food and fibre sector.

Farming and growing in Aotearoa has been at the global leading edge in terms of efficiency in recent decades. Changing farm management practices will keep Aotearoa in that position and maintain credibility with consumers as their attention increasingly turns to climate change and other environmental issues.

Making these practice changes is both ambitious and achievable, in line with what is required under the Act. This widespread change requires many of the people who own or manage the 20,000 – 30,000 farms in Aotearoa to calculate their emissions, assess what changes are needed to reduce emissions, and put these changes into practice.

Farms are complex biological systems. The mix of animals, plants, soils and feed means that each farm has its own unique emissions profile. Changing one element of the farm system will have impacts on other parts of the system, and on emissions. For example, changing what an animal is fed will affect how much meat or milk it produces, how much methane it emits, as well as how much nitrogen is deposited.

What an optimal system looks like will vary considerably between farms. Reducing emissions on-farm requires each farmer to be able to tailor solutions to their specific farm context, including the farm's climate, soil and geography. Each farmer will need to carefully balance stocking rates, pasture and fertiliser management, and supplementary feed to optimise for production, profit, emissions reductions and other environmental outcomes.

Farmers will need advice from expert farm advisers to estimate what their farm emissions are and to identify how they can optimise their farm system to reduce emissions and address other environmental and business objectives. Developing these plans across the tens of thousands of farms in Aotearoa will take time. It will also take time to upskill farm advisers so they can provide advice on the comprehensive range of issues farmers will need to consider.

He Waka Eke Noa, the Primary Sector Climate Action Partnership, has milestones for 100% of farmers and growers to know their total annual on-farm emissions by the end of 2022, and for 100% to have a written plan for measuring and managing their emissions by the end of 2024.

More detail on how policy can help deliver widespread farm management practice changes is discussed in *Chapter 17: Policy direction for agriculture.*

5.1.6 Develop emissions budgets that can be delivered in light of uncertainty

48 We developed a range of scenarios to look at possible futures to 2050 and beyond to understand the changes that are possible and required. Our scenarios were designed to look at how Aotearoa could meet the 2050 targets if future conditions around technology and behaviour change were more, or less, favourable.

49 The Headwinds scenario is our least optimistic scenario that examines what could happen if there are more barriers to adopting new technology and less behaviour changes in the future. The Tailwinds scenario is our most optimistic scenario and shows what could be possible if there were fewer barriers to technology and more behaviour changes. See *Chapter 6: Long term scenarios to 2050* for more detail.

50 We cannot be certain in how technologies develop or behaviours change. So, while policy should aim for a Tailwinds performance, we cannot be confident that Aotearoa could achieve emissions reductions in line with Tailwinds and so are not recommending emissions budgets quite as ambitious as this.

51 The Act requires us to recommend emissions budgets that are both ambitious and achievable. For this reason, we have tested that there are different paths that could deliver our recommended emissions budgets.

5.2 Principles to guide the Aotearoa transition

52 Underpinning the judgements in the previous sections are a set of key principles that can help guide people's decisions on the transition to low emissions.

53 During consultation, feedback we heard from submitters indicated that we needed to clarify the purpose of the principles. We put together these principles as a practical distillation of the considerations of the Act. These principles can be used by everyone involved in the transition – individuals, Iwi/Māori, the private sector and public sector – to shape their strategy and make decisions. Individuals, Iwi/Māori, the private and public sectors will all play unique but important roles in the transition.

54 These principles build on our framework described in *Chapter 3: The role of the Climate Change Commission*. At the foundation, we must approach the transition through the lens of people, the environment, te ao Māori and give effect to Te Tiriti o Waitangi/The Treaty of Waitangi principles of partnership, protection, participation, and equity. Accordingly, our approach must recognise the guarantee of rangatiratanga and kaitiakitanga for Iwi/Māori under Te Tiriti o Waitangi/The Treaty of Waitangi.

55 The key principles for a low-emissions transition strategy are as follows:

1. **Transition in an equitable and inclusive way.** Aotearoa should take an approach to the transition that is in line with tikanga values. It must give effect to partnership with Iwi/Māori. Working inclusively also means working in collaboration with businesses, workers and unions, and different community groups. How Aotearoa responds to climate change should consider who will be most impacted and how any negative impacts can be mitigated. Aotearoa should take immediate action to set up well-paced and sustained emissions reductions, reducing the risk of abrupt shocks. By doing this, Aotearoa will be best placed to enhance living standards, health and wellbeing of both current and future generations. The path Aotearoa takes should aim to reduce or even reverse inequities on different groups of society, not compound historic grievances with Iwi/Māori, and not penalise early movers.
2. **Take a long-term view to 2050 and beyond**. Aotearoa will need to adopt actions that not only set it on a path to meet emissions reduction targets, but which sustain those targets beyond 2050, set up for net negative emissions later and contribute to the global effort to limit warming to 1.5°C. Meeting these goals requires a long-term view of investments and infrastructure developments. Actions that are taken in the next five years will need to set Aotearoa up to deliver the deeper reductions required in subsequent emissions budgets to meet and sustain the 2050 targets.

3. **Prioritise gross emissions reductions.** Emissions must be reduced at source to prevent further warming of the atmosphere and meet emissions reduction targets. Aotearoa should prioritise actions that reduce gross greenhouse emissions rather than reducing production. Removing and storing carbon through forestry will still play an important role but should not displace making gross emissions reductions. Relying heavily on forestry before 2050 is likely to make maintaining net zero long-lived greenhouse gas emissions after 2050 challenging. It would delay action, lead to higher cumulative emissions and put the burden of reducing gross emissions on to future generations. It would also require significantly more land to be converted to forestry in the future.
4. **Create options and manage uncertainty**. There is much uncertainty in embarking on this decades-long transition. Uncertainty is not a reason for delay. There is value in creating options for meeting the targets and having the ability to adjust course as the transition proceeds. Aotearoa should deploy low-emissions technologies that are commercially available now. People should also make decisions that open up a wide range of future options and keep options open for as long as possible. This will spread risk and make the transition more resilient.
5. **Take a systems view.** Addressing climate change requires people to transform the way they live and how they go about business. All sectors have a role to play in the low-emissions transformation, and each should take actions in line with the available opportunities. Making a change in one sector can have flow-on consequences in other sectors. The actions people take now also have flow-on consequences to the emissions reductions people can achieve later. People should consider the dynamics and interconnections, what opportunities they could bring, and the potential for unintended consequences.
6. **Avoid unnecessary cost.** The actions Aotearoa takes to meet emissions budgets and targets should avoid unnecessary costs. This means using measures with lower costs and planning ahead so that technologies, assets and infrastructure can be replaced with low-emissions choices on as natural a cycle as possible. This will help to avoid scrapping assets before the end of their useful lives or being left with stranded assets.
7. **Increase resilience and manage risks.** The actions Aotearoa takes to reduce emissions should help manage increasingly extreme weather events, increasing risk of drought and flooding, increasing fire danger, and increasing incidence of pests and diseases. Where possible, actions should increase the country's resilience to the impacts of climate change that are already being experienced and that will increase in the future.
8. **Leverage co-benefits**. The actions Aotearoa takes to meet emissions budgets and targets should consider the wider benefits, including benefits to health, broader wellbeing and the environment. Co-benefits can provide further reason to take particular actions where the initial emissions reductions may be modest or appear relatively costly.

5.3 Our recommendation on the level of the first three emissions budgets

56 Under the Act, we must provide the Minister of Climate Change with advice on the level of the first three emissions budgets. The first emissions budget covers the 4-year period from 2022 to 2025, while the second and third budgets are both 5 years, covering 2026 to 2030 and 2031 to 2035.

57 We have provided our recommendation on the level of the first three emissions budgets in Recommendation 1. In making this recommendation, we have drawn on the judgements outlined in the preceding sections, and on the analysis provided in Chapters 6-9 of this report. We consider that our recommended emissions budgets are both ambitious and achievable. Box 5.4 outlines the potential consequences of setting emissions budgets more or less ambitious than we have recommended.

58 If new technologies were to come on the market in the next few years, it may be possible and sensible to overachieve on these budgets. The time it takes to roll out new technologies and change behaviour means that significant emissions reductions may not be observed until the next emissions budget period. However, in this case we would have reason to revise future emissions budgets in light of these developments.

59 We are required under the Act to provide emissions budgets that include all greenhouse gases expressed as a net quantity of carbon dioxide equivalent. In the next section, we also provide the breakdown by gas and for biogenic methane and long-lived greenhouse gases. Providing the breakdown of biogenic methane and long-lived gases allows us to distinguish between different greenhouse gases and align with the country's domestic emissions reduction targets.

60 The Act requires us to use the GWP_{100} metric to calculate emissions budget levels. GWP_{100} values are regularly reassessed by the IPCC. Our recommended 'all gases' emissions budgets outlined in Recommendation 1 are expressed in units of $MtCO_2e$, based on the GWP_{100} metric from the IPCC's *Fifth Assessment Report (AR5)*. The Government should set emissions budgets using the *AR5* GWP_{100} values, to be consistent with international obligations relating to Inventory reporting. Net emissions and removals by forestry are calculated using a modified activity-based approach (see *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets*).

61 Our analysis throughout this report is based on the GWP_{100} values from the IPCC's *Fourth Assessment Report (AR4)*. Table 5.1 outlines the GWP_{100} values from *AR4* and *AR5* for carbon dioxide, methane, nitrous oxide and the common refrigerant gas HFC-134a. This table does not include a full list of all greenhouse gases, in particular the large number of F-gases.

62 Table 5.2 outlines the draft emissions budgets that we consulted on (in *AR4* GWP_{100} values) and our recommended emissions budgets (both in *AR4* and *AR5* GWP_{100} values).

63 Our recommended emissions are higher than in our draft advice primarily due to increases in historic emissions estimated in *New Zealand's Greenhouse Gas Inventory* and increases in projected emissions under the Current Policy Reference case.

Table 5.1: GWP_{100} values from the IPCC's AR4 *and* AR5 *for some greenhouse gases*

	GWP_{100} values	
	AR4, no climate-carbon feedbacks	*AR5*, no climate-carbon feedbacks
Carbon dioxide	1	1
Methane	25	28
Nitrous oxide	298	265
HFC-134a	1,430	1,300

Table 5.2: The levels of the first three emissions budgets in our draft advice and our final recommendations

	2019	Emissions budget 1 (2022 - 2025)	Emissions budget 2 (2026 - 2030)	Emissions budget 3 (2031 - 2035)
Draft emissions budgets (*AR4*) Annual average	72.1 Mt CO_2e/yr	271 MtCO_2e 67.7 Mt CO_2e/yr	286 MtCO_2e 57.3 Mt CO_2e/yr	223 MtCO_2e 44.6 Mt CO_2e/yr
Final emissions budgets (*AR4*) Annual average	74.9 Mt CO_2e/yr	278 MtCO_2e 69.5 Mt CO_2e/yr	298 MtCO_2e 59.7 Mt CO_2e/yr	240 MtCO_2e 47.9 Mt CO_2e/yr
Final emissions budgets (*AR5*) Annual average	78.0 Mt CO_2e/yr	290 MtCO_2e 72.4 Mt CO_2e/yr	312 MtCO_2e 62.4 Mt CO_2e/yr	253 MtCO_2e 50.6 Mt CO_2e/yr

Recommendation 1

Emissions budget levels

We recommend the Government set and meet the emissions budgets as outlined in the table below. These emissions budgets are expressed using GWP_{100} values from the IPCC's *Fifth Assessment Report (AR5)* for consistency with international obligations relating to Inventory reporting.

	2019	Emissions budget 1 (2022 - 2025)	Emissions budget 2 (2026 - 2030)	Emissions budget 3 (2031 - 2035)
All gases, net (AR5)		290 MtCO_2e	312 MtCO_2e	253 MtCO_2e
Annual average	78.0 MtCO_2e	72.4 MtCO_2e/yr	62.4 MtCO_2e/yr	50.6 MtCO_2e/yr

Box 5.4: The consequences of setting emissions budgets more or less ambitious than recommended

In recommending emissions budgets, we have balanced the need for budgets to be ambitious, achievable, and fair, inclusive and equitable.

Some submitters to our *2021 Draft Advice for Consultation* have requested faster transitions, and in particular for deeper reductions starting immediately. More ambitious emissions budgets would mean transitioning faster than real-world constraints for deploying technology, developing supply chains, infrastructure and markets allow. This has a number of consequences:

- Communities may not have time to work together to plan for the changes they'll see in their community, or to determine solutions for supporting those most adversely impacted and least able to adjust.
- Households and businesses could need to prematurely scrap some assets like vehicles and boilers before the end of their useful life, increasing costs.
- Acting too quickly could have unintended consequences for reducing emissions. For example, reducing fossil gas too quickly could increase electricity prices and reduce electricity reliability. However, reliable and affordable electricity is vital for enabling greater emissions reductions by electrifying transport and process heat.
- Some of our industries – like cement and steel – are bespoke and hard to abate. Solutions for decarbonising these industries are further off. Acting too quickly could see some of these industries close before strategic decisions can be made. Once closed, it would be difficult to get these industries back again.
- Some businesses that do have solutions for reducing emissions may not have the time to plan, upskill staff and deploy these solutions. A quicker transition may therefore force these businesses to reduce production.
- Reducing production and closing industries would have significant flow-on effects to jobs, broader society and the economy. This could undermine public support for the transition. It would also reduce our resilience and ability to put in place solutions to make continual and lasting emissions reductions. Environmentally and socially sustainable jobs, a productive economy and the wellbeing of the people who live here are vital for future generations and sustainable prosperity over the long term.

Other submitters requested a slower transition, stating that our draft emissions budgets would be costly to meet. A less ambitious transition would mean transitioning slower than real-world constraints allow and comes with a number of consequences:

- Delaying action on reducing emissions would increase cumulative emissions and our contribution to warming. It would push the burden of reducing emissions to young people and future generations. It would risk other countries following suit. Slower global action would reduce the ability for society and natural systems to adapt to the physical impacts of climate change and expose a greater number of people to climate-related risks, including risks to health, water supply, and food security.
- Businesses would risk missing opportunities for developing new low-emissions products and services, and could lose market share or access to some markets or to investment from delayed action. Businesses could also be left with stranded assets from a delayed but more disruptive transition later. Climate change is a material financial risk, and investors are increasingly taking account of this. Businesses are responding to consumer demand for low-emissions products, and are increasingly looking at emissions across their supply chains and requiring their suppliers to reduce emissions.

- Delaying action could risk a faster, and more disruptive transition later that could have significant impacts on jobs, society and the economy. It risks missing opportunities for economic growth. It risks missing opportunities for driving down costs from deploying solutions and learning by doing. It may not allow time to plan and signal the transition, and ensure that costs do not disproportionately fall on those who are least able to bear those costs. It could also miss opportunities for improving health and health equity.
- It risks Aotearoa not being able to deliver on the 2050 targets as it fails to take account of the time it takes to deploy technologies, scale up supply chains and build infrastructure. In some areas, immediate and concerted action is needed now to build the momentum needed to deliver the emissions reductions needed by 2050.
- A slower domestic transition would require Aotearoa to pay for more offshore mitigation to meet our Nationally Determined Contribution (NDC) under the Paris Agreement. While offshore mitigation could be used to increase our contribution, it should be used in addition to domestic action rather than replace it (see *Chapter 22: Factors relevant to setting the level of the Nationally Determined Contribution*).
- A slower transition could put the country's international reputation on climate change and environmental issues at risk.
- A slower transition would fail to meet the criteria outlined in the Act to balance intergenerational equity and contribute to global action, and has social and economic risks as described in the preceding bullet points.

5.4 Contribution of different gases, and domestic emissions reductions and domestic removals

64 We have assessed how different greenhouse gases contribute to warming, and the different amounts of domestic emissions reductions and domestic removals needed to meet the emissions budgets and targets. At the core of this assessment is the need to set Aotearoa up to meet the 2050 targets and sustain them beyond 2050.

65 The split-gas nature of the 2050 targets means that forestry removals cannot be used to offset biogenic methane emissions from agriculture and waste to meet this target. Gross biogenic methane emissions need to be reduced by at least 10% below 2017 levels by 2030 and 24-47% below 2017 levels by 2050.

66 Aotearoa would reduce biogenic methane emissions from agriculture and waste by 12.5% by 2030 relative to 2017 under the demonstration path, 11.4% under alternative path A, and 13.3% under alternative path B (see *Chapter 7: Demonstrating emissions budgets are achievable).* Aiming for slightly more than a 10% reduction in biogenic methane by 2030 gives some flexibility to deal with unexpected events, and sets Aotearoa on course to achieve the 2050 targets.

67 Gross emissions of long-lived greenhouse gases need to be reduced to the maximum extent possible to set Aotearoa up to meet and sustain the target of net zero by 2050. Our analysis in *Chapter 6: Long-term scenarios to 2050* shows that, in many sectors, there are clear solutions for reducing gross emissions of long-lived greenhouse gases. This means we could confidently set Aotearoa on a trajectory that would achieve near complete decarbonisation of low- and medium-temperature heat used in industry, electricity generation, energy use in buildings and land transport. Taking actions to meet our recommended emissions budgets would put Aotearoa on track to achieve net zero long-lived gas emissions in the early 2040s.

68 Relying too heavily on forestry removals to offset emissions carries risks. It would require ongoing land-use change to continue offsetting emissions and put the burden of reducing gross emissions on young people and future generations.

69 Table 5.3 outlines what the emissions budgets would equate to in terms of percentage reductions for each gas by 2025, 2030 and 2035, relative to 2019. The biogenic methane target for Aotearoa is at least a 10% reduction by 2030 compared to 2017 levels. Aotearoa would reduce biogenic methane emissions from agriculture and waste by 12% by 2030 relative to 2017 under the demonstration path – an 11% reduction by 2030 relative to 2017 for biogenic methane from agriculture, and 29% from waste.

Table 5.3: The percentage reduction of the different greenhouse gases by 2025, 2030 and 2035. The percentage reductions in this table cannot be directly compared to those in the IPCC pathways, as the IPCC used 2010 as the base year.

	2025	2030	2035
Net long-lived greenhouse gases	15% below 2019	38% below 2019	63% below 2019
Net carbon dioxide	18% below 2019	47% below 2019	78% below 2019
Nitrous oxide	7% below 2019	11% below 2019	16% below 2019
F-gases	6% below 2019	25% below 2019	34% below 2019
Non-biogenic methane	18% below 2019	27% below 2019	32% below 2019
Biogenic methane	8% below 2019	13% below 2019 (12% below 2017)	17% below 2019

Recommendation 2

Break down of emissions budgets

We recommend that the Government implement policies that will meet emissions budgets based on the balance of emissions and removals as outlined in the table below.

	Emissions budget 1 (2022 - 2025)	**Emissions budget 2 (2026 - 2030)**	**Emissions budget 3 (2031 - 2035)**
Total net emissions budget *Annual average*	278 $MtCO_2e$ 69.5 $MtCO_2e/yr$	298 $MtCO_2e$ 59.7 $MtCO_2e/yr$	240 $MtCO_2e$ 47.9 $MtCO_2e/yr$
REMOVALS Forestry carbon removals *Annual average*	26 $MtCO_2e$ 6.6 $MtCO_2e/yr$	50 $MtCO_2e$ 10.0 $MtCO_2e/yr$	69 $MtCO_2e$ 13.8 $MtCO_2e/yr$
EMISSIONS - LONG-LIVED GASES Gross long-lived gases	178 $MtCO_2e$	199 $MtCO_2e$	166 $MtCO_2e$
Carbon dioxide	136 $MtCO_2e$	149 $MtCO_2e$	121 $MtCO_2e$
Nitrous oxide	32 $MtCO_2e$	38 $MtCO_2e$	36 $MtCO_2e$
F-gases	7 $MtCO_2e$	8 $MtCO_2e$	6 $MtCO_2e$
Non-biogenic methane	3 $MtCO_2e$	4 $MtCO_2e$	3 $MtCO_2e$
EMISSIONS - BIOGENIC METHANE Gross biogenic methane*	5.04 $MtCH_4$	5.99 $MtCH_4$	5.70 $MtCH_4$

* Note that biogenic methane amounts are provided in megatonnes of methane ($MtCH_4$). Megatonnes of methane do not equate one-for-one to megatonnes of carbon dioxide equivalent ($MtCO_2e$). As a result, the amounts in this table cannot be summed to give the total net emissions budget. However, the methane volume can be converted into a CO_2e amount by multiplying by 25, the IPCC *AR4* GWP100 value for methane.

Recommendation 3

Reductions by greenhouse gas to meet the emissions budgets

We recommend that the Government implement policies that deliver emissions reductions of each greenhouse gas as outlined in the table below.

	2019	Emissions budget 1 (2022 – 2025)	Emissions budget 2 (2026 – 2030)	Emissions budget 3 (2031 – 2035)
Total net emissions ($MtCO_2e/yr$)				
Annual average	74.9	69.5	59.7	47.9
Reduction from 2019		5.4	15.3	27.0
Total gross emissions ($MtCO_2e/yr$)				
Annual average	82.3	76.1	69.7	61.7
Reduction from 2019		6.2	12.6	20.6
Broken down by:				
Carbon dioxide (gross) ($MtCO_2e/yr$)				
Annual average	37.5	34.0	29.8	24.1
Reduction from 2019		3.5	7.7	13.4
Nitrous oxide ($MtCO_2e/yr$)				
Annual average	8.4	7.9	7.6	7.2
Reduction from 2019		0.4	0.8	1.2
F-gases ($MtCO_2e/yr$)				
Annual average	1.8	1.8	1.6	1.3
Reduction from 2019		0.0	0.2	0.6
Non-biogenic methane ($MtCO_2e/yr$)				
Annual average	0.9	0.8	0.7	0.7
Reduction from 2019		0.1	0.2	0.3
Biogenic methane ($MtCH_4/yr$)				
Annual average	1.35	1.26	1.20	1.14
Reduction from 2019*		0.09	0.15	0.21

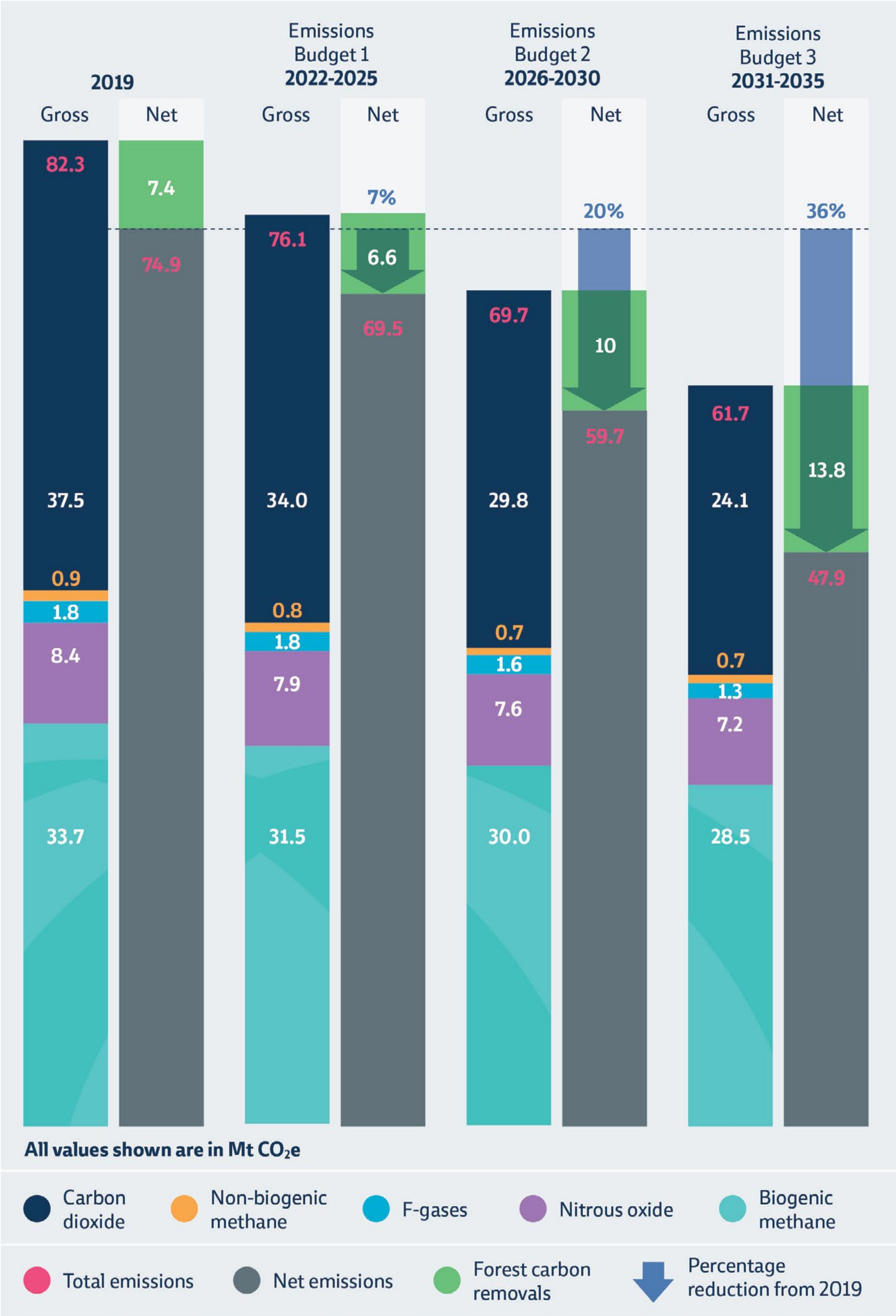


Figure 5.2: Average annual emissions and removals (AR4) by Emissions Budget

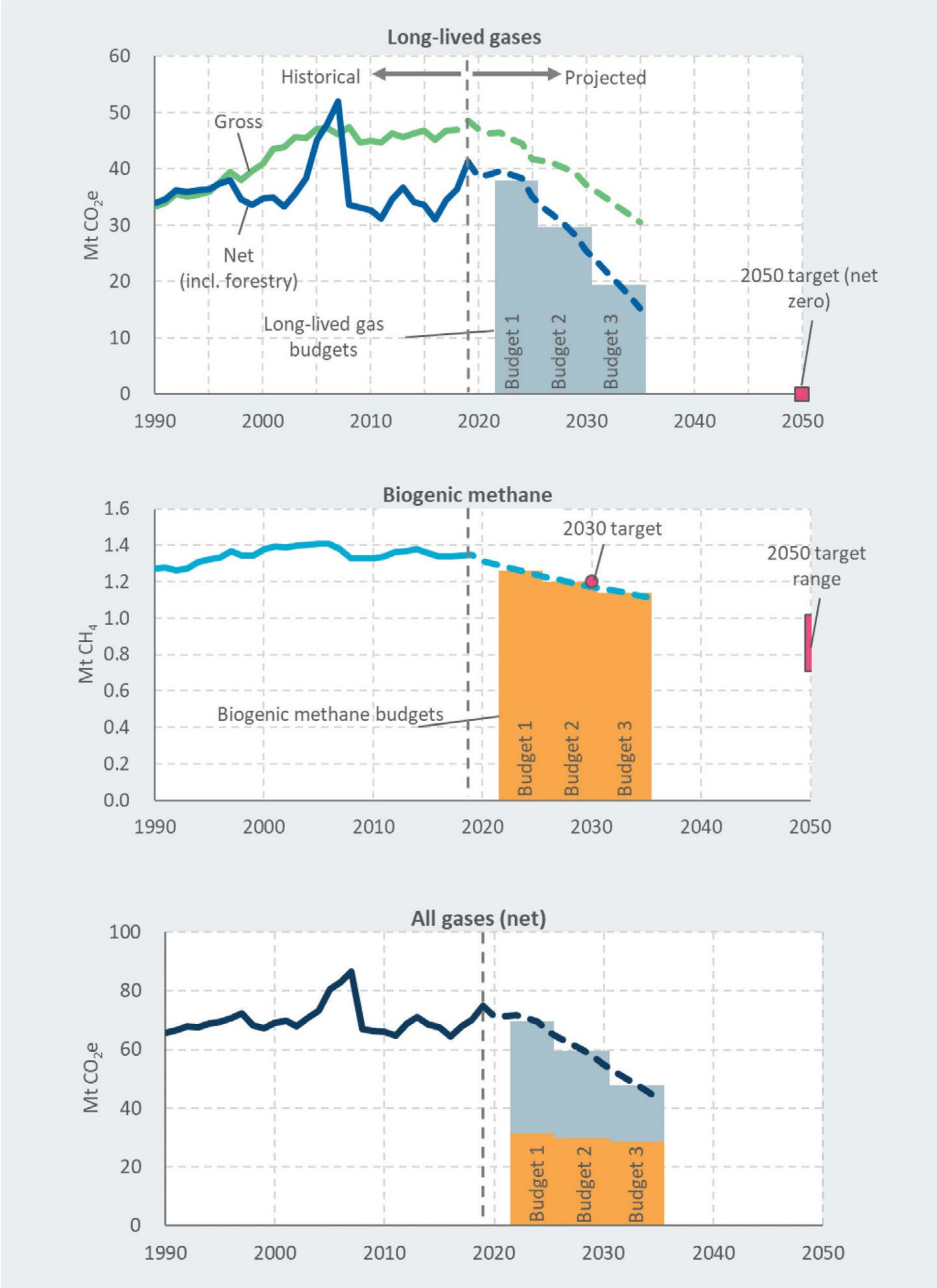


Figure 5.3: These three figures show how our proposed emissions budgets would step Aotearoa towards its emissions reduction targets. The top figure shows long-lived greenhouse gases, the middle figure shows biogenic methane, and the bottom figure shows all gases combined as CO_2-equivalent.

Source: Commission analysis.

Figure 5.4: Emissions of long-lived gases (top) and biogenic methane (bottom) by sector at the end of each budget period in the demonstration path, compared to 2019

Source: Commission analysis.

5.5 Flexibilities for meeting emissions budgets, including offshore mitigation

70 The Act requires the Minister to set emissions budgets for Aotearoa that can be met domestically. In line with this we have recommended emissions budgets that are achievable through deploying technologies and changing behaviour within Aotearoa.

71 This differs from Nationally Determined Contributions (NDCs) adopted under the Paris Agreement. The current NDC for Aotearoa was set on the basis that it would include a contribution from offshore mitigation, in addition to domestic action to reduce emissions (Figure 5.5). More discussion on this can be found in *Chapter 21: The global 1.5°C effort and Nationally Determined Contribution for Aotearoa.*

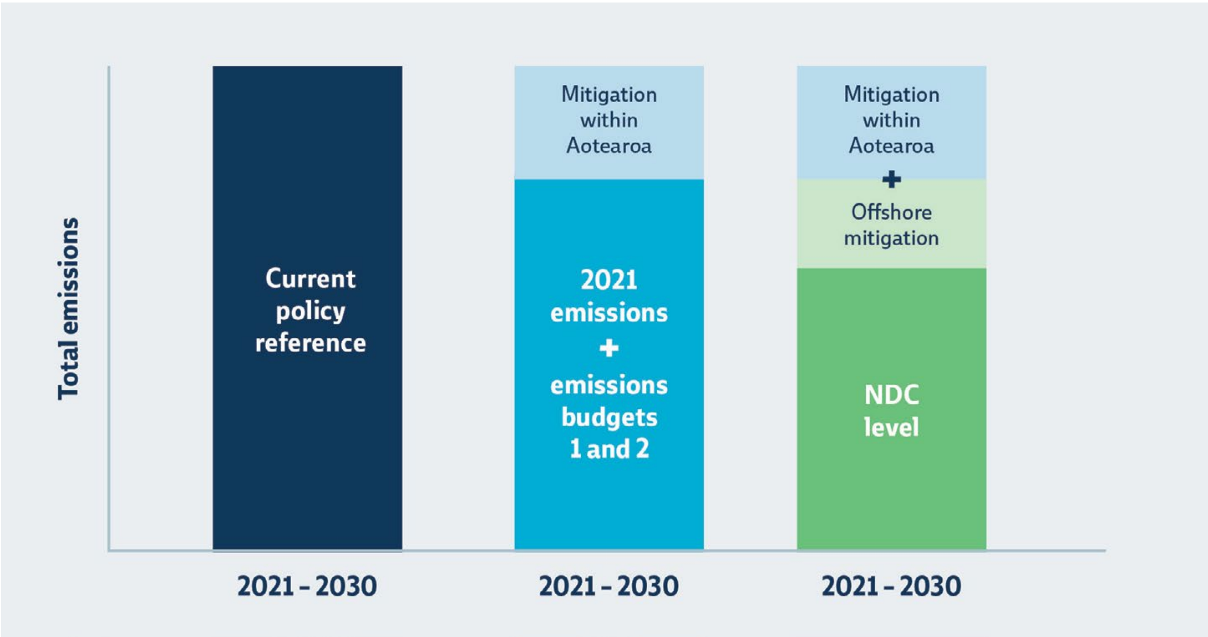


Figure 5.5: Illustration of the role of international mitigation in the NDC compared to emissions budgets

72 While emissions budgets must be set in a way that allows for them to be met domestically, there is always uncertainty when projecting forward in time. In recommending the emissions budgets, we have aimed for them to be resilient to uncertainty and tested that they can be delivered by different paths. The Act also provides some flexibility measures to help manage uncertainty about the future. This section looks more closely at these flexibility measures, how they might be useful and provides advice on the use of one of them, offshore mitigation.

5.5.1 Revising emissions budgets

73 Emissions budgets that have already been set can be revised when a further emissions budget is put in place. For example, in 2024 the Commission will provide advice and in 2025 the Government will set the fourth emissions budget. At this time, the second and third emissions budgets can also be revised if there has been a significant change in circumstances since those emissions budgets were set. The exception is an emissions budget for which the period has already started, in which case revisions are only possible in exceptional circumstances.

74 This flexibility is likely to be useful when relatively long-term technology or behaviour change trends play out differently than anticipated. For example, if a methane inhibitor or vaccine was to become commercially available there may be reason to revise emissions budgets.

5.5.2 Borrowing from the next emissions budget

75 At the end of an emissions budget, up to 1% of the volume from the next emissions budget can be borrowed to help meet the current emissions budget. Borrowing brings emissions forward in time and increases risks that subsequent budgets will be more difficult to meet.

76 The risks to future budgets mean that borrowing should be approached with caution. Our view is that in light of uncertainty, the Government's emissions reduction plans should be set to not only meet but overachieve the budgets. We consider it is prudent to only use borrowing to a very limited extent, for example when the Government finds itself in a position where there is insufficient time in the budget period to adjust policies to ensure emissions are below the budget level.

5.5.3 Offshore mitigation

77 The use of offshore mitigation – buying emissions units or emissions reductions and removals from overseas – should only be used as a last resort for meeting emissions budgets.

78 There was strong support for this advice from submitters, who were overwhelmingly in favour of Aotearoa aiming to meet emissions budgets domestically. A small group of submissions, including some businesses and business-affiliated interest groups, thought offshore mitigation should be allowed, to reduce costs. However, meeting emissions budgets this way shifts the burden of reducing gross emissions onto future generations.

79 We expect that most of the uncertainties in meeting emissions budgets can be managed in the way they are set and revised, and in the way the Government implements its emissions reduction plan. The latter should involve planning to overachieve budgets and refining policies over time in response to how emissions reductions are tracking.

80 Exceptional circumstances may, however, arise – such as force majeure events – which are unpredictable, unpreventable, outside the control of the Government and which cause a large one-off increase in emissions. Examples include disasters such as an earthquake, a volcanic eruption, or a major disruption.

81 If such events occur, the timing and scale of the emissions increase may be so large that it cannot be made up for domestically. We consider that for the first three emissions budgets, only these types of exceptional circumstances justify using offshore mitigation. Even if this happens, Aotearoa should exhaust its domestic options first, with offshore mitigation being the last resort.

82 As emissions reduce, however, it may become harder and more expensive to reduce emissions further. If there were consistent barriers in the known areas of uncertainty or if technologies were to repeatedly deliver fewer emissions reductions than expected, it could become more difficult to stay on track to meet the 2050 target. This is why the Commission may revisit the possibility of offshore mitigation for later emissions budgets as Aotearoa approaches 2050.

83 By their nature, the exceptional or force majeure circumstances that would justify using offshore mitigation are difficult to foresee or quantify. It is not possible to predict the scale of offshore mitigation that might be needed if they occur. Therefore, we advise a limit on offshore mitigation of zero for the first three emissions budgets except in exceptional circumstances, for example force majeure events.

Recommendation 4

Limit on offshore mitigation for emissions budgets and circumstances justifying its use

We recommend that, given that emissions budgets must be met as far as possible through domestic action, for the purposes of meeting emissions budgets:

a. The limit on offshore mitigation should be zero for the first three emissions budgets.
b. The only circumstances that at this stage would justify the use of offshore mitigation is as a last resort in exceptional circumstances beyond the Government's control, such as force majeure events, where domestic measures cannot compensate for emissions impacts.

Chapter 6

Te pae tawhiti ki 2050
Long-term scenarios to 2050

Summary

There are a number of actions that are critical over the next 15 years to put Aotearoa on track to meeting its 2050 targets. How quickly these actions can be taken up is uncertain and will depend on a number of factors, for example availability of technology.

The Commission has developed multiple scenarios to understand how Aotearoa could meet the 2050 targets under a range of possibilities. This shows what actions are key to meeting the 2050 targets.

We have also looked at what would happen to emissions if Aotearoa continued as it is now and made no changes to policy, and what would happen if Aotearoa followed an approach that focused on reducing net rather than gross emissions. The 2050 targets would not be achieved or sustained under either scenario.

Our scenarios allow us to gain a number of insights on critical actions:

For long-lived gases

- Replacing fossil fuels with low-emissions electricity is an essential part of the transition and will require major expansion in the electricity system that needs to start now.
- Road transport can be almost completely decarbonised by 2050 by increasing walking, cycling and public transport use, reducing travel by working from home, and by switching to low emissions vehicles.
- Reducing emissions from transport will require a rapid increase in electric vehicle sales so that nearly all light vehicles entering the country are electric by 2035.
- Low- and medium-temperature heat in industry and buildings could be decarbonised by 2050 through a switch away from coal, diesel and fossil gas to electricity and biomass.
- New native forests can be established on steeper, less productive land to provide a long-term carbon sink.
- Exotic production forestry has a role to play until other more enduring sources of carbon removals, such as native forestry, can scale up.

For biogenic methane

- Meeting the 2050 biogenic methane target is possible through widespread adoption of improved farm management practices, and a combination of waste reduction and diversion from landfills.
- Developing and widely adopting new technologies to reduce livestock methane emissions could enable Aotearoa to exceed the more ambitious end of the 2050 methane target range. Increasing landfill gas capture would also contribute.
- Without new technologies, meeting the more ambitious end of the target range would likely require significantly lower agricultural production from livestock and more land-use change.

Changes in our final advice

We have provided more details of would happen without changing policy, and what would happen if Aotearoa focused on net emissions and not gross.

Figures for greenhouse gas emissions have been updated to reflect the latest national Greenhouse Gas Inventory published in April 2021. This update provided estimates of emissions in 2019, as well as improving estimates of past emissions.

Introduction

1 Under the Climate Change Response Act (the Act), emissions budgets must put Aotearoa on track to meet its 2050 emissions reduction targets (2050 targets).

2 To understand the pace and types of change that might be needed over the next 15 years to put Aotearoa on track to meet these targets, we modelled a series of long-term scenarios. Each of these long-term scenarios differed in the assumed amount of technology and behaviour change.

3 Assessing the potential for future emissions reductions always has some uncertainty. Technologies could end up reducing in cost faster than we expect, while other technologies could be slower. To provide us with confidence that Aotearoa can meet the 2050 targets, Aotearoa needs to make decisions now that open up options in the future. This will provide some contingency in the case that particular technologies or behaviour changes do not play out as expected.

4 In this chapter, we look at the emissions reductions that could be achieved if Aotearoa was to continue under its current policy settings. We then look at several long-term scenarios to understand the actions that would be critical to deliver the 2050 targets. We also looked at what would happen if Aotearoa was to take an approach that focused on reducing net rather than gross emissions.

6.1 Emissions in Aotearoa now

5 In 2019, gross greenhouse gas emissions in Aotearoa were about 48.6 $MtCO_2e$ of long-lived greenhouse gases and 1.35 $MtCH_4$ of biogenic methane. These are the most recent numbers available.

6 Agriculture is currently the largest source of biogenic methane, with the remainder from waste.

7 Long-lived greenhouse gas emissions are mainly from carbon dioxide, but also include nitrous oxide. We have also included non-biogenic methane and F-gases in this category to align with the split-gas target in the Act, although non-biogenic methane and some F-gases are short-lived. Transport, buildings, heat, industry and electricity, agriculture and waste all emit long-lived greenhouse gases (Figure 6.1).

8 The level of gross emissions has been relatively stable in recent years. However, emissions from domestic transport have continued to rise even as emissions from other sectors stabilised or decreased. The next section considers how emissions could change in the coming years under current policy settings.

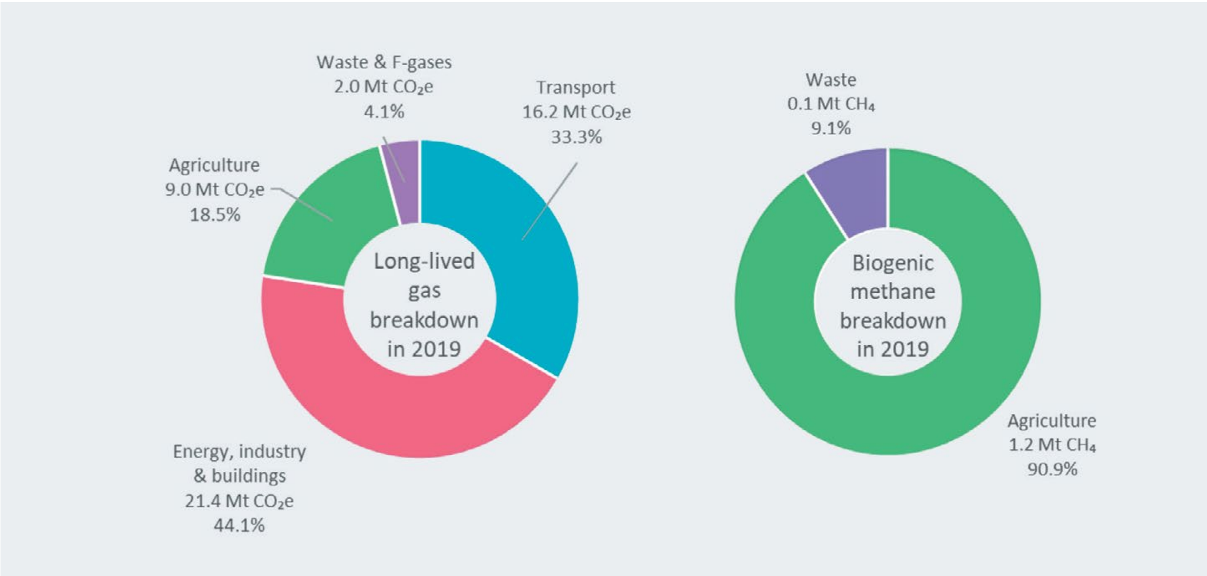


Figure 6.1: The sources of gross long-lived greenhouse gases and biogenic methane in 2019 broken down by sector. Agricultural biogenic methane emissions are 50% dairy, 48% sheep and beef and 2% other. Note: Building emissions relates to their energy use, but not construction.

Source: *New Zealand's Greenhouse Gas Inventory.*

Box 6.1: Revisions to New Zealand's Greenhouse Gas Inventory

Figures for greenhouse gas emissions presented in this report have been updated to reflect the latest version of *New Zealand's Greenhouse Gas Inventory* (the GHG Inventory) which was published by the Government in April 2021. This update provided estimates of emissions in 2019, as well as improving estimates of past emissions.

The new estimates are higher than the estimates that were available when the Commission provided its *2021 Draft Advice for Consultation* in February 2021. Improvements to the GHG Inventory can increase or decrease the estimated level of emissions and are important for keeping the GHG Inventory in line with the latest understanding of the science. The Government will need to take into account the impact of changes in the GHG Inventory in how it plans to meet the emissions budgets. This is discussed further in *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets.*

6.2 Current policies do not enable Aotearoa to achieve targets

9 As a starting point for our analysis, we looked at how emissions and activities could evolve assuming no changes to current government policy between now and 2050.

10 We assess this through our Current Policy Reference case, which is a scenario that aligns with government agencies' latest emissions projections as far as possible. Under current policies, long-lived greenhouse gas emissions (Figure 6.2) and biogenic methane emissions (Figure 6.3) are both projected to fall. However, the level of emissions reductions would not be sufficient to meet the 2030 and 2050 targets.

11 Net long-lived greenhouse gas emissions are projected to fall from 41.3 $MtCO_2e$ in 2019 to 9.8 $MtCO_2e$ by 2050 under current policy settings. These net emissions reductions come mostly from increased carbon removals, with 1.1 million hectares of new forest, mostly exotic, planted by 2050. This level of forest planting is projected to occur in response to emissions prices, and in particular the price of units in the New Zealand Emissions Trading Scheme (NZ ETS), staying constant in real terms at $35.

12 Gross long-lived greenhouse gas emissions would also fall. This is primarily due to widespread use of electric vehicles expected after 2035, the announcement by Rio Tinto that the Tiwai Point aluminium smelter would close at the end of 2024, and the assumption that declining fossil gas supply results in methanol production declining in Aotearoa in the next few decades. Other sources of long-lived greenhouse gas emissions are largely unchanged.

13 Biogenic methane emissions are projected to fall 7% below 2017 levels by 2030 compared with the target of 10%. By 2050, they are projected to fall 11% below 2017 levels compared with the target range of 24–47%. Emissions reductions occur through a combination of land-use change from agriculture to forestry and other uses, reductions in dairy cow numbers partly due to freshwater policy, and ongoing improvements in the emissions efficiency of agricultural production.

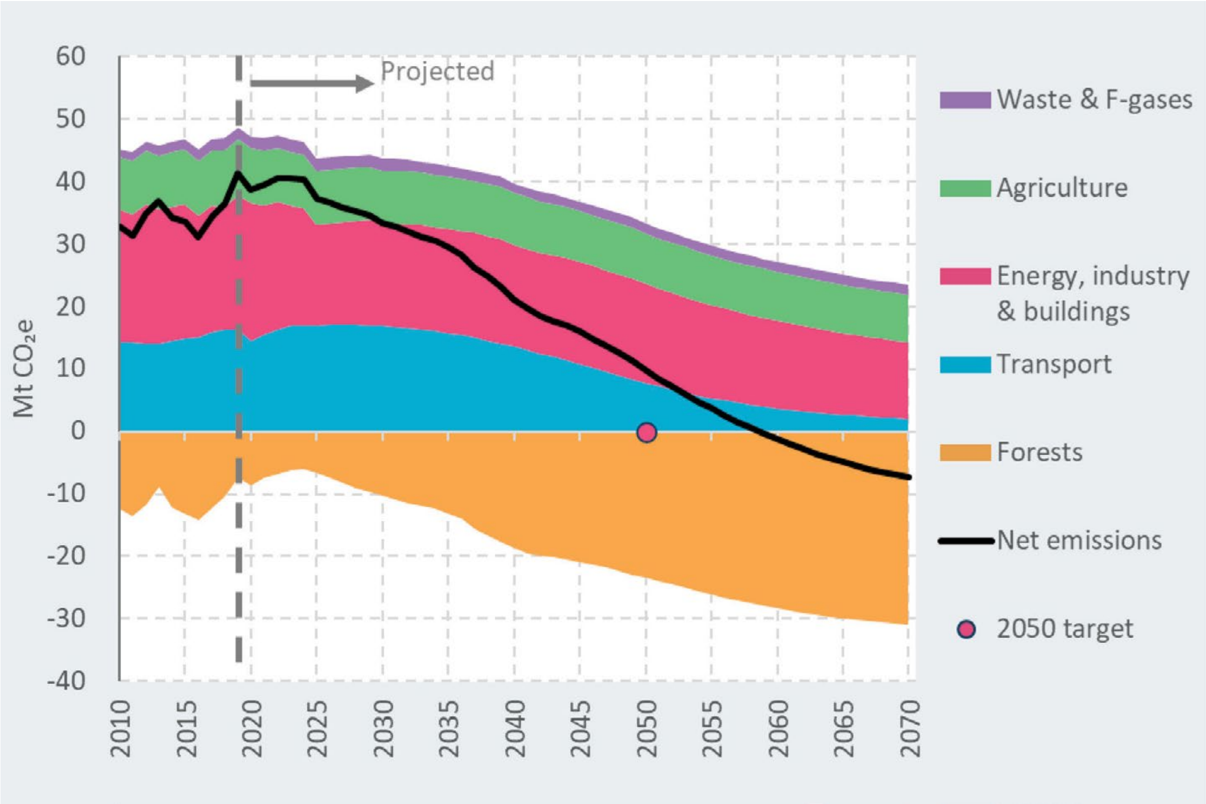


Figure 6.2: Long-lived greenhouse gas emissions to 2070 projected under current policies.

Source: Commission analysis.

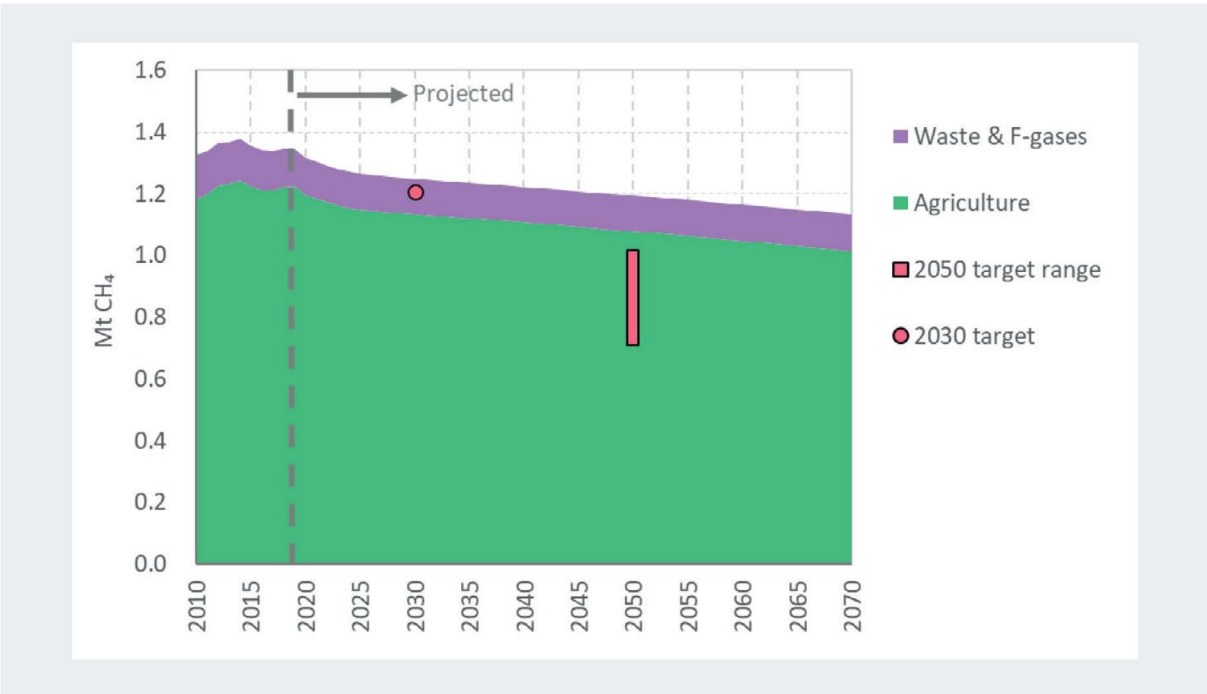


Figure 6.3: Biogenic methane emissions to 2070 projected under current policies.

Source: Commission analysis.

6.3 Relying too much on forests will not lock in net zero

14 Previous analysis of how to reach a low-emissions Aotearoa by the Productivity Commission and Ministry for the Environment have focused on reducing net emissions without constraining the contribution of carbon removals by forests. This is different to the approach we have taken in our analysis, which is focused on delivering the requirements in the Act.

15 We ran a scenario where we did not constrain carbon removals by forests to get a sense of what the future could look like under that approach. We found that increasing the emissions price from $35 a tonne of CO_2e under the Current Policy Reference case to $50 a tonne of CO_2e would come close to meeting the 2050 net zero target for long-lived greenhouse gases (Figure 6.4).

16 However, the slightly higher emissions price under this 'unconstrained removals' scenario would encourage only a very small reduction in gross long-lived greenhouse gas emissions, of around 0.5 $MtCO_2e$.

17 Instead, it would encourage much more exotic forestry to be planted. Exotic forestry would sequester a further 8.7 $MtCO_2$ in 2050 compared to the Current Policy Reference case. This would come from planting a further 400,000 hectares of new forest by 2050, in addition to the 1.1 million hectares expected under the Current Policy Reference case.

18 Significant further forest planting would be required after 2050 to maintain net zero long-lived greenhouse gas emissions. Figure 6.4 shows that if there were no further forestry planting or policy changes, net emissions would bounce back above zero before 2065 as the temporary exotic forest carbon sink declines.

19 This would be despite gross emissions reducing significantly after 2050 due to continued turnover of vehicles from internal combustion engine models to electric, and reductions in fossil gas use as supply declines.

20 An approach that does not constrain carbon removals by forests would not drive meaningful decarbonisation before 2050 and would instead use up land resources for the purpose of offsetting emissions in areas where there are proven options to reduce gross emissions.

21 This approach is not sustainable, would leave Aotearoa out of step with the rest of the world, and would leave the next generation with the task of reducing gross emissions at the same time as they will need to be adapting to escalating climate change impacts.

22 As described in the next section, our scenarios for meeting the 2050 targets represent a shift away from this approach.

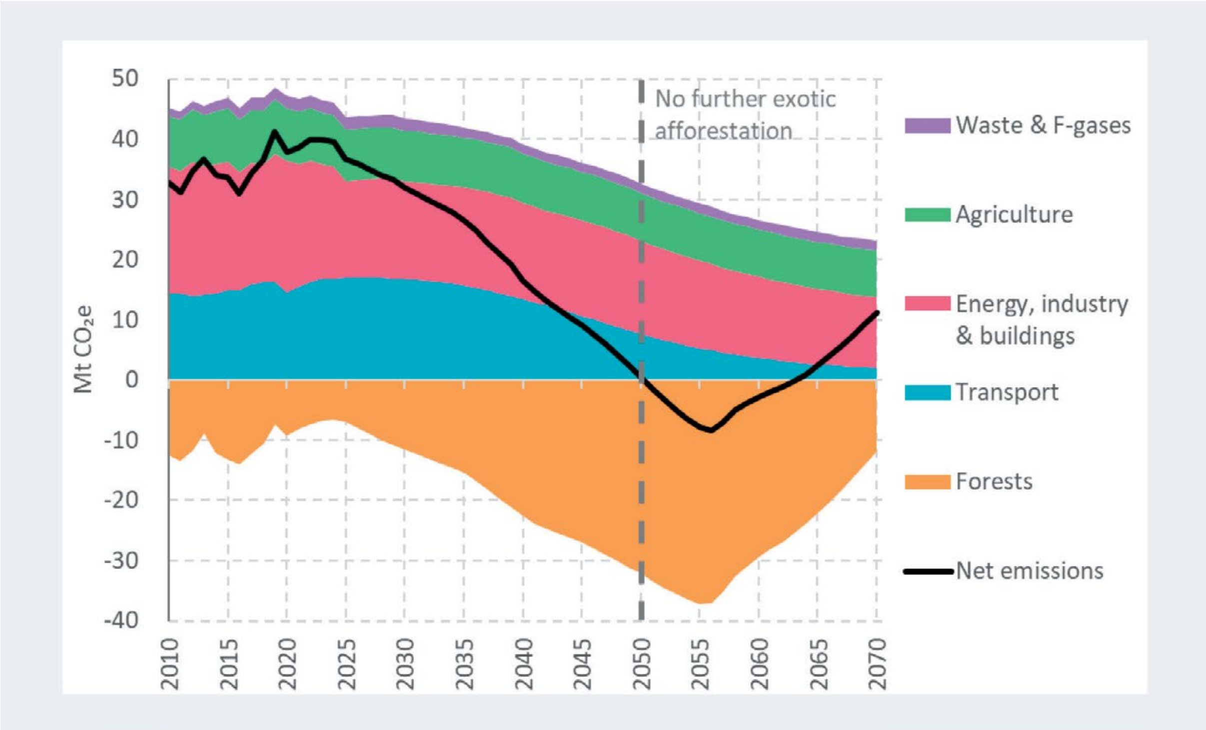


Figure 6.4: Long-lived greenhouse gas emissions in the 'unconstrained removals' scenario, with a $50/tonne emissions value applied to forestry, energy and transport.
Source: Commission analysis.

6.4 Understanding the changes required to reach 2050 targets

23 We have developed a set of scenarios (depicted in Figure 6.5) designed to deliver the 2050 targets, with an emphasis on gross emissions reductions, under a range of future conditions.

24 This set of scenarios helps us to understand the changes that are possible over time. Our scenarios have been designed to look at how Aotearoa could meet the 2050 targets if future conditions were more, or less, favourable. The main scenarios are:

- **Headwinds** – our least optimistic scenario. It examines a future where there are more barriers to adopting both technology and behaviour changes in the future.
- **Further Technology Change** – examines a future where there are fewer barriers to technology changes. Relative to the Headwinds scenario, technologies could be available sooner, perform better or have lower costs which help drive greater adoption.
- **Further Behaviour Change** – examines a future where there are fewer barriers to people and businesses changing behaviour and choosing low emissions options. There are conservative improvements in technology as per the Headwinds scenario, but barriers to adopting existing technologies are lower.
- **Tailwinds** – our most optimistic scenario. It examines a future where there are fewer barriers to technology and behaviour changes.

25 More information on these scenarios can be found in *Chapter 12: Long-term scenarios to meet the 2050 target* of the *2021 Supporting Evidence.*

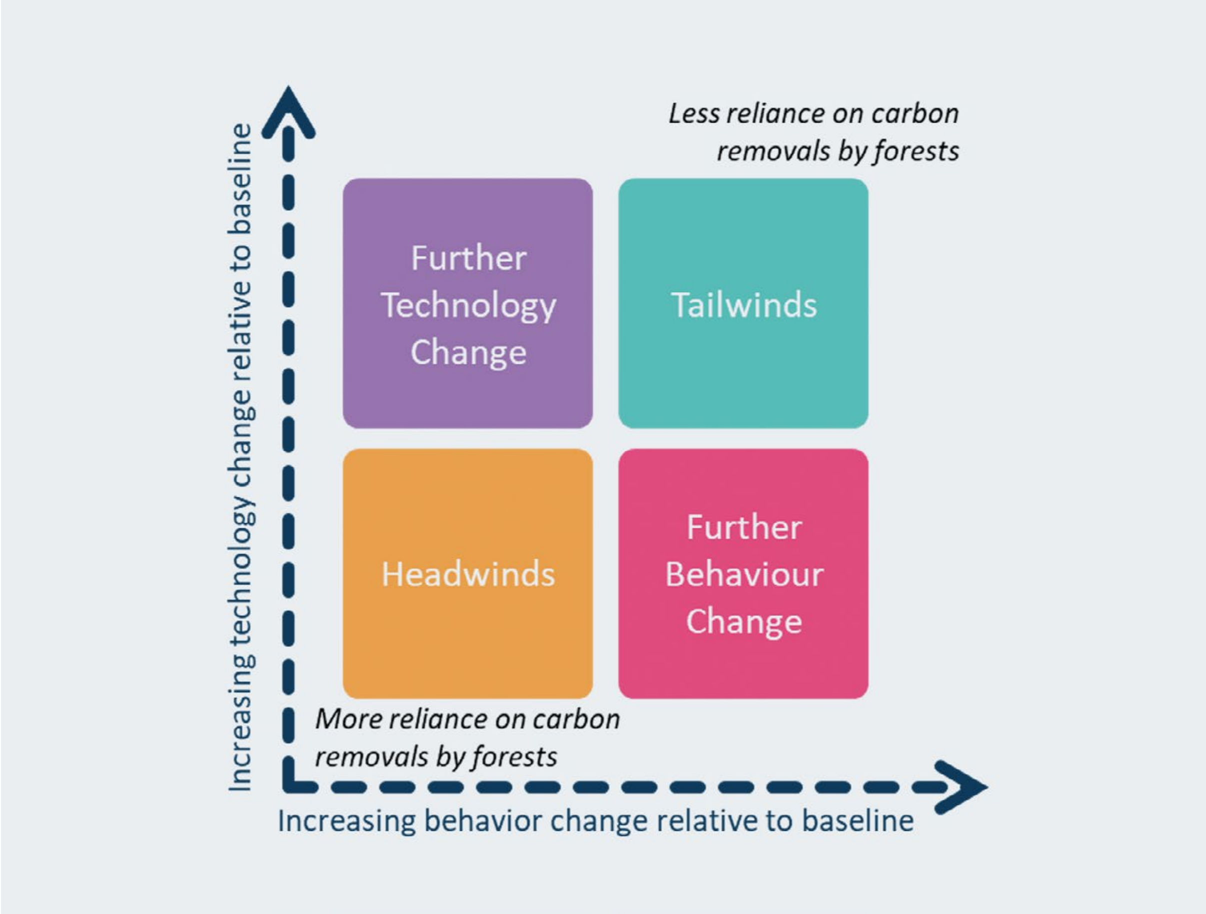


Figure 6.5: Scenario structure for the long-term scenarios to 2050.

6.4.1 Key insights from our scenarios for long-lived greenhouse gases

26 Aotearoa could achieve net zero long-lived greenhouse gases sometime in the 2040s through changes in technology and behaviour (Figure 6.6). Our Tailwinds scenario achieves this by 2040. In our Headwinds scenario net zero long-lived greenhouse gases would still be achieved by 2048, with a greater reliance on carbon removals by forests (Figure 6.7).

27 Many actions to reduce emissions are common to both the Headwinds and Tailwinds scenarios, but differ in terms of the timing or level of uptake. This is because most of the solutions for reducing long-lived greenhouse gases already exist and are commercially available. This means it is not a question of 'if', rather it is a question of 'how fast' and 'how much'. Tailwinds also includes some actions to reduce emissions which are dependent on further innovation or behaviour change, and which are not included in Headwinds.

28 Key insights into emissions reductions from our scenario analysis include:

- Displacing fossil fuels with electricity is an essential part of the transition and will require major expansion of the electricity system. Wind, geothermal and solar power can meet the expected growth in demand from electrifying transport and heat to 2050 while keeping electricity affordable. Despite this growth, the emissions from generating electricity can reduce considerably relative to today.

- Road transport can be almost completely decarbonised by 2050 by increasing walking, cycling and public transport use, reducing vehicle travel, and by switching to low emissions vehicles. Decarbonising transport will require a rapid increase in electric vehicle sales so that nearly all vehicles entering the country are electric by 2035.
- Low- and medium-temperature heat in industry and buildings could be decarbonised by 2050 through a switch away from coal, diesel and fossil gas to electricity and biomass. The scale of switching required would require a steady and sustained effort over the 2020s, 2030s, and 2040s.
- Energy efficiency and behaviour changes that reduce energy demand will play an important role in many areas. These can help to cut emissions sooner and in hard-to-abate sectors. They can also contribute cost reductions and co-benefits.
- Nitrous oxide emissions from agriculture are relatively difficult to reduce, but reductions are possible through changes to farm practices, including reducing use of nitrogen fertiliser and by developing technology such as nitrification inhibitors.
- New native forests can be established on steeper, less productive land to provide a long-term carbon sink. With a sustained high rate of planting through to 2050, new native forests could provide a long-term carbon sink of more than 4 $MtCO_2$ per year, helping to offset residual long-lived greenhouse gas emissions from hard-to-abate sources.
- Exotic production forestry continues to have a role to play in removing carbon dioxide, particularly until other more enduring sources of carbon removals, such as native forestry, can scale up. The deep reductions in gross emissions in our scenarios mean the 2050 targets could be met with a significantly smaller area of new exotic forestry than would occur under current policy settings: a total of 570,000–760,000 hectares to 2050.

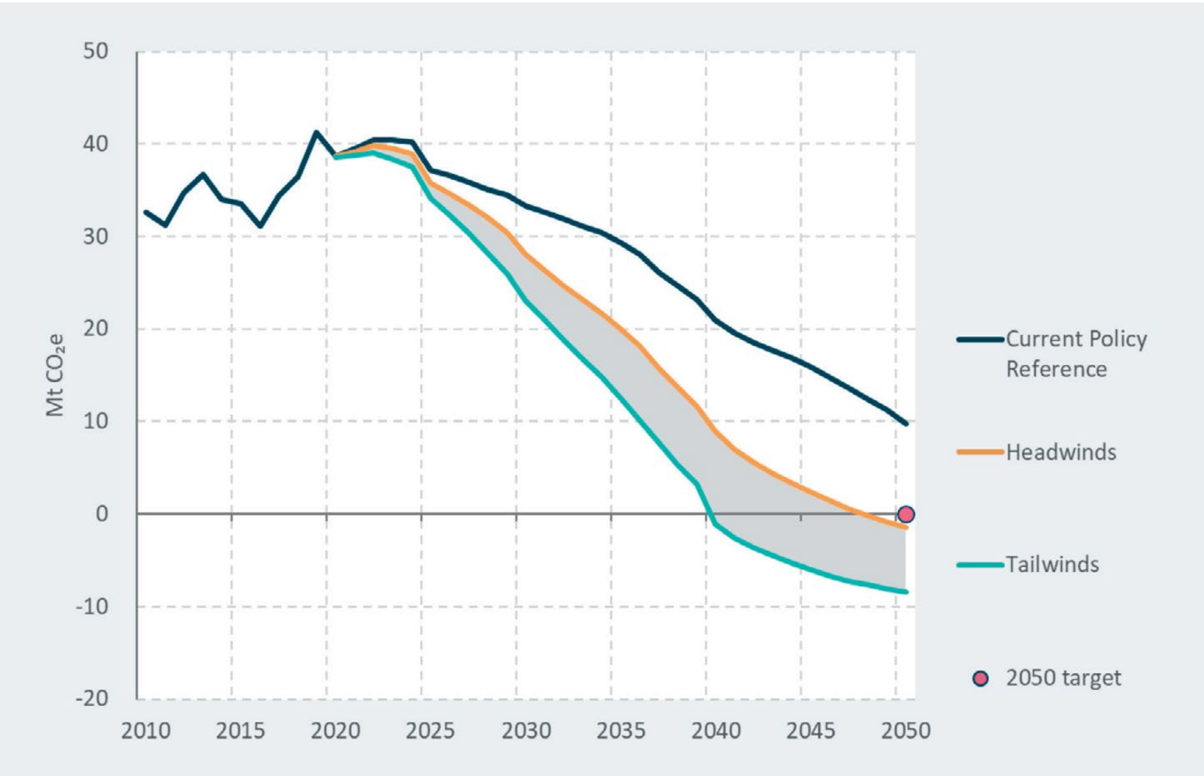


Figure 6.6: The path for net long-lived greenhouse gas emissions in the Headwinds and Tailwinds scenarios, compared with under current policies.
Source: Commission analysis.

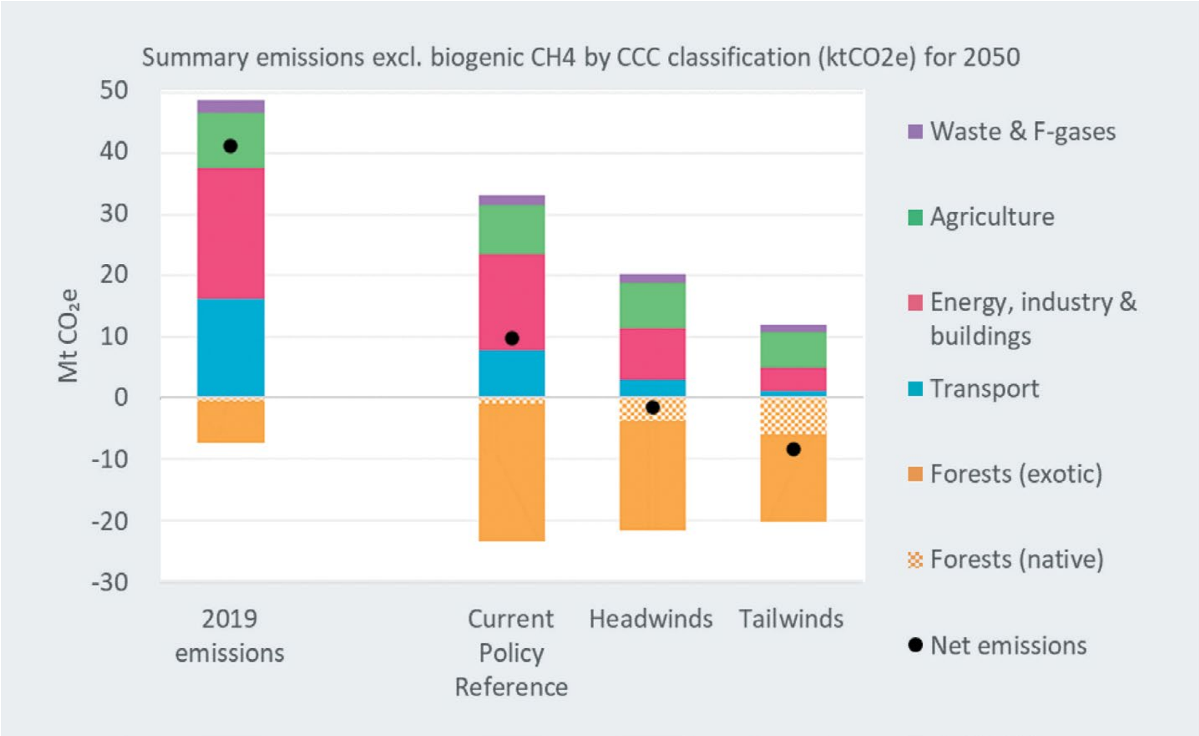


Figure 6.7: Long-lived greenhouse gas emissions by sector in 2050 in the Headwinds and Tailwinds scenarios, compared with under current policies and with 2019 emissions.

Source: Commission analysis.

6.4.2 Key insights from our scenarios for biogenic methane

29 Our scenarios show that, depending on technology and behaviour change in the next 30 years, it is possible to meet both the less ambitious (24% reduction) and more ambitious (47% reduction) ends of the 2050 target range for biogenic methane.

30 As our Headwinds and Tailwinds scenarios look out to 2050, we have anticipated that some new technologies are commercialised. However, for emissions budgets out to 2035 we have tested to ensure they could be met without any new technologies.

31 Under the Tailwinds scenario, major technology and behaviour changes combine to reduce biogenic methane to 57% below 2017 levels by 2050. This scenario assumes that:

- Biogenic methane inhibitors, biogenic methane vaccines and low emissions breeding are developed and widely adopted
- Farmers successfully implement ambitious practice changes to become more emissions efficient
- More than 100,000 hectares is converted from livestock agriculture to horticulture by 2050, nearly doubling the current area of horticulture
- Total organic waste to landfills is almost halved by 2035 alongside major expansion of landfill gas capture

32 Under the Headwinds scenario, slower changes in technology and behaviour make it challenging to meet the biogenic methane targets of 10% below 2017 levels by 2030 and 24% below 2017 levels by 2050 (Figure 6.8). Compared with our other scenarios, meeting these 2050 targets requires more land use change from livestock farming to exotic forestry, which is also needed to provide sufficient carbon removals to meet the net zero long-lived greenhouse gas target.

33 The difference between the Tailwinds and Headwinds scenarios for biogenic methane is larger than for long-lived greenhouse gases (Figure 6.9). This is because there is more uncertainty in what is achievable – meeting the more ambitious end of the 2050 target range for biogenic methane depends on whether new technology is developed and commercialised.

34 Insights from our scenario analysis for biogenic methane include:

- It is possible to meet the 2030 target and the less ambitious end of the 2050 target range through widespread adoption of low emissions farm management practices and a combination of waste reduction and diversion from landfills. This is with less land-use change to forestry than expected under current policies.
- Developing and widely adopting new technologies to reduce livestock methane emissions could enable Aotearoa to exceed the more ambitious end of the 2050 biogenic methane target range. Increasing landfill gas capture would also contribute.
- Without new technologies, meeting the more ambitious end of the 2050 target range would likely require significantly lower agricultural production from livestock and more land-use change.

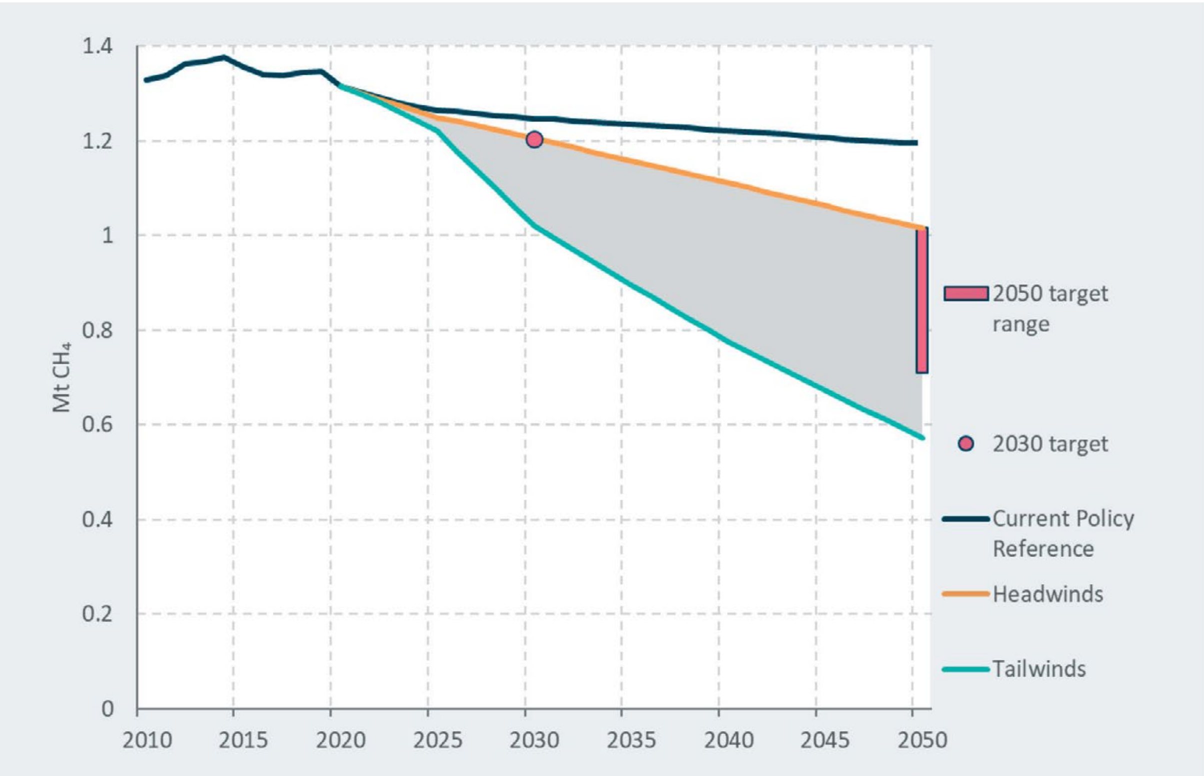


Figure 6.8: The path for biogenic methane emissions in the Headwinds and Tailwinds scenarios.
Source: Commission analysis.

Figure 6.9: Biogenic methane emissions by sector in 2050 in the Headwinds and Tailwinds scenarios, compared with under current policies and with 2019 emissions.
Source: Commission analysis.

6.5 International aviation and shipping

35 Emissions from international aviation and shipping are not currently part of the 2050 targets in Aotearoa. We have heard from stakeholders that this is an important issue. We agree that these emissions are significant and part of the overall emissions footprint of Aotearoa that should not be ignored. As required by the Act, we will review whether these should be included in the 2050 targets in 2024.

36 We have designed the paths presented in the next chapter to make sure that our emissions budgets could allow Aotearoa to meet the net zero long-lived greenhouse gas 2050 targets including international aviation and shipping emissions in case a decision is made in future to include these.

Chapter 7

Te Tahua Tukunga Hauwaro – Te Porotutuki
Demonstrating emissions budgets are achievable

Summary

The Commission's analysis shows that while our recommended emissions budgets are ambitious, they are also achievable.

To establish this, we have developed a series of possible paths outlining different rates of technology and behaviour change to 2035 to test the budgets are resilient and ensure uncertainty about the future does not stall or delay climate action. These scenarios follow different paths of technology and behaviour changes to 2035, and include the critical actions identified through our analysis that must be carried out over the next 15 years. These actions are outlined in *Chapter 6: Long term scenarios to 2050*. We have also developed detailed assumptions that support those actions.

This chapter provides detail on our analysis to show the emissions budgets can be met. This includes:

- Detail on the demonstration path, including assumptions that underpin that path over the next 15 years.
- Detail on two alternative paths that show the recommended emissions budgets could be met under a different mix of actions. These are 'less technological change, more behaviour change' and 'more technological change, less behaviour change'.
- Sensitivity analysis to test how further uncertainties could impact on the ability to meet the budgets. The analysis gives us confidence that these uncertainties are manageable.

It is important that we set budgets that have enough flexibility to respond to unanticipated change. Aotearoa may need to adjust its course as the low emissions transition proceeds. This will mean government, industry, businesses and individuals will be able to adapt as new information, technologies and approaches to lowering emissions are developed.

Changes in our final advice

During consultation, we received feedback from submitters about our models and assumptions. This has been fed into our analysis and changed some of our underlying assumptions. We have presented more paths for achieving the budgets. We have rerun our models and carried out sensitivity analysis.

The key areas where we received feedback from submitters and made changes to our modelling in response to new evidence are detailed sector by sector in the chapter.

Introduction

1 Our work shows that there are multiple paths for Aotearoa to achieve our recommended emissions budget levels. We have looked at multiple scenarios that follow different paths of technology and behaviour changes to 2035. We have also undertaken sensitivity analysis of our assumptions. All of this analysis tells us that the recommended emissions budgets are achievable despite uncertainty around how fast technology will develop and how behaviours could change in the next 15 years.

2 Figure 7.1 below shows the process we have gone through to test that our recommended emissions budgets are achievable and will put us on track to meet the 2050 emissions reduction targets (2050 targets). We constructed a demonstration path that includes a portfolio of actions across the economy. We used the demonstration path to calculate the level of the first three emissions budgets which are set out in *Chapter 5: Recommended emissions budgets.*

3 The demonstration path includes the actions from the long-term scenarios (outlined in *Chapter 6: Long term scenarios to 2050)* that were identified as being critical for meeting the 2050 targets. The portfolio of actions in the demonstration path are also consistent with the judgements described in *Chapter 5: Recommended emissions budgets*.

4 The evidence base underpinning the assumptions for each action is outlined in detail in *Chapters 5-9* of the *2021 Supporting Evidence*. The detailed lists of assumptions for all the path runs are available on our website www.climatecommission.govt.nz/modelling.

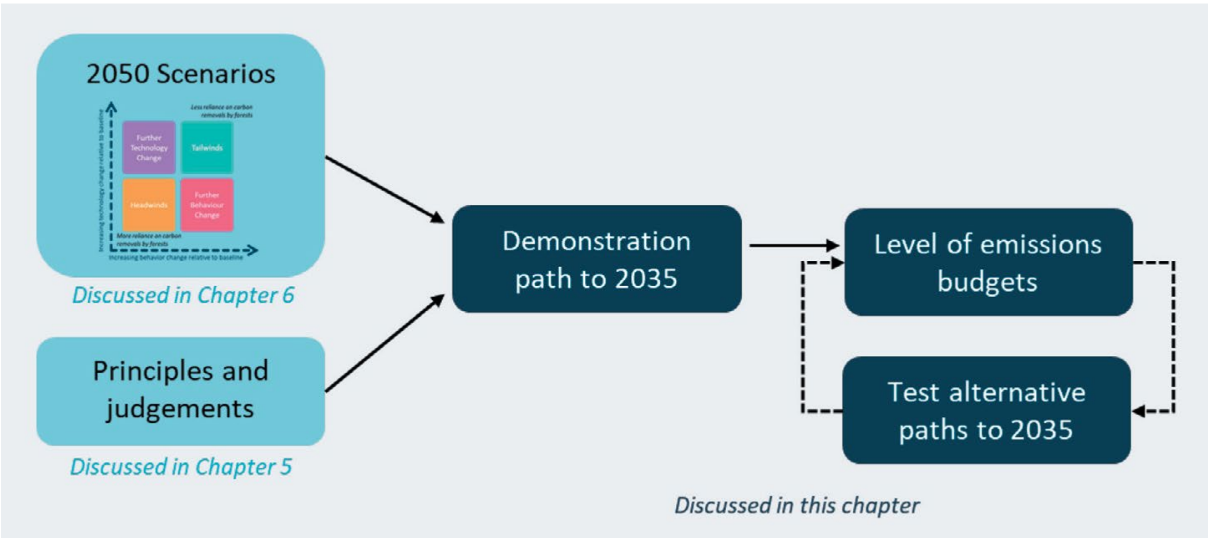


Figure 7.1: Our process to determine the levels at which to set the first three emissions budgets

5 We also checked to see whether these emissions budget levels were still achievable if some technology or behaviour changes happened faster or slower than in the demonstration path. To do this we designed two alternative paths which are variations on the demonstration path, and carried out sensitivity analysis.

6 The alternative paths include the same emissions reduction options as the demonstration path but vary the speed with which the options are taken up. These paths are:

- **Alternative path A** – this includes less technological change and more behaviour change than the demonstration path.
- **Alternative path B** – this includes more technological change and less behaviour change than the demonstration path.

7 The purpose of these paths is not to prescribe the exact mix of technologies that Aotearoa should use, but to show that our recommended emissions budgets are achievable in light of uncertainty about the future. Some technologies or behaviour changes not included in these paths could end up eventuating, depending on the relative economics and people's preferences.

8 We have recommended emissions budgets that are ambitious, but also achievable. For this reason, the demonstration path focuses on technologies that are commercially available now. Recommending emissions budgets that are so ambitious they could only be met if new technologies were developed and deployed would undermine the purpose of emissions budgets – to set a credible course for medium-term emissions reductions.

9 In response to submissions, we have made a number of amendments to our modelling and assumptions. The changes we have made are detailed in Box 7.3 at the end of this chapter.

Box 7.1: Emissions values

All the paths to 2035 we set out in this chapter include the same future emissions values, which increase over time (Figure 7.2). These emissions values apply to the energy and transport sectors only in our modelling. These values should not be directly interpreted as New Zealand Emissions Trading Scheme (NZ ETS) prices, as that will depend on the mix of policies Government chooses to implement in meeting the emissions budgets.

We have arrived at the emissions values by looking at the abatement costs that would be required in 2050 to eliminate fossil fuel emissions from those sectors where there are low-emissions alternatives. Our modelling suggests that a price of around $250/tonne would be required to achieve this.

A more detailed description of how we arrived at the emissions values and how they are used in our modelling is set out in *Chapter 12: Long-term scenarios to meet the 2050 target* in the *2021 Supporting Evidence*.

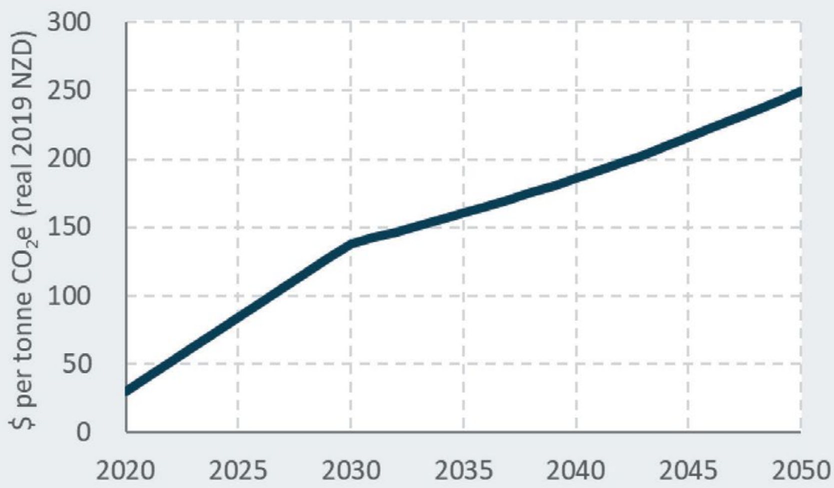


Figure 7.2: Emissions values for the energy and transport sectors applied in the paths

7.1 Summary of the demonstration path

10 This section outlines a demonstration path – one set of measures and actions within each sector that would deliver our recommended emissions budgets. The final assumptions that sit behind the demonstration path are outlined throughout this section.

11 Table 7.1 below provides a summary of key actions in the demonstration path across the first three budget periods. In the following sections we give a more detailed description of the changes that would happen within each sector.

12 In relation to the long-term scenarios described in *Chapter 6: Long-term scenarios to 2050*, the demonstration path would see reductions in long-lived greenhouse gas emissions near the more ambitious end of the range (Figure 7.3). Net long-lived greenhouse gas emissions would fall by 15% by 2025, 38% by 2030, and 63% by 2035 compared to 2019. This path would set Aotearoa up to achieve net zero long-lived greenhouse gas emissions in the early 2040s.

13 These emissions reductions would mostly come from road transport and energy, industry and buildings (Figure 7.3). The demonstration path would see gross and net carbon dioxide emissions reduced by 27% and 47% respectively by 2030, compared to 2019.

14 For biogenic methane, in the demonstration path we have assumed no adoption of a biogenic methane inhibitor or other biogenic methane reducing technologies that are not already commercially available. Because of this, the demonstration path sees biogenic methane emissions reductions towards the less ambitious end of the scenario range (Figure 7.4). The demonstration path would see ambitious and sustained changes to low-emissions farm practices such as stock and pasture management, alongside strong action to reduce biogenic methane emissions from landfills (Figure 7.4).

Table 7.1: Key transitions along the demonstration path

		Budget 1	Budget 2	Budget 3
Transport	Lower-emissions vehicles	Accelerate uptake of electric and zero-emissions cars, buses and trucks Improve efficiency of vehicles and freight movement		Phase out imports of internal combustion engine light vehicles
	Reducing vehicle trips	Encourage switching to walking, cycling and public transport Reduce demand for travel, for example through smart urban development and increased working from home Increase use of rail and coastal shipping for freight		
	Aviation and shipping	Improve efficiency	Start electrifying ferries and coastal shipping	Start electrifying short-haul flights
	Low carbon liquid fuels		Increase use of biofuels	
Energy, industry and buildings	Buildings	No new fossil gas heating systems installed after 2025 Improve thermal efficiency		Start phasing out existing fossil gas use in buildings
	Electricity	Phase out fossil base-load generation	Transmission and distribution grid upgrades Expand renewable generation	Achieve ~95% renewable generation
	Industrial process heat	Replace coal with biomass and electricity		Replace fossil gas with biomass and electricity
Land	Agriculture	Adopt low-emissions practices on-farm	Adopt low-emissions breeding for sheep	Encourage new low biogenic methane technologies to be adopted when available
	Native forests	Ramp up establishing new native forests		Establish 25,000 ha per year
	Exotic forests	Average 25,000 ha per year of new exotic forests		Ramp down planting new exotic forests for carbon storage
Waste and F-gases	Waste	Divert organic waste from landfill Improve and extend landfill gas capture		
	F-gases	Increase end-of-life recovery of F-gases		

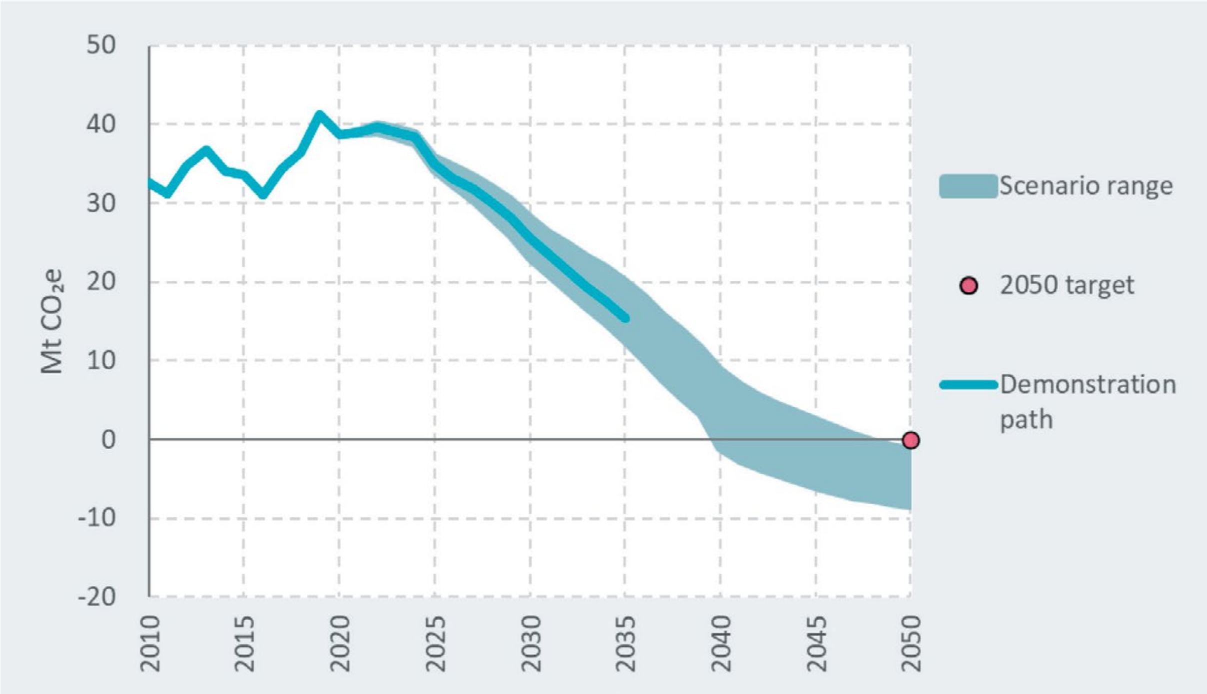


Figure 7.3: Long-lived greenhouse gas emissions in the demonstration path to 2035 compared with the long-term scenario range
Source: Commission analysis

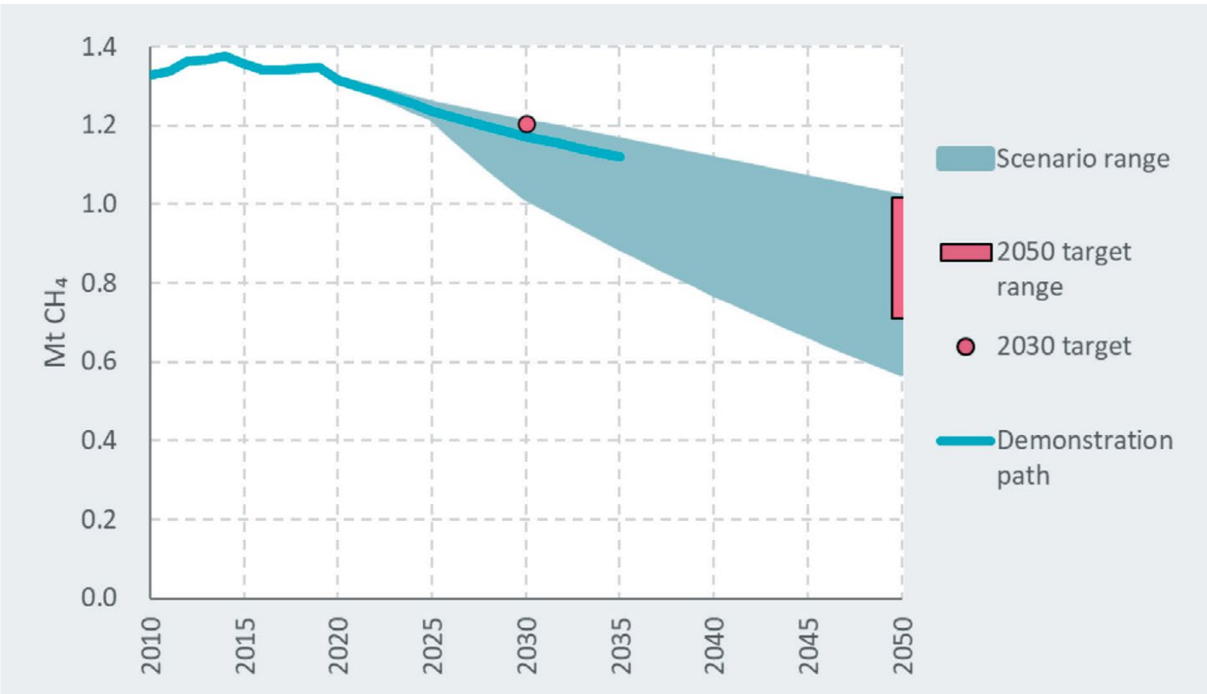


Figure 7.4: Biogenic methane emissions in the demonstration path to 2035 compared with the long-term scenario range
Source: Commission analysis

Figure 7.5: Snapshots of emissions in 2025, 2030 and 2035 in the demonstration path, compared with 2019

Source: Commission analysis

7.2 Transport in the demonstration path

15 Our approach to meeting the 2050 targets would see Aotearoa almost completely decarbonising the transport system. The demonstration path includes the necessary actions over the next 15 years to put Aotearoa on track for the 2050 targets while delivering immediate emissions reductions and co-benefits. This means travelling less, or shorter distances; using public transport, walking and cycling more; and changing how most vehicles are powered.

16 The evidence base underpinning these assumptions and the full reasoning is outlined in *Chapter 6: Reducing emissions from transport, buildings and urban form* of the *2021 Supporting Evidence*.

7.2.1 Changes to how New Zealanders move

17 Changes to how and how much New Zealanders travel play an important role in the demonstration path.

18 We assume the average household travel distance per person can be reduced by around 3% by 2030, relative to our Current Policy Reference case in 2030. This could be achieved, for example, through more compact urban development and encouraging remote working for those who can.

19 We also assume that the mode share of total distance travelled by low-emissions options – walking, cycling, public transport, and emerging options such as e-scooters – can be increased, from around 6% nationally in 2019, to 11% by 2030 and 14% by 2035. Within this, we assume that cycling grows from around 0.6% of household travel distance in 2019 to 1.5% in 2030, and public transport grows from around 3.5% to 7.7%.

20 These figures are built up from regional-level assumptions. For example, we assume that share of travel distance by public transport nearly triples in Auckland by 2030, compared with growing by around 60% in Wellington and 20% in the rest of Aotearoa. We have considered the different circumstances and opportunities in urban, rural and provincial areas.

21 Overall, these assumed changes would see total household vehicle travel holding flat from 2023 and then declining, despite a growing population. We assume household light vehicle travel can be reduced by 9% by 2030, relative to our Current Policy Reference case in 2030 (Figure 7.6).

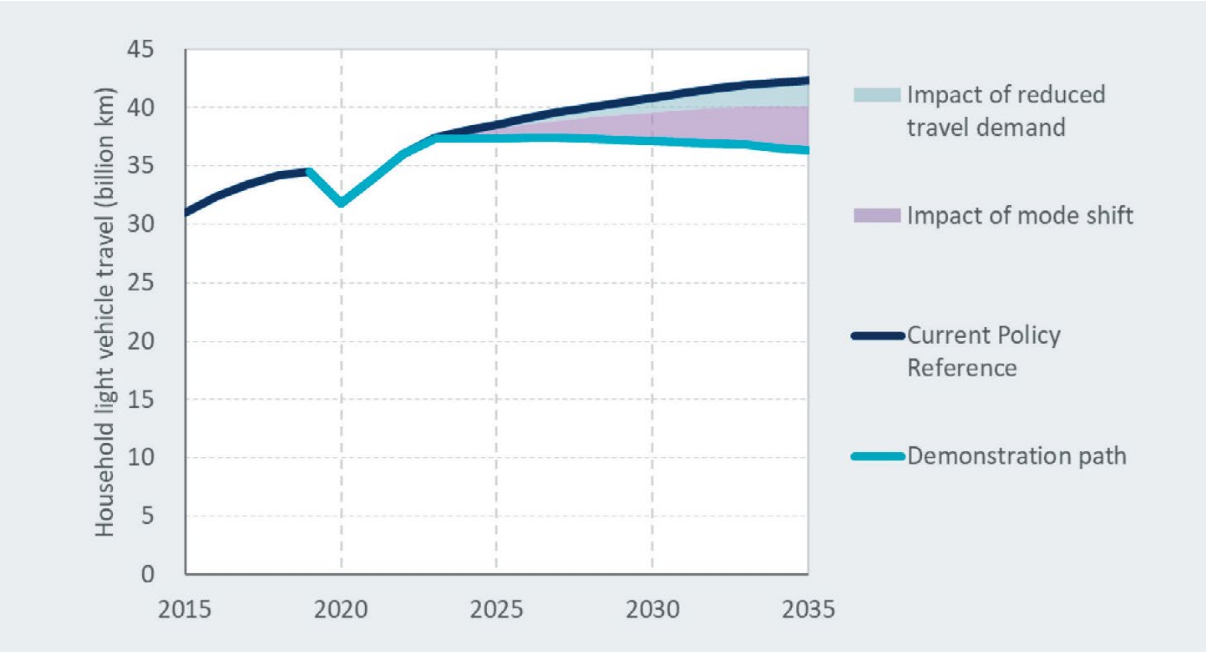


Figure 7.6: Household light vehicle travel in the demonstration path compared with under current policies

Source: Commission analysis

7.2.2 Switching to electric and zero-emissions vehicles

22 Electric vehicles (EVs) – that could include hydrogen fuel cell vehicles where battery electric is not feasible – have zero tailpipe emissions, and the electricity to power them can come from clean, renewable sources.

23 The long-term scenarios outlined in *Chapter 6: Long term scenarios to 2050* show that electrifying the vehicle fleet is a critical element of meeting the 2050 net zero target. Ending the import of internal combustion engine (ICE) light vehicles in the early 2030s is necessary in order to have most travel electrified by 2050 without forcing significant early scrappage of vehicles.

24 EVs are currently more expensive to purchase than ICE vehicles, with the additional cost partly offset by cheaper running costs. The upfront cost of EVs is expected to continue to fall through continued reductions in lithium ion battery costs and rapidly increasing global production.

25 In the demonstration path, we assume EVs reach purchase price parity with ICE vehicles on average by 2031.

26 For light vehicles – cars, SUVs, vans and utes – imports of new and used ICE vehicles are phased out by 2032 and 2035, respectively. This timeframe is consistent with phase out dates set by a growing number of countries and automakers. While we have modelled different phase-out dates for new and used ICE vehicles, our advice on the direction of policy does not distinguish between the two (see *Recommendation 17, Chapter 14: Policy direction for transport).*

27 Under the demonstration path, EVs would make up at least half of total light vehicle imports by 2029. By 2035, 46% of all light vehicle travel would be in EVs and 36% of light vehicles on our roads would be electric (Figure 7.7).

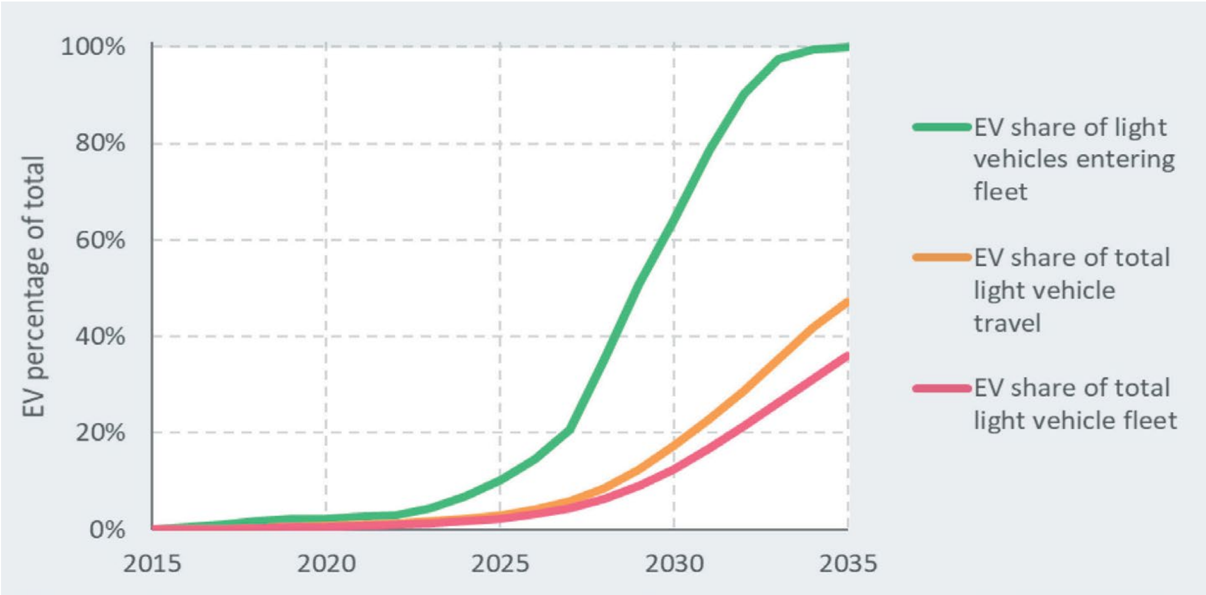


Figure 7.7: Uptake of light EVs in the demonstration path
Source: Commission analysis

28 The demonstration path also sees significant electrification of heavy transport. This includes a rapid switch to electric buses, led by favourable economics and in line with commitments from local councils and central government. Electrification of trucks, on the other hand, is slower to begin due to higher costs and technology barriers, such as current battery technology not allowing for the greater daily distances many trucks need to travel.

29 For heavy duty trucks in particular, the extent to which batteries or hydrogen fuel cells will provide a more viable and cost-effective solution is uncertain. Battery electric trucks are a more efficient use of energy, requiring roughly one-third as much input electricity as a fuel cell truck running on green hydrogen. However, hydrogen fuel cell trucks offer other advantages such as being faster to refuel, travelling longer distances, and not having heavy batteries that take the place of freight.

30 While we have modelled battery electric trucks as the electrification route, the resulting uptake could also represent fuel cell trucks powered with green hydrogen. In our consultation, we heard from councils and industry that there are multiple green hydrogen heavy transport projects underway.

31 Of the trucks imported in 2030, 42% of medium trucks and 18% of heavy trucks would be electric. By 2035, these would increase to 95% and 73% respectively.

Box 7.2: Costs of electric vehicles now and in the future

Electric vehicles (EVs) today cost more to purchase than a comparable internal combustion engine (ICE) vehicle. We estimate the additional upfront cost for a EV in Aotearoa is currently around $16,000 excluding GST, of which about $11,000 is the cost of the battery. However, the outlook is positive, with leading international analysts such as Bloomberg New Energy Finance forecasting that electric cars will be cheaper to make than petrol cars by 2030.

These expected cost reductions come through a combination of falling battery costs and other manufacturing cost reductions as automakers retool their production lines and scale up EV production. The cost of lithium ion batteries has already fallen 88% from 2010 to 2020 and is projected to more than halve again by 2030.

In the demonstration path, we assume that EVs reach purchase price parity with ICE vehicles on average by 2031. We have been conservative to reflect uncertainty around manufacturer pricing and other factors. We have tested faster and slower cost reductions in the alternative paths.

Because EVs are cheaper to fuel and run, they will have a lower total cost of ownership compared with an ICE vehicle several years ahead of reaching purchase price parity. We estimate this would occur by 2026 on average for a new car purchase, for a five-year ownership period. For vehicles driven more than average, the time when an electric car is cheaper will come sooner. For vehicles driven less than average, that time will come later.

Figure 7.8 shows the different components of the total cost of ownership for a new car purchase in 2021, 2025 and 2030. In addition to the falling capital costs, the operating cost for the battery electric car also falls. This is because we assume a shift to cost-reflective electricity pricing, with vehicles primarily charged overnight at a low rate.

Looking over the whole life of the vehicle, which for a new car entering Aotearoa is around 20 years on average, the time when an EV becomes cheaper arrives even sooner. We estimate the whole-of-life cost for a new battery electric car will be lower than a new petrol car from 2022 (Table 7.2). By 2030, we estimate this whole-of-life cost would be 20% lower.

For more information on how the numbers in Figure 7.8 and Table 7.2 have been calculated and on the underlying assumptions, see *Chapter 12: Long-term scenarios to meet the 2050 target* in the *2021 Supporting Evidence*. The *2021 Supporting Evidence* also contains cost assumptions for other vehicle types.

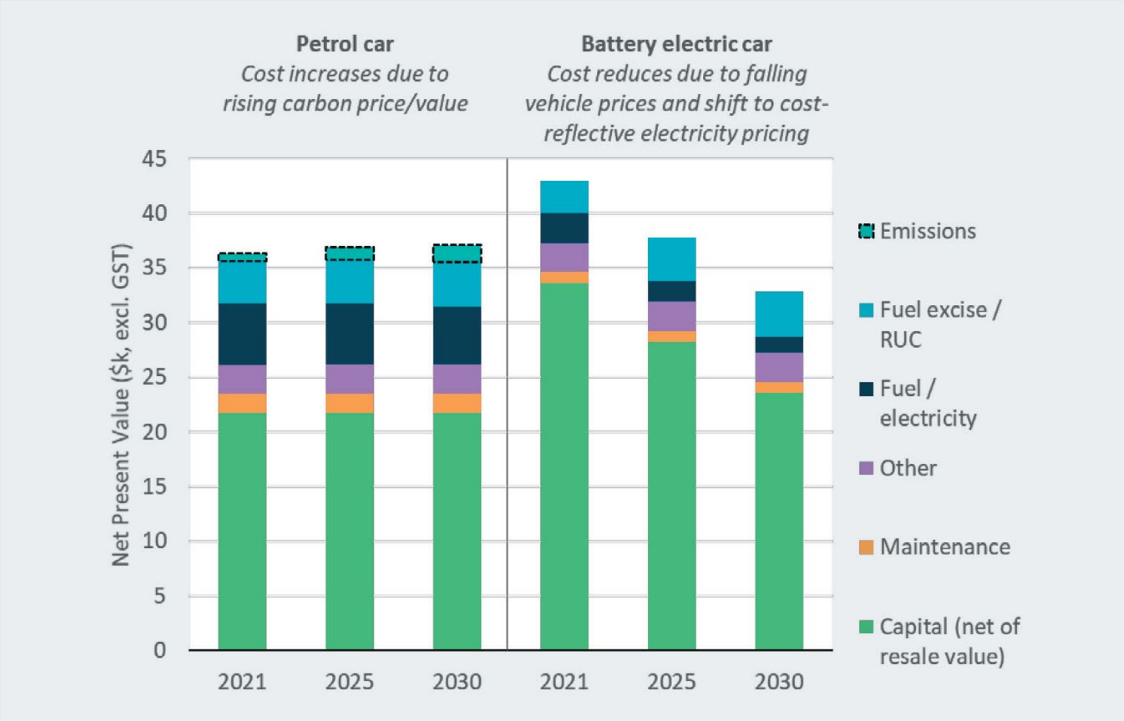


Figure 7.8: Projected five-year total cost of ownership for a new battery electric car compared with a new ICE engine car in 2021, 2025 and 2030 (private perspective)

Source: Commission analysis

Table 7.2: The year that a new electric car becomes cheaper than a new petrol car on whole-of-life cost, total cost of ownership and purchase price under the demonstration path assumptions

	Whole-of-life cost (societal perspective, 3% discount rate)	Five-year total cost of ownership (private perspective)	Purchase price
Year by which new battery electric car is cheaper than new petrol car on average	2022	2026	2031

Source: Commission analysis

7.2.3 Improving the efficiency of vehicles and freight movement

32 Even with the rapid switch to EVs, roughly 80% of the vehicles entering the fleet this decade would still be ICE vehicles. Improving their efficiency is therefore important for reducing emissions out to 2035 and beyond.

33 The demonstration path assumes the efficiency of light ICE vehicles entering the fleet improves by around 1.3% per year on average, leading to a fleet-wide efficiency improvement of 11% by 2035. This is based on Ministry of Transport projections and includes the effect of a growing share of conventional hybrid vehicles.

34 We assess there are fewer opportunities for improving the efficiency of trucks. However, further opportunities to reduce emissions from freight exist through operational efficiency (such as route optimisation and collaborative use) and switching some freight movements from road to rail and coastal shipping. The demonstration path assumes 5% operational efficiency gains in road freight and that 3% of total freight tonne-kilometres can switch by 2030, relative to the Current Policy Reference case. Further reductions in freight emissions could be achieved by completing the electrification of the Auckland to Wellington railway line and electrifying the Hamilton to Tauranga railway line.

7.2.4 Increasing use of low carbon liquid fuels

35 Low carbon liquid fuels, such as biofuels, are another way to reduce emissions from ICE vehicles now. They may also have a long-term role in hard-to-electrify uses, particularly long-haul aviation and shipping.

36 The demonstration path assumes the use of low carbon fuels increases to 5 petajoules per year by 2030 and 9.5 petajoules per year by 2035. This is equivalent to around 270 million litres of fuel or roughly 5% of total liquid fuel demand in 2035. For simplicity, we have modelled this as an equal share across all fuel types (petrol, diesel, jet fuel and marine fuel oil).

7.2.5 Reducing emissions from domestic aviation and shipping

37 Aviation and shipping face more challenges for decarbonisation than land transport. Still, in addition to low carbon liquid fuels there are other proven and emerging opportunities.

38 The demonstration path assumes further improvements in efficiency, which have played an important role in limiting emissions growth historically.

39 Based on stakeholder feedback and our analysis, we assume that from 2030, short-haul aviation – such as a trip from Wellington to Nelson – begins to convert to new generation planes. We modelled this as electric planes, but biofuels or hydrogen could also be used to make sustainable aviation fuel for longer distance flights. Overall, we assume 5% of aviation fuel use can be displaced by 2035.

40 We also assume that domestic shipping, including the Cook Strait ferries, switches to zero-emissions fuels at the same rate as heavy trucks. Use of batteries, hydrogen or ammonia fuel cells are all potential options.

7.3 Buildings in the demonstration path

41 The long-term scenarios show that actions to improve the energy efficiency of buildings, alongside decarbonising the energy used for heating, hot water and cooking, will be important for meeting the 2050 targets. Improving the energy efficiency of homes reduces emissions and can improve the occupants' health, particularly for low-income households. This is because homes in Aotearoa are typically underheated in winter. Households may choose to maintain a warmer home after improving energy efficiency, rather than reducing their energy use or emissions. A warmer drier home is also healthier (see *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable).*

42 In the demonstration path, we assume that the heat demand for existing homes reduces by 6% by 2035. We assume newly built homes require 35% less heating compared to today's performance.

43 It is already possible to transition away from heating homes with coal and fossil gas. Heat pumps already offer a lower cost way to heat homes compared to fossil gas. For hot water, where possible, electric resistive hot water cylinders offer an alternative to fossil gas systems with comparable costs.

44 Heat pumps will offer a lower cost option to heat most new commercial and public buildings. For existing buildings, renovations offer an opportunity to replace fossil fuel heating systems, such as fossil gas central heating, with lower emissions alternatives such as heat pumps or biomass.

45 Commercial and public buildings offer large opportunities to improve energy efficiency through improved insulation and greater control of energy use. New commercial and public buildings can be built to higher standards with new technologies to monitor and control energy use, and existing buildings retrofitted to achieve these improvements.

46 The demonstration path assumes a 30% reduction in new commercial and public buildings' heat demand is possible by 2035 compared to today's performance. We assume that existing commercial and public buildings' heat demand reduces by 25% by 2035.

47 Commercial and public buildings can transition away from coal to alternatives such as biomass which could be used in existing boilers.

48 The demonstration path assumes that by 2030 coal use in commercial and public buildings will be largely eliminated. The Government announcement in 2020 that all coal boilers in public sector buildings will be phased out is a step towards this.

49 Fossil fuel heating systems will typically last for 20 years or longer. The demonstration path looks to avoid new heating systems having to be scrapped before the end of their useful lives to avoid unnecessary costs.

50 This means that we assume all new space heating or hot water systems installed after 2025 in new buildings are electric, to put Aotearoa on track for nearly completely decarbonising building heating systems by 2050.

51 For existing buildings, to be consistent with the insights from our long-term scenarios, we assume the phase out begins in 2030 (Figure 7.9). We also assume that no further fossil gas connections to the grid, or bottled LPG connections, occur after 2025. This would allow time for a steady transition, to be on track for a complete transition away from using fossil gas in buildings by 2050.

52 While they have not been directly modelled, it is possible that low emissions gases, such as biogas or hydrogen, could be blended into the current fossil gas network. This would reduce its emissions.

53 There are also emissions from building construction, producing construction materials and from waste generated throughout the lifecycle of a building. We account for emissions from construction, building energy use and producing construction materials under industry.

54 The evidence base underpinning these assumptions and the full reasoning is outlined in *Chapter 6: Reducing emissions from transport, buildings and urban form* of the *2021 Supporting Evidence*.

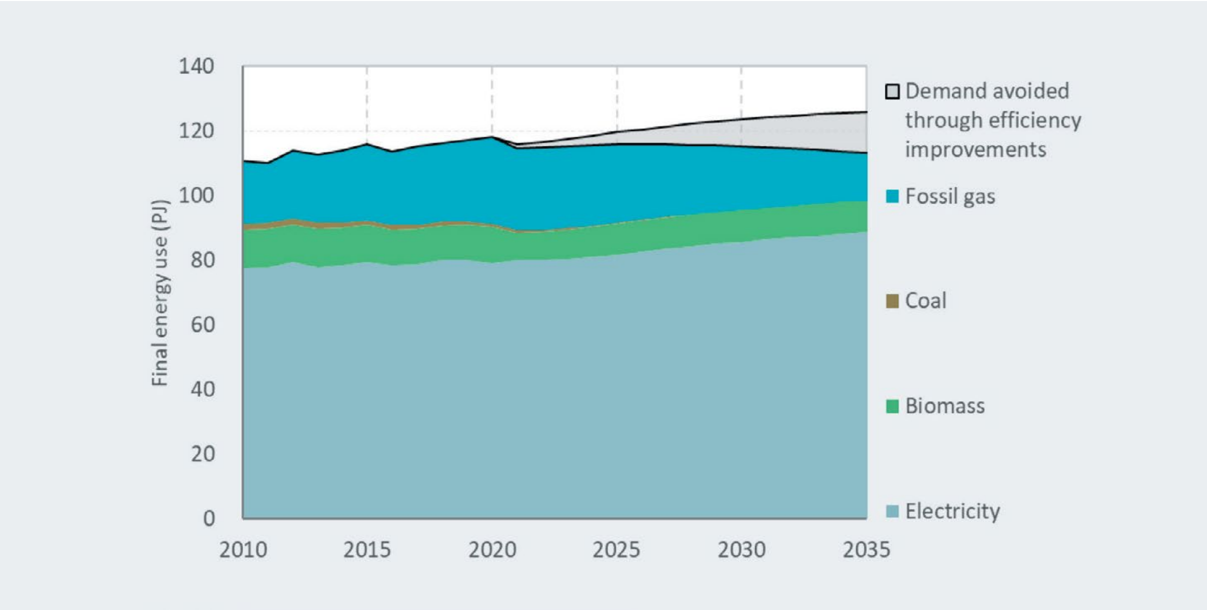


Figure 7.9: Energy use in buildings in the demonstration path
Source: Commission analysis

7.4 Electricity in the demonstration path

55 The use of low emissions electricity allows other sectors to reduce emissions. Electrifying transport and process heat will require significant expansion in electricity generation capacity. Demand for electricity will also increase as buildings and process heat switch away from fossil fuels. Increased generation and demand will need to be accompanied by expanding infrastructure for transmission and distribution.

56 The long-term scenarios showed that renewable wind and solar generation need to rapidly expand in the 2030s and beyond to meet increased electricity demand as electric vehicles (EVs) are widely adopted. This rapid expansion has been modelled in the demonstration path (Figure 7.10 and Figure 7.11).

57 However, in the short term, electricity generation companies may not commit to this expansion in capacity while there is uncertainty around the future of the New Zealand aluminium smelter at Tiwai Point.

58 The New Zealand aluminium smelter is the single largest consumer of electricity. Over the last five years it used on average around 13% per year of the country's electricity. During the course of the Commission preparing its advice, the future of the smelter was under review by its owner Rio Tinto. If Rio Tinto decides to close it, this electricity would be available for other uses, delaying the need for new generation. In January 2021 the New Zealand aluminium smelter reached a deal to extend its electricity contract through to December 2024, enabling it to continue operations until 2024.

59 In the demonstration path, as in the Current Policy Reference case, we assume the Tiwai Point aluminium smelter comes to a full close at 31 December 2024 and assume electricity becomes available for other uses in Aotearoa.

60 Wind, solar and geothermal offer low cost and low emissions ways of generating electricity. The demonstration path would see 3.8 TWh of currently committed generation projects built between 2020 and 2024. The building of further renewables pauses due to the New Zealand aluminium smelter closing and resumes in the late 2020s. Beyond 2030, our modelling shows increases in wind, solar and geothermal generation greater than 1 TWh per year. This is illustrated in Figure 7.10 and 7.11. The exact combination of renewable generation that is built in reality will depend on how the relative economics pan out.

61 Some geothermal fields have high emissions from their geothermal fluid, with an equivalent emissions intensity to fossil gas generation. In the demonstration path these high emitting geothermal fields would continue to operate. However, these high emitting fields have naturally degassed in recent years and we assume a continuation of their historic rate of reduction in emissions intensity. Geothermal power generation increases 23% while emissions increase 6% above 2019 levels by 2035.

62 Fossil gas generation provides flexibility to meet daily and seasonal peaks in demand and backs up renewable generation. While the demonstration path would see reductions in fossil gas generation, some fossil gas is still required to provide this flexibility until 2035 at least. In the demonstration path, coal fired generation at Huntly closes in the mid-2020s.

63 The evidence base underpinning these assumptions and the full reasoning is outlined in *Chapter 5: Reducing emissions from energy and industry* of the *2021 Supporting Evidence*.

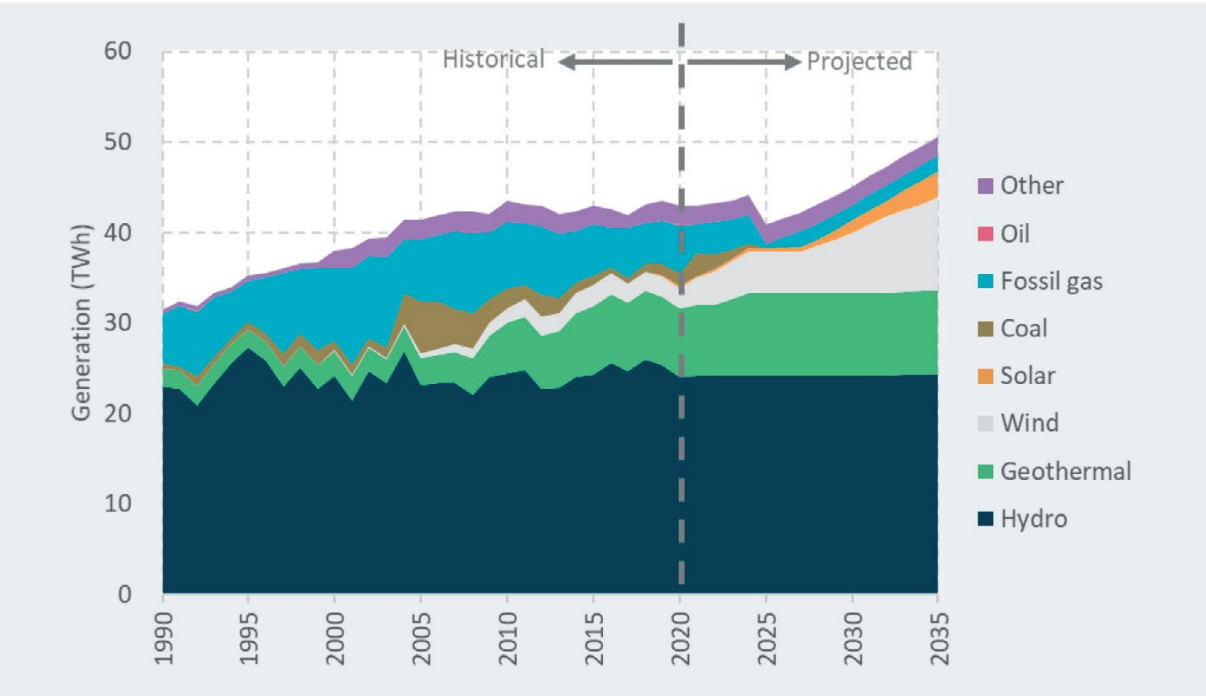


Figure 7.10: Electricity generation by fuel in the demonstration path
Source: Commission analysis

Figure 7.11: Annual increase (positive) or decrease (negative) in electricity generation in the demonstration path compared to the previous year. Note that 2020 was an historic dry year with low inflows into the hydro lakes, resulting in low hydro generation.
Source: Commission analysis

7.5 Industry and heat in the demonstration path

64 There are proven options for decarbonising low- and medium-temperature process heat. These include switching fuel use from coal and fossil gas to biomass and electricity. There are also opportunities to improve energy efficiency.

65 Some coal boilers in the food processing sector are already being replaced with biomass or electricity.

66 The demonstration path would see a steady, but reasonably rapid, rate of conversion to be on track to eliminate coal use for food processing before 2040 (Figure 7.12). Coal use would decline at around 1.4 PJ per year to 2030 – the equivalent of converting one to two very large dairy processing plants away from coal each year or converting a larger number of smaller plants.

67 Along with boiler conversion, the demonstration path assumes significant improvements in energy efficiency across the food processing sector, averaging 1.1% per year.

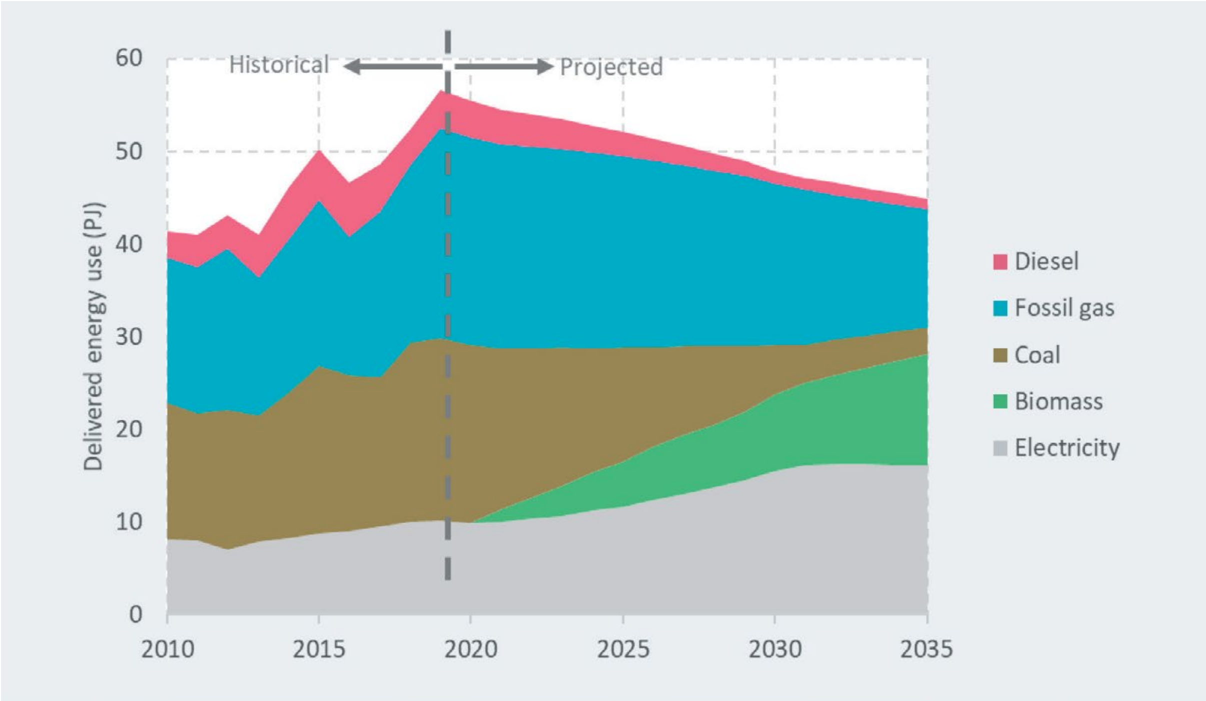


Figure 7.12: Food processing energy use in the demonstration path
Source: Commission analysis

68 Where available, biomass from forestry and wood processing residues are a low-cost fuel switching opportunity. There may be constraints on biomass supply in some regions where there is not significant forestry. In these regions, electric boilers will be needed, however they will have a higher operational cost than fossil fuel boilers at current carbon prices. Electrifying process heat will also require expanding the electricity transmission and distribution grids. This will add to the total cost.

69 In the demonstration path, fuel switching to biomass also occurs in some other energy-intensive industries such as wood, pulp and paper production. Biomass use in the wood, pulp and paper production sector steadily increases from current levels, reaching an additional 3 PJ by 2035.

70 Overall, the demonstration path takes advantage of the country's currently underused biomass resource to help decarbonise transport and process heat, moving towards a more circular economy. We assume that the biomass resource is from accessible domestic forestry residue and pulp logs. Achieving this uptake will require developing supply chains for gathering and processing biomass along with establishing local markets.

71 High-temperature process heat is more challenging to decarbonise and the demonstration path assumes continued use of fossil gas and coal in these sectors. While there is potential to further decarbonise a range of industrial processes through emerging technologies, we assume these are not available for use before 2035.

72 The evidence base underpinning these assumptions and the full reasoning is outlined in *Chapter 5: Reducing emissions from energy and industry* of the *2021 Supporting Evidence*.

7.6 Agriculture in the demonstration path

73 The two main agricultural greenhouse gases are biogenic methane and nitrous oxide. Biogenic methane has a different target to other gases, recognising the different nature of the gas. Nitrous oxide is included in the long-lived greenhouse gas target.

74 The long-term scenarios showed that widespread adoption of existing farm management practices would be important for meeting the less ambitious end of the 2050 biogenic methane target. Meeting the more ambitious end would require developing and deploying new technologies.

75 In the demonstration path, we have also focused on the changes that farmers can make using current technology and practice. Achieving the 2030 targets and putting Aotearoa on track to meet the 2050 targets in the demonstration path involves changes in farming practices. This will take substantial work for the sector to deliver but is achievable with a sustained effort.

76 New technologies that could reduce biogenic methane emissions from agriculture are not required to meet the recommended emissions budgets but would be of substantial benefit if developed, providing greater flexibility and the ability to reduce emissions further.

77 Converting to lower emissions land uses such as horticulture also provides an opportunity to reduce emissions in the agricultural sector. However, there are currently barriers.

78 The evidence base underpinning these assumptions and the full reasoning is outlined in *Chapter 7: Reducing emissions from agriculture* of the *2021 Supporting Evidence*.

7.6.1 Reducing emissions through changes in farming practices

79 The work of the Biological Emissions Reference Group (BERG), the New Zealand Agricultural Greenhouse Gas Research Centre, and others, has identified several changes farmers can make that can reduce their greenhouse gas emissions. These include improving per animal performance while reducing stocking rates, reducing replacement animals, and moving to a lower input farm system. These options will interact within farm systems. No one approach or option will work for all farmers, nor should all farmers be expected to achieve the same level of emissions reductions.

80 The key requirement for any practice change to reduce total biogenic methane emissions, and not just emissions intensity, is to reduce total dry matter consumption. The challenge for farmers is to find a better balance between livestock numbers, production levels and feed inputs (supplementary feed and fertiliser), which enables them to maintain farm profitability while reducing emissions. This generally means a greater proportion of dry matter consumed is used for production and less is used for animal 'maintenance'. Numerous modelling studies and farm trials suggest this is possible over time with data, skills and knowledge. With improving animal genetics, the performance frontier is continually advancing.

81 In the long-term scenarios we have made different assumptions about overall changes to livestock numbers and average production per animal that could result from a range of practice changes being adopted across different farms. We have tested these against more detailed assumptions on specific measures used in the BERG work to confirm they are plausible. We have also validated our modelling of emissions against the Ministry for Primary Industries' (MPI's) agricultural greenhouse gas inventory model.

82 The demonstration path follows the 'Tailwinds' future (see *Chapter 6: Long term scenarios to 2050)* where farmers succeed in making significant productivity gains at the same time as reducing livestock numbers. The alternative paths presented below in Section 7.9 consider a future where productivity improvements are much more limited.

83 In the Current Policy Reference case, total dairy cattle numbers fall by around 8% from 2019 levels by 2030 while milk solids production drops by around 4%. This is based on MPI's projections.

84 In the demonstration path, practice changes enable total dairy cattle numbers to be reduced further – to 13% below 2019 levels – while maintaining roughly the same milk production as in the Current Policy Reference case (Figure 7.13). This is consistent with work for the BERG assessing the potential for increasing individual animal performance and reducing replacement rates.

85 Sheep and beef animal numbers are projected to fall by around 8% from 2019 levels by 2030 under the Current Policy Reference case, due to continued retirement of farmland and land-use change to forestry. Animal numbers are expressed as a weighted average of sheep and beef numbers based on approximate relative feed intake – one beef cattle is the equivalent of five sheep.

86 The demonstration path sees deeper reductions in sheep and beef animal numbers of an additional 5 percentage points below 2019 by 2030, with only a small additional drop in meat production of around 1 percentage point. This includes the impact of new native forests established on sheep and beef farms, which is assumed to have a small effect on production.

87 Through these changes, the demonstration path sees agricultural methane emissions reduced by almost 11% below 2017 levels by 2030.

88 The changes would lead to a similar drop in nitrous oxide emissions. This includes modelled reductions in nitrogen fertiliser use on dairy farms that would be consistent with the reduction in dry matter consumption per hectare (ha). We estimate a potential reduction on the order of 20% by 2030 in the demonstration path, though the precise number would depend on farmer decisions around use of supplementary feed and grazing off. We have also assumed the share of urea fertiliser coated with urease inhibitor increases to 100% by 2030.

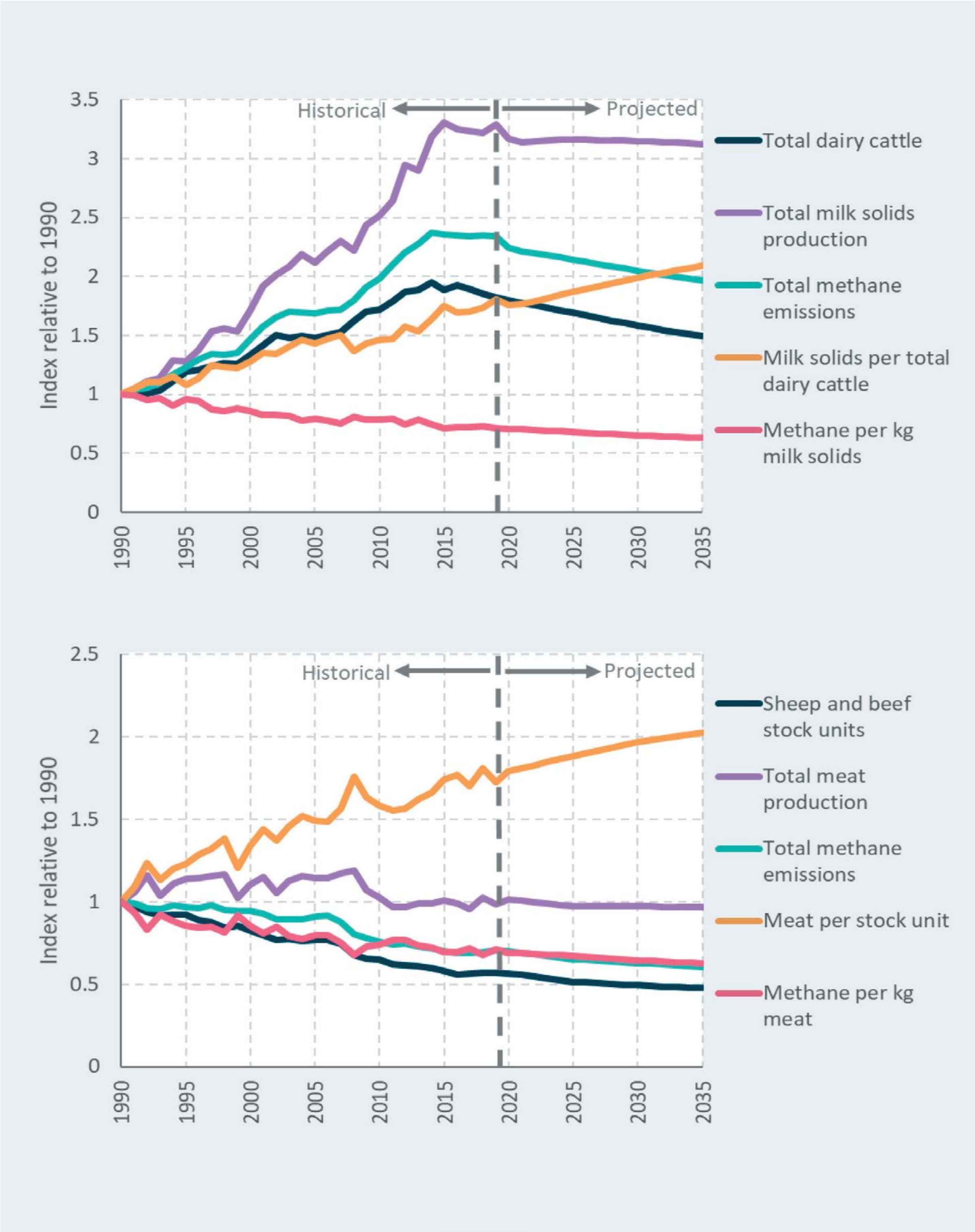


Figure 7.13: Changes in livestock numbers, production and emissions since 1990 and in the demonstration path for dairy farming (top) and sheep and beef farming (bottom)
Source: Commission analysis

7.6.2 New technologies to reduce emissions

89 Selective breeding for lower emissions sheep is a proven option which is in the early stages of commercial deployment. The demonstration path assumes that this can be progressively adopted, reducing overall biogenic methane emissions from the sheep and beef farming sector by 1.5% by 2030 and 3% by 2035.

90 We have assumed selective breeding does not have an emissions impact before 2025. Breeding for low emissions cattle has commenced, but it will take a decade or so to see an impact on emissions from selective breeding. We therefore assume there is no selective breeding for cattle by 2035.

91 Biogenic methane inhibitors and vaccines are being researched and trialled. These could reduce the amount of biogenic methane that is released from cattle and sheep. While there has been progress on inhibitors, these are not yet commercially available. There might be an inhibitor on the market in the near future, but there are still barriers to overcome like uncertainties about what their costs could be and how effectively they could reduce emissions.

92 In the demonstration path, we have assumed that biogenic methane inhibitors and vaccines are not used before 2035. However, if any of these technologies could be brought to market before 2035, they would provide additional options for meeting the emissions budgets. We will review how these technologies are progressing and will consider changes to the emissions budgets if evidence becomes available that they can be widely adopted in the future.

7.6.3 Converting land to lower emissions land uses

93 In the demonstration path, we assume 2,000 ha of land is converted to horticulture per year from 2025 (Figure 7.14). We expect that this could increase in the future if barriers – such as water availability, labour, supply chains and path to market – are addressed.

94 Converting land to exotic and native forests is discussed in the next section.

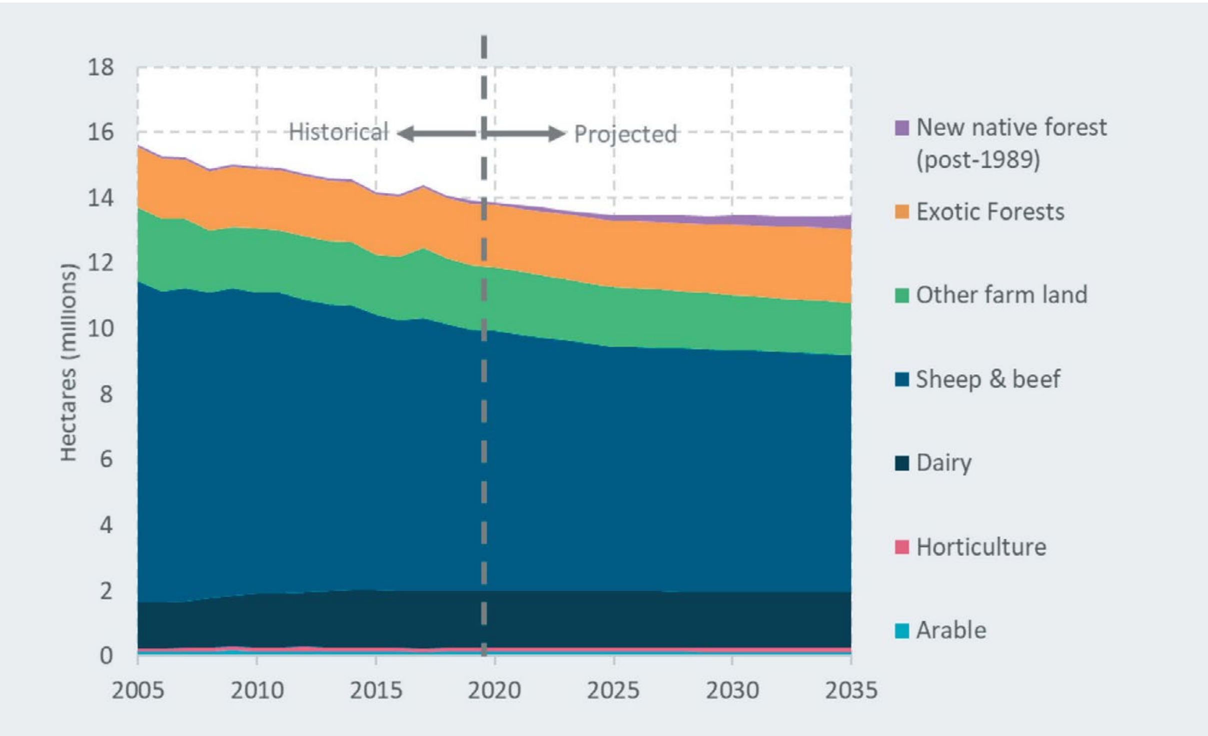


Figure 7.14: Land use for agriculture and forestry in the demonstration path

Source: Commission analysis

7.7 Forests in the demonstration path

95 The demonstration path would see a significant increase in new native forests established on less productive land, through a combination of active planting and letting land revert to native forests. This is in line with the insights from the long-term scenarios. In these scenarios we saw the need for new native forests to build a long-term carbon sink to offset residual long-lived greenhouse gas emissions from hard-to-abate sectors.

96 MPI has forecast that there will be around 12,000 ha of new native forests established in 2021. The demonstration path would see this ramp up to 25,000 ha per year by 2030 (Figure 7.15). In total, close to 300,000 ha of new native forests would be established from 2021 to 2035 (Figure 7.14 above). The rate that we can plant or revert native forest would likely be limited by nursery capacity (where planting is needed), pest control and fencing.

97 Estimates from recent studies suggest there is in the order of 1,200,000 to 1,400,000 ha of marginal land that could be converted to forests, 740,000 ha of which could revert to native forests naturally. As much of this land is steep and prone to erosion, we consider that it would be more suitable for permanent forests, particularly native forests.

98 Establishing close to 300,000 ha of native forests could cost between $5 billion and $15 billion. The carbon benefits alone could outweigh the establishment and maintenance costs after a few decades. This return could be achieved in as short as about 15 years for reverted forests or as long as about 70 years for higher cost planted forests. Native forests also provide a range of benefits.

99 In the demonstration path, exotic forestry planting would continue the trajectory expected under Current Policy Reference scenario up until 2030, averaging around 25,000 ha per year over the decade. From 2030 onwards, the rate of exotic forestry planting for carbon removals would reduce. In total, around 380,000 ha of new exotic forestry would be established from 2021 to 2035.

100 We have assumed there is no change in permanent exotic forest planting beyond what is included in the Current Policy Reference case as additional planting would not be required to reach the 2050 targets.

101 As well as planting new forests, the demonstration path would see reduced deforestation, which is still a considerable source of emissions in Aotearoa. The demonstration path assumes that no further native deforestation occurs after 2025.

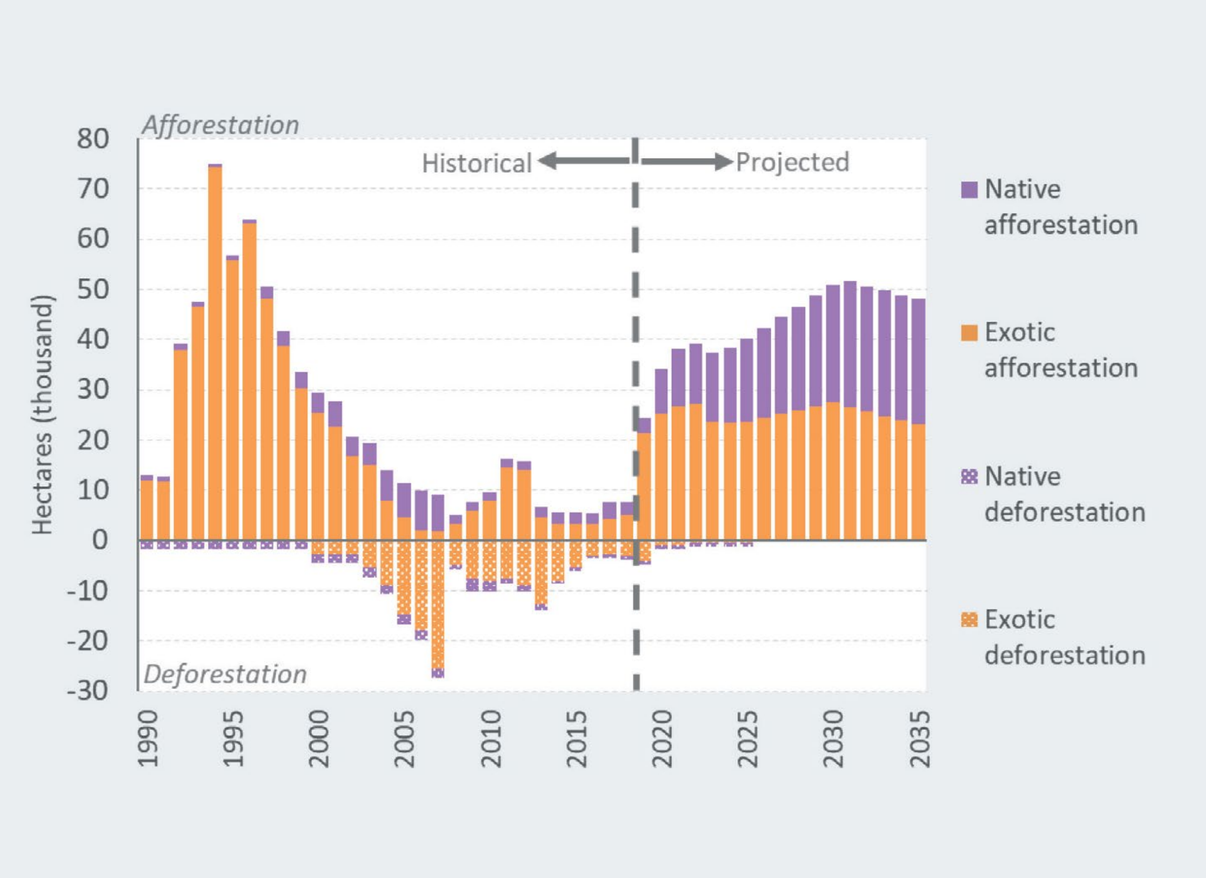


Figure 7.15: Afforestation and deforestation by year in the demonstration path
Source: Commission analysis

102 Trees can help in the transition to a low emissions Aotearoa in other ways.

103 Bioenergy offers a low cost route for decarbonising some sectors, including process heat. Overall, there appears to be a large potential biomass supply from pulp logs and collecting and using waste from forestry and wood processing.

104 However, availability is likely to vary across the country due to regional mismatches in supply and demand, and the cost of transporting biomass. While the supply of biomass residues may appear to be abundant in some regions, trade-offs may also need to be made when deciding what parts of the economy to decarbonise using biomass first.

105 Timber can displace emissions-intensive materials such as steel and cement in buildings. This reduces embodied emissions and can lock up carbon for several decades.

106 The evidence base underpinning these assumptions and the full reasoning is outlined in *Chapter 9: Removing carbon from our atmosphere* of the *2021 Supporting Evidence*.

7.8 Waste and F-gases in the demonstration path

107 Reusing and recovering waste materials is a key part of a circular economy. The demonstration path would see a reduction in the amount of waste generated, and a focus on reducing the amount of organic waste, such as food, wood and paper, that goes into landfills. Overall, the share of total organic waste avoided or recovered from landfill would increase to 28% by 2030 (Figure 7.16).

108 Waste emissions can be further reduced by increasing the amount of methane that is captured and destroyed from landfills. This could be achieved through upgrading or installing new landfill gas capture systems, or by diverting organic waste from sites without landfill gas capture to those with capture. Installing gas capture at existing sites that have received substantial volumes of organic waste in the past would be particularly impactful as it enables the capture of legacy emissions as this waste decomposes.

109 In the demonstration path we assume that by 2030, it is possible to capture roughly one-quarter of the methane that would have been emitted from landfills currently without capture systems (non-municipal and smaller municipal landfills). We also assume that the efficiency of existing gas capture systems is slightly increased.

110 Overall, these changes see methane emissions from waste falling 29% by 2030 relative to 2017 levels in the demonstration path.

111 The evidence base underpinning these assumptions and the full reasoning is outlined in *Chapter 8: Reducing emissions from waste* of the *2021 Supporting Evidence.*

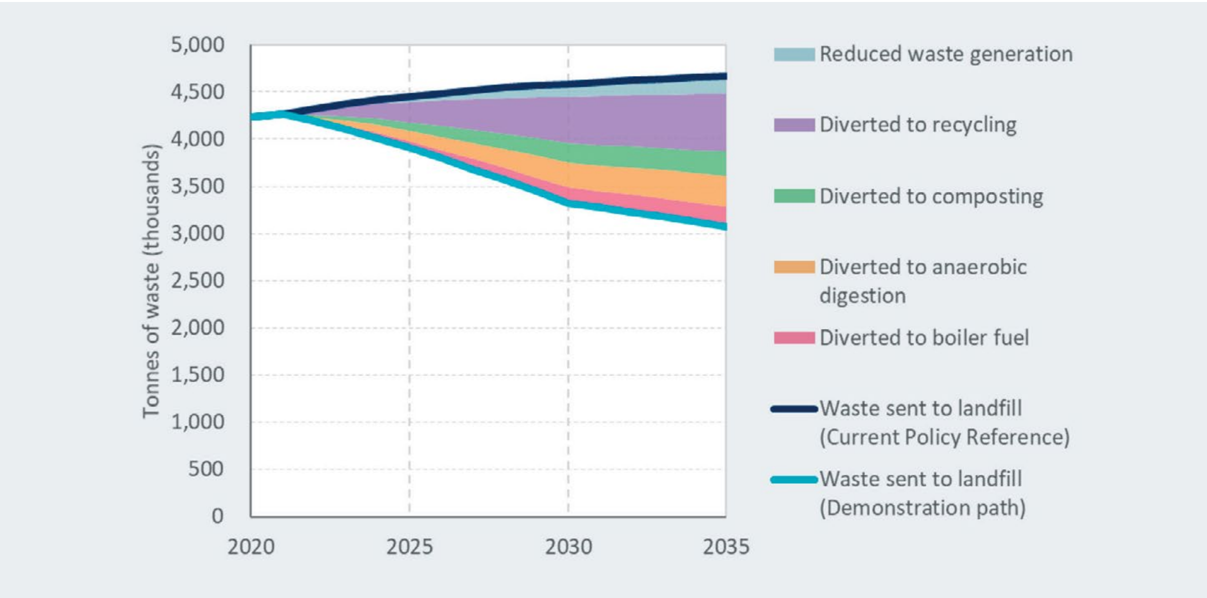


Figure 7.16: Total organic waste sent to landfill in the demonstration path

Source: Commission analysis

112 Fluorinated gases, particularly hydrofluorocarbons (HFCs), are greenhouse gases that are primarily used as refrigerants in fridges, freezers and air conditioning systems. The demonstration path assumes greenhouse gas emissions from HFCs reduce by 21% by 2030 and 32% by 2035 relative to 2019, in line with the actions Aotearoa takes under the Kigali Amendment to the Montreal Protocol. This can be achieved through reducing the import of HFCs contained within products, reducing equipment leakage and increasing end-of-life recovery of products that contain these gases.

7.9 There are different ways Aotearoa could meet the budgets

113 We are required under the Climate Change Response Act 2002 to recommend emissions budgets that are ambitious but achievable. There is inherent uncertainty when assessing the future – some technologies may develop faster than predicted, while others may be slower or not become commercially viable.

114 To ensure that emissions budget levels are achievable, we have tested to ensure that they can be met across a range of future circumstances.

115 Being able to meet the budgets in different ways gives us confidence that there is enough flexibility in how the recommended emissions budgets can be met. Putting Aotearoa on track to its emissions targets and playing its part in the global effort to limit warming to 1.5°C requires budgets to be set at an ambitious level that will require hard work to achieve. However, if we make them too hard, there is no flexibility if things do not turn out how we plan.

116 We have developed two alternative paths to the demonstration path. These build on the long-term scenarios and demonstrate how the recommended emissions budgets could be met with different mixes of actions. This helps to test the degree of flexibility the budget levels allow and how slower progress in some areas could be made up for by further progress in others. It also helps to understand which actions are critical in any path.

117 The specific variations in alternative paths A and B (see *Chapter 6: Long term scenarios to 2050)* compared with the demonstrated path are set out in Table 7.3. Other actions common to all three paths are as described in the previous section above.

118 Figure 7.17 shows the emissions and removals for each path over the three budget periods. The alternative paths would meet the overall emissions budgets defined by the demonstration path to within 1 $MtCO_2e$. They would also meet the 2030 biogenic methane target.

119 The alternative paths would also achieve broadly the same balance of long-lived gases and biogenic methane within the budgets. Due to the different warming impacts of different greenhouse gases, altering the balance of long-lived gases and biogenic methane would impact the country's contribution to warming and our ability to meet the 2050 targets.

7.9.1 Alternative path A: Less technological change, more behaviour change

120 We have tested whether our recommended emissions budgets could still be met through a slower uptake in electric vehicles (EVs) and with less emissions reduction achieved through changes in farm management practices. In this case, the emissions budgets could be met through:

- Further reducing travel and shifting to lower emissions travel modes such as walking, cycling and public transport
- Further improving the emissions efficiency of internal combustion engine (ICE) vehicles entering the fleet, particularly through higher uptake of conventional hybrids
- Further land-use change from livestock agriculture into horticulture and exotic forestry
- Further reducing the amount of organic waste sent to landfill
- Further increasing end of life capture and destruction of F-gas refridgerants
- An earlier switch away from fossil gas use in the wood processing sector

7.9.2 Alternative path B: More technological change, less behaviour change

121 We have also tested whether our recommended emissions budgets could be met if people do not change behaviour as far as assumed in the demonstration path. In this case, the emissions budgets could be met through:

- further accelerating uptake of EVs so that by 2030 all new light vehicles entering the country are electric
- a biogenic methane inhibitor being widely adopted on dairy farms, reducing biogenic methane emissions from dairy cattle by around 5% in 2030 and 15% by 2035
- further increases to landfill gas capture coverage and efficiency.

122 This path would overachieve the third emissions budget by 8 $MtCO_2e$, illustrating the opportunities to extend future ambition through driving strong and early adoption of key technologies.

Table 7.3: Actions and outcomes that differ between the demonstration path and alternative paths A and B

	Demonstration path	Alternative path A	Alternative path B
EV share of light vehicle registrations	50% by 2029 ~100% by 2032	50% by 2031 ~100% by 2035	50% by 2027 ~100% by 2030
Household light vehicle travel	36 billion vehicle-km in 2035 (5% increase from 2019)	33 billion vehicle-km in 2035 (5% decrease from 2019)	39 billion vehicle-km in 2035 (12% increase from 2019)
Fuel economy of ICE cars entering fleet	Average improves to 7.1 L per 100 km by 2035 (20% lower than 2019)	Average improves to 6.0 L per 100 km by 2035 (32% lower than 2019) with higher share of conventional hybrids	Same as demonstration path
Low carbon liquid fuels	12 PJ (~270 million litres) per year by 2035, including non-transport use		None
Electric air travel	5% of domestic air passenger-km electric by 2035	None	10% of domestic air passenger-km electric by 2035
A large pulp mill conversion to high efficiency recovery boiler	2030	2025	2030

Farm management changes	Reduce average emissions per ha by 13% for dairy and 4% for sheep and beef by 2035 relative to 2019	Reduce average emissions per ha by 8% for dairy and 1% for sheep and beef by 2035 (compared with baseline reduction of 6% for dairy and increase of 3% for sheep and beef)	
Biogenic methane inhibitors and vaccine	None		Reduces dairy enteric methane by 5% by 2030 and 15% by 2035
Exotic afforestation	Average of 25,000 ha per year to 2030	Average of 29,000 ha per year to 2030	Same as demonstration path
Land-use change to horticulture	2,000 ha per year converted to horticulture from 2025	From 2021, additional 3,500 ha per year converted from dairy	Same as demonstration path
Waste recovery/ diversion	Reduce total organic waste to landfill by 34% by 2035, relative to current policy reference case	Reduce total organic waste to landfill by 51% by 2035, relative to current policy reference case	Same as demonstration path
Landfill gas capture	By 2035: Average municipal landfill capture efficiency increased from 68% to 73% Capture systems cover 60% of methane generated from smaller and non-municipal landfills		Municipal landfill capture efficiency increased to 80%; Capture systems cover 73% of methane generated from smaller and non-municipal landfills
HFCs	32% emissions reduction by 2035, relative to 2019	39% emissions reduction by 2035, relative to 2019	Same as demonstration path, relative to 2019

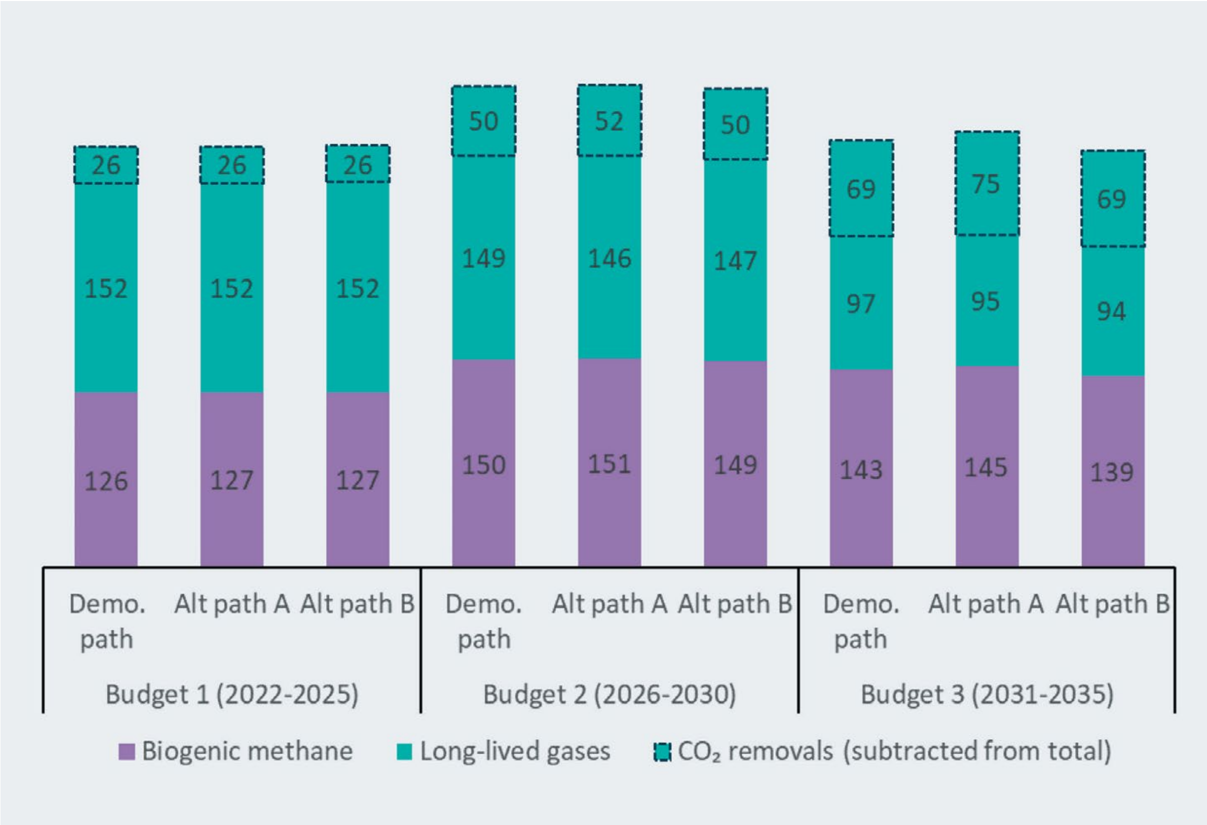


Figure 7.17: Emissions and removals by budget period in the demonstration path and alternative paths A and B

Source: Commission analysis

7.10 Risks to meeting the budgets and opportunities to outperform

123 We have undertaken sensitivity analysis to test how further uncertainties could impact on the ability to meet the recommended emissions budgets.

124 Figure 7.18 shows the modelled impact on emissions in each budget period for the 13 individual factors tested.

125 Holding all other assumptions constant, we have modelled how the demonstration path would be affected by:

- **Slower or faster rates of population and GDP growth.** We have tested population growth rates 0.4 percentage points faster or slower, and GDP growth rates 0.3 percentage points higher or lower, based on government projections.
- **Continued operation of the New Zealand aluminium smelter.** We have tested what happens if the smelter continues to operate beyond 2024. Two variants have been modelled to highlight different potential outcomes for the electricity sector. The first assumes full certainty that the smelter will continue to operate (solid bars in Figure 7.18). The second assumes ongoing uncertainty around whether the smelter will continue to operate, resulting in lower investment in new renewable generation (hatched bars in Figure 7.18).
- **Potential closure or continued operation of other large industrial emitters.** For illustrative purposes, we have tested the impact if steel production, oil refining or methanol production were to close for the last two years of each budget period. For methanol, we have also tested a case where full output resumes from 2026 with the reopening of the mothballed Waitara Valley methanol train.
- **Variability in hydro in-flows.** We have estimated the variability in emissions that could occur with more dryer or wetter hydro years occurring in the budget period, compared to mean hydro years as assumed in our modelling.
- **Uncertainty in projected levels of afforestation and deforestation.** We have tested using the high and low bounds of the Ministry of Primary Industries' projections for exotic afforestation and deforestation of post-1989 forests.
- **Potential for constrained supply of used EVs.** We have tested what happens if imports of used EVs are constrained to the same level as in the Current Policy Reference case (assuming no other changes in the vehicle market).
- **Uncertainty around projected energy and vehicle costs.** We have tested high and low values for EV costs, oil price, capital cost reductions for renewable generation, and biomass prices. Note that in our transport modelling, the oil price only affects the choice of vehicle technology – it does not affect travel demand or choice of travel options.

126 Appendix 1 in *Chapter 12: Long-term Scenarios to meet the 2050 target* of the *2021 Supporting Evidence* provides further detail on the assumed variations or sensitivity ranges tested in each case, compared with what is assumed in the demonstration path.

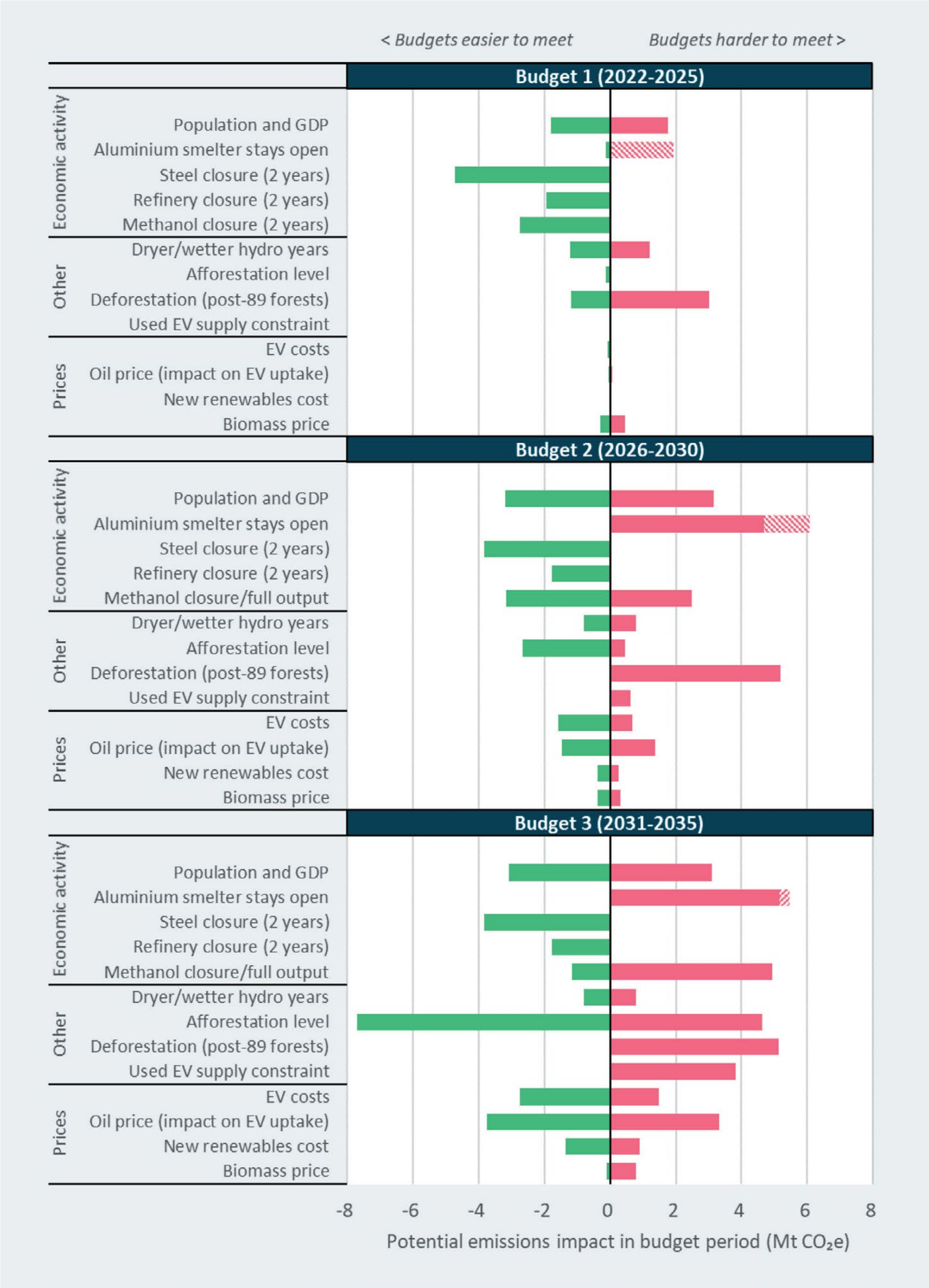


Figure 7.18: Sensitivity analysis of budget period emissions to selected factors or events

Source: Commission analysis

127 The range of impact for the individual sensitivities tested is less than 2% of the total emissions budget for Budgets 1 and 2. For most, the range of impact is less than 1%. For some – particularly afforestation and those affecting EV uptake – the impact is minimal in Budget 1 but is larger by Budget 3 due to cumulative effects and the time taken for forests to grow.

128 Overall, this assessment gives us confidence that the risks these uncertainties pose for meeting the recommended budgets are manageable. In general, the Government can manage these risks through aiming to outperform the budgets in its emissions reduction plan. This will provide headroom to accommodate unexpected events that increase emissions, as well as underperformance against expectations in some areas.

129 For example, the faster progress and further actions seen in the Tailwinds scenario would deliver further emissions reductions that significantly outweigh the upside risks identified in the sensitivity analysis (Figure 7.19). The biggest opportunities seen here are in faster uptake of EVs, further behaviour change in transport, and successful adoption of new methane-reducing technologies in agriculture. By the same token, the risks of delayed action and slower progress seen in the Headwinds scenario are much larger than any risks identified through our sensitivity analysis.

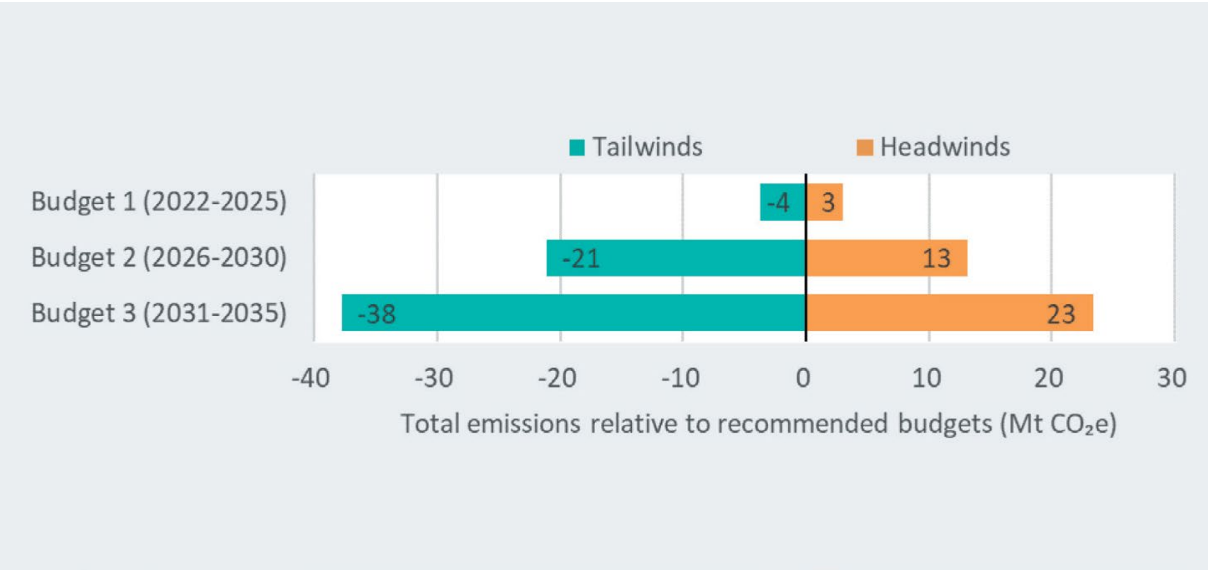


Figure 7.19: Where our recommended emissions budget levels sit relative to the Headwinds and Tailwinds scenarios. The Tailwinds scenario would deliver a further 4 Mt CO_2e in emissions reductions in budget period 1 than our recommended emissions budgets.

Source: Commission analysis

130 Two specific risks our assessment highlights for the first budget period may warrant particular attention from the Government:

- **Deforestation of post-1989 forests.** We have assumed no change from the Ministry for Primary Industries' projected deforestation area over the first emissions budget period, but there is a considerable uncertainty range around this. Some post-1989 forests have no deforestation liability because they are not registered in the New Zealand Emissions Trading Scheme (NZ ETS), and some post-1989 forests that are registered in the NZ ETS have no incentive to replant after harvest due to their age class (this differs from pre-1990 forests which face a deforestation liability through the NZ ETS). Under current policy the Government has limited ability to affect deforestation decisions about these forests.

- **Uncertainty around the future of the New Zealand aluminium smelter. I**f the smelter were to unexpectedly stay beyond its currently signalled closure in 2024, this would lead to more fossil fuel electricity generation in addition to the direct emissions from the smelting process. The continued operation of the aluminium smelter could result in continued baseload thermal generation and new fossil gas peaker plants to meet growth in electricity demand across the economy. However, if this were to be signalled early and with certainty, this would likely bring forward construction of renewable generation projects and minimise the increase in fossil fuel electricity generation. Taking steps to provide greater certainty to the electricity sector could help to mitigate this and other risks. We discuss this further in *Chapter 15: Policy direction for energy, industry and buildings.*

131 We have not attempted to quantify how potential future updates to *New Zealand's Greenhouse Gas Inventory* could impact on meeting budgets. We discuss how such updates can be handled in *section 10.8* of *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets.*

7.11 What does this mean for policy?

132 We have recommended emissions budget levels that are technically achievable and economically affordable. We have demonstrated there are multiple ways to achieve our recommended emissions budgets and tested their sensitivity to our assumptions.

133 But our recommended emissions budget levels are also ambitious. There is some but not a lot of flexibility in how they can be delivered – there are a number of actions that are critical under all scenarios. Meeting these budget levels relies on moving as quickly as real world constraints allow. The changes that are needed will not be delivered without hard work from individuals, Iwi/Māori, the private sector and public sector.

134 There are a number of critical outcomes that Aotearoa will need to achieve:

- Expanding native forests to build a long-term carbon sink.
- Increasing the number of people who walk, cycle, use public transport and emerging low emissions options like e-scooters and e-bikes rather than petrol cars.
- Accelerating EV uptake and phasing out light ICE engine vehicle imports sometime between 2030-2035 – consistent with the phase out dates being set by a growing number of countries – and importing more efficient ICE vehicles, including conventional hybrids, while the EV supply grows.
- Improving the efficiency of heavy transport and freight, including through freight optimisation, and increasing the share of rail and coastal shipping.
- Scaling up low emissions fuels like biofuels or hydrogen-derived synthetic fuels. Biofuels are particularly useful in decarbonising the current vehicle fleet.
- Increasing energy efficiency in homes, commercial and public buildings.
- Phasing out new fossil gas connections and switching existing fossil gas appliances to low emissions fuels.
- Eliminating coal use in commercial and public buildings by 2030, and for food processing before 2040.
- Expanding the electricity system in a timely, reliable, and affordable way, while managing the opposing risks of under or over-investing in the system. Over-investment risks increasing the delivered cost of electricity or stranded assets, which would disincentivise electrification. Under-investment risks delaying progress on wider decarbonisation efforts in transport, industry, and buildings.

- Adopting farm management practices that will reduce biogenic methane and nitrous oxide emissions.
- Developing and deploying new technologies that could reduce biogenic methane emissions from agriculture.
- Opening up opportunities for more conversion to lower emissions production systems and land uses, including horticulture.
- Increasing the availability of low-waste and low emissions options for businesses and consumers when purchasing and disposing of goods.

135 Government will need to use its policy levers to enable, incentivise, or require changes as appropriate. There are challenges and barriers to meeting emissions budgets, but there are barriers that can be overcome through policy (see *Chapter 11: Approach to developing advice on policy direction* for more information).

136 Looking internationally, it is clear that policy can be designed to deliver these actions. The countries that have had the most successful EV uptake have had a range of policies to encourage that uptake. The countries that have developed markets for low carbon energy have had policy to support that.

137 To deliver these emissions budgets, the Government will need to encourage a wider set of actions than what is simply 'necessary' under any one of the paths to meet the emissions budgets. The Government should aim to overachieve the emissions budgets as some policies and actions may not deliver the expected reductions, and some technologies may not develop as expected.

138 Building in this flexibility and keeping options open will be important. Keeping options open will allow Aotearoa to adjust course as the low emissions transition proceeds. In this way government, industry, businesses and individuals will be able to adapt as new information, technologies and approaches are developed – which can help support a lower cost and more equitable transition.

139 There are some low regret choices that are sensible to adopt under any future, such as increasing energy efficiency and accelerating electrification of the transport fleet. It is also possible that some policies or approaches could shut down future options, and this should be avoided. For example, some infrastructure investments or urban planning decisions might lock Aotearoa into modes of transport or ways of living that make it hard to take advantage of new technologies in the future.

140 At the same time, it will also be important that we build on our successes – such as our already highly renewable electricity generation – and accelerate progress where possible, and make decisions that take advantage of key windows of opportunity. When important new opportunities are identified, the Government will need to act swiftly and decisively to drive faster and deeper emissions reductions. At times, the Government and businesses might need to invest significantly in key technologies to help make the transition cheaper and faster.

141 Uncertainty about the future is not a reason for delay. In fact, it is a reason for stronger action. It is important that we chart a path forward that has enough flexibility to ensure it is resilient.

Box 7.3: Key changes we have made to our modelling as a result of consultation feedback

During consultation, we received feedback from submitters about our models and assumptions. The key areas where we received feedback from submitters and made changes to our modelling in response to new evidence are detailed by sector in Table 7.3 below. In some cases, we made amendments to the assumptions we used in the demonstration path. In other cases, we made amendments to the alternative paths, long-term scenarios or carried out sensitivity analysis.

We do not intend for the demonstration path to be a prescriptive path that Aotearoa must follow to meet our recommended emissions budgets, but rather as a path to show that our recommended emissions budgets are achievable. Assessing the level at which to set assumptions in the various scenarios and paths is a difficult task. Reality will pan out differently. However, by running various scenarios, paths and sensitivity analyses, we are confident that our recommended emissions budgets are achievable and ambitious, with sufficient flexibility around how they can be met.

Table 7.3: Feedback we received about our assumptions and modelling, and what we have changed.

	Key feedback we received	What we have changed since our *2021 Draft Advice for Consultation*
Transport	Our active and public transport assumptions did not reflect the difference between urban areas and rural areas.	We modelled regional shifts to better reflect the differences between urban and rural areas. Instead of averaging our results across Aotearoa, we modelled five regions: Auckland, Waikato, Wellington, Canterbury and Rest of Aotearoa. We increased our assumptions on the proportion of travel shifting to both public and active transport in urban areas in our scenarios and paths. These changes are more reflective of the transport targets set out in regional climate plans such as the *Auckland Climate Action Plan*. We reduced our assumption on the proportion of people shifting to public transport in provincial areas, and increased shifting to some modes of active transport, such as cycling. In aggregate, this has increased the level of ambition in our mode shift assumptions in the demonstration path. We have also tested the impact of greater or reduced mode shift in our alternative paths A and B.

Transport	Our EV uptake may be too ambitious in the short term as Aotearoa could face supply issues.	We carried out additional analysis on potential supply constraints for EVs. As a result, we reduced the level of supply of *used* EVs available in the 2020s in the demonstration path. However, we have not changed our assumptions for how fast *new* EVs will be adopted as the global EV market is rapidly developing. We expect that any supply constraints Aotearoa may face for new EVs would be minor and short lived. We also increased the rate of fuel efficiency improvements for imported ICE vehicles in the demonstration path. This includes a faster uptake of conventional hybrid vehicles in the used import market. This is due to tighter constraints on the supply of used EVs. EVs are a key technology for meeting the third emissions budget. In alternative path A, we tested whether the budgets can still be met through a slower EV uptake. We carried out a sensitivity analysis on EV costs, the oil price, and supply constraints on used EVs to test how variations to our assumptions could impact meeting the emissions budgets.
	Our heavy transport assumptions were too conservative and needed to consider the potential for more efficiency improvements and greater use of low emissions fuels such as biofuels or hydrogen.	We introduced new assumptions on operational efficiency improvements for road freight in the demonstration path. We also increased the amount of biofuels in the demonstration path to be in line with the level in our Tailwinds scenario – double what it was in our *2021 Draft Advice for Consultation*. This reflects potential supply from other feedstocks, such as tallow or imported feedstocks. We did not specifically model hydrogen use in heavy transport as the ENZ model does not include this functionality. However, the heavy transport that becomes electric in the model could include hydrogen fuel cell vehicles.
	We had not included low emissions aircraft, particularly electric aircraft in our primary path. Aviation could use all of the biofuels that we modelled if international aviation was to be included in future budgets.	We included some electrification of short haul domestic air travel in the demonstration path from 2030 onwards based on feedback from sector stakeholders and our analysis. As noted above, we increased the supply of biofuels in the demonstration path. For simplicity, we have modelled this as an equal share across all domestic transport fuels. Our assumptions are for domestic use only and do not consider biofuel use in international aviation and shipping.

Buildings	Our assumptions around the energy efficiency improvements possible in buildings were too conservative.	We carried out additional analysis on potential rates of energy efficiency improvements across different building types. However, we have not changed our modelling assumptions. Rather, we put increased emphasis on the emissions reductions that could be achieved through building design and construction practices in our qualitative discussion. We also highlight the work being undertaken by the Ministry of Business, Innovation and Employment's Building for Climate Change programme to address operational energy and embodied emissions in Part two of our advice: *Emissions reduction plan advice*.
	Our assumptions on the cost of transitioning away from fossil fuelled heating systems were too low.	We carried out additional analysis on the lifetime costs of new gas connections compared to continued use of fossil fuels. We assumed a 25% reduction in heat demand in existing commercial and public buildings by 2035, compared to a 16% reduction in our *2021 Draft Advice for Consultation*.
Electricity	Our wholesale electricity price trajectory underestimated near-term wholesale electricity prices. However, the longer-term price trajectory was largely in line with industry and other stakeholders' expectations.	We re-ran EnergyLink's EMarket and I-Gen models, which complements our ENZ modelling. We refined the methodology to better model peak demand and reflected higher starting prices in line with current conditions. We explicitly included certain market conditions such as tight gas supply, low wind generation and low hydro lake storage levels in the model. We also carried out sensitivity analyses through the EnergyLink models where 1) fossil gas prices increase and 2) the smelter remains open. We refined the ENZ model with updated network development and cost allocation settings, and modelled a move to cost-reflective pricing by 2030.
	Our assumption that high emissions intensity geothermal power generation stations would become uneconomic and close due to a rising emissions price was not nuanced enough.	We refined the ENZ model to differentiate between existing geothermal fields and new fields. For each grouping, the model now specifies average emissions intensity, natural degassing rate, a location factor, and individual operation and maintenance costs. In the Tailwinds and Further Technology scenarios, a carbon capture rate of 35% is applied.

Industry and heat	Our assumptions about Methanex exiting the market in 2029 was too early.	We adjusted Methanex's exit so that it is no longer based on the 2029 end date of their publicly available gas supply contracts. The modelling now stages their closure to 2040. This assumption was changed in the Current Policy Reference case and flows through to the demonstration path. This is compatible with modelled fossil gas supply but assumes continued investment to enhance extraction from onshore and offshore fields.
	Our assumption about Tiwai Point aluminium smelter's exit did not align with Rio Tinto's publicly signalled date.	We adjusted our assumption so that all potlines at the smelter close by 31 December 2024 to align with the publicly signalled closure date. Previously, the smelter underwent a staged closure from August 2024 to August 2027, closing one potline at a time. This assumption was changed in the Current Policy Reference case and flows through to the demonstration path. We carried out sensitivity analysis on the smelter's closure. The results of this are discussed in Section 7.10.
	Our assumption that NZ Steel's emissions reduce by 10% as part of the COVID-19 economic shock did not eventuate.	We adjusted our assumption so that NZ Steel's emissions remain constant at 2018 levels. The *2021 Draft Advice for Consultation* had modelled a 10% reduction in fuel use and emissions from 2020. This assumption was changed in the Current Policy Reference case and flows through to the demonstration path.
	Our assumption about energy efficiency improvements in the food processing sector was too ambitious as remaining opportunities to further improve efficiency can be costly.	In the demonstration path, we adjusted the annual rate of energy efficiency improvements in the food processing sector from 1.3% to 1.1%, in line with the Further Behaviour and Further Technology scenarios.

Agriculture	Our assumptions about on-farm improvements were overly optimistic and beyond what can be achieved.	We revised the productivity projections in the Current Policy Reference case based on new data and information from MPI and further analysis. This included separating out estimated meat production from the dairy sector, and sheep and beef sector, and updating assumptions on factors contributing to future production such as lambing rates. The result of this is significantly lower projected productivity improvements for the sheep and beef sector. We also revised downwards the assumed potential of on-farm management practice improvements for sheep and beef. We did this after reassessing our assumptions against evidence including the Biological Emissions Reference Group's 2018 report (BERG report). We found that, by looking at potential contributions from individual measures to improve productivity, the reduction in stock numbers we had previously assumed would likely only be achievable with reduced production. Separately, we have tested our modelled emissions outcomes under the demonstration path against MPI's more detailed Greenhouse Gas Inventory model for validation.
	We 'stacked' mitigations that could not be added together.	We checked our modelling assumptions. They are based on the BERG report, which included the 'stackability' of how different emissions mitigations interact. Our modelling avoids double-counting emissions reductions from technologies and practices.
	Our assumptions about how much land might convert to horticulture were too low.	We used different assumptions for land-use change to horticulture in the different paths to explore the effects of different levels of land-use change to horticulture. In the demonstration path, we assumed 2,000 ha per year converting to horticulture. In alternative path A, we tested removing some of the barriers by increasing the rate of conversion to horticulture to 3,500 ha per year.
Forestry	Our modelling did not take into account the loss in production due to native forests	The *2021 Draft Advice for Consultation* assumed that native afforestation would not result in any loss of grazing land. We have updated our modelling so that native afforestation now results in an effective loss in grazing land of 20% of the area afforested. This recognises that a lot of new native forests will be established on steeper, erosion prone land with relatively low grass growth.

Waste	Our assumptions on the amount of landfill gas (LFG) capture were low.	We have strengthened our assumptions based on submitter feedback and further analysis of the potential for installing new LFG capture systems at existing sites. We assumed that 50% of emissions from landfills that do not currently have LFG capture will be subject to gas capture by 2030. This is an increase from 10% in our *2021 Draft Advice for Consultation*. We have assumed the efficiency of the LFG capture is 52%. This means a total of 26% of the methane that would have been emitted from these landfills is captured. In the Tailwinds scenario, we assume that the proportion of gas subject to capture is 65% by 2030 and the efficiency of the LFG capture systems is 68%.
	Our assumptions on the amount of organic waste diverted from landfill were not ambitious enough.	We increased the proportion of organic waste recovered in 2030 from 21% in the *2021 Draft Advice for Consultation* to 28% in this report. In the Tailwinds scenario, the proportion of organic waste recovered in 2030 is 42%.

Chapter 8

Te Tahua Tukunga Hauwaro – Te Matatika, Te Urutika, Te Tautika
Demonstrating emissions budgets can be fair, inclusive and equitable

Summary

For our emissions budgets to be ambitious and achievable, they must be met in a way that is fair, equitable and inclusive. This means government must manage potential negative impacts and encourage positive benefits that come with climate action. These will vary across regions, parts of society and the economy, depending on the path the Government chooses and the policies it puts in place.

This chapter outlines the impacts and co-benefits considered when setting the emissions budgets. These include:

- **Impact on GDP:** Aotearoa can reduce emissions while continuing to grow the economy. We assess that in 2050, the level of GDP could be around 1.2% lower than if we continued with the policies we have today. Investment in low emissions technologies and processes now will open up new markets and reduce the risk of losing others. Delaying key action including the move to EVs and more efficient farm practices could result in GDP in 2050 being up to 2.3% lower.
- **Recognising Iwi/Māori:** climate action must recognise Iwi/Māori priorities and not exacerbate existing inequities. The Government will need to ensure that policies consider the different priorities and historic inequities that Iwi/Māori face.
- **Future generations:** it is important that future generations are not disadvantaged. Aotearoa must strike a balance in how quickly it acts so it does not pass on the cost of climate change. Young people have told us often that this is a concern.
- **Benefits to health:** there are many co-benefits from climate action, particularly to health because of warmer, drier homes, more walking and cycling, and less air pollution. These benefits are significant and immediate and can improve the quality of life for people now and in the future.
- **Cost of living:** in general, we do not think New Zealanders' living costs will increase. Some changes, for example how people travel or heat their homes, will save money. It is essential government considers the needs of groups such as Māori, Pacific peoples, the elderly, people with disabilities, and those on low incomes, as well the most impacted regions and sectors in its planning.

- **Employment and skills:** there will be fewer jobs in some sectors and more jobs in other sectors. Although there may be some job loss in the next few years, a lot of the change will occur through natural attrition and older workers retiring. One of the biggest challenges is making sure Aotearoa has the workers with the skills it needs to support the transition.
- **Rural communities:** communities that rely on the food and fibre sector could be impacted by widespread planting of new production forests. Limiting these forests aligns with the Commission's recommendation to focus on reducing gross emissions (rather than offsetting emissions with trees) and reduce negative impacts on communities.

Changes in our final advice

We have added more detail on health benefits, the impacts on jobs, and the costs of inaction. We have updated our modelling results and included the results of new sensitivity analysis in our impacts analysis.

Introduction

1 The transition to a thriving, climate-resilient and low-emissions Aotearoa will bring opportunities, benefits, challenges and costs. Aotearoa has the opportunity to transition in a way that considers the wellbeing of people, the land, and the environment, both now and in the future.

2 We have specifically recommended emissions budget levels that can be met in a way that is fair, inclusive and equitable, that bring significant co-benefits to our wellbeing and environment, and that reduce existing inequities.

3 Under the Climate Change Response Act 2002 (the Act), we must consider the potential impact of our recommended emissions budgets on different generations, the economy, businesses, Iwi/Māori, different regions and communities, households, workers, the environment, and on government taxation and spending.

4 We must also recognise and respect the Government's responsibility to give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi. Where there are potential negative impacts, we have ensured we are satisfied that there are ways to manage those impacts. That could be through choosing a different transition path, or by implementing policies to manage the impacts.

5 We have not attempted to sum up the positive and negative impacts of the transition. Instead, we have addressed each potential impact in turn, considering where impacts could compound on particular groups of society and how negative impacts could be managed.

6 More detail on our assessment of impacts can be found in Chapters 11-15 *of the 2021 Supporting Evidence.*

7 Ultimately, the Government will decide on its course for meeting emissions budgets and the policies it will put in place. The impacts on different groups of society will depend on policy decisions the Government makes. Ensuring that these policy decisions are fair, inclusive and equitable is covered in more detail in *Chapter 20: Policy direction for a fair, inclusive and equitable transition*.

Box 8.1: Themes from submitters on our consultation

Through consultation, we received feedback from a range of different population groups who were interested in understanding what our emissions budgets meant for them and their community.

We received strong support for the need for a transition that is fair, equitable and inclusive. Submitters emphasised the need for a partnership approach with Iwi/Māori in line with Te Tiriti o Waitangi/The Treaty of Waitangi. Submitters also emphasised the need for co-designing transition planning and policies with Iwi/Māori, different population and community groups, unions and workers, businesses, regional economic development agencies, and central and local government.

Some submitters emphasised the need for equity – ensuring the transition does not exacerbate or create inequities for New Zealanders, and takes opportunities to reverse some existing inequities.

Some submitters also mentioned the importance of intergenerational equity and that it is unfair to leave the costs of climate change to future generations.

Some submitters noted that some groups could face greater challenges and would need support through the transition for their different circumstances. This included some Iwi/Māori, Pacific peoples, women, elderly people, people with disabilities, young people, people on low incomes and people living in rural areas.

Private sector submitters were particularly concerned about the cost of the transition, what it would mean for their business and their ability to be competitive. Submitters were also interested in the opportunities to produce low-emissions products or build new low-emissions industries, and noted how the business response would flow through to employment.

These themes are addressed throughout this chapter.

8.1 Intergenerational equity

8 Te ao Māori recognises the interconnectedness of all living things within nature and the reciprocal relationship between tangata (people) and the whenua (land).

9 In considering how New Zealanders will experience the impact of the transition to a low-emissions economy, we must consider how the actions we take today will affect the wellbeing of current and future generations.

10 Some industries, regions and communities of Aotearoa will be more affected by the transition than others. It is important that the speed and nature of the transition is well signalled to allow time to plan. People who work in industries that extract and use fossil fuels will be particularly affected by the transition. These people will increasingly need to move into new industries.

11 Carefully balancing our transition to a low-emissions society requires a considered approach that does not create or exacerbate social inequities. The transition can be economically affordable and socially acceptable if it is well-paced, planned together with communities, and well-signalled. Society will benefit from improved health and wellbeing.

12 Intergenerational equity is reflected in He Ara Waiora, part of the Government's wellbeing framework, through the dimensions of wellbeing ('ends') and the tikanga ('means'). Both of these are essential to intergenerational wellbeing. This aligns closely with the concept of tiakitanga and guides Aotearoa to carefully consider the pace of the transition.

13 Climate change will disproportionately affect young people and future generations. However, if Aotearoa transitions too quickly, both current and future generations will also bear the brunt of the costs of disruptive change.

14 We have recommended emissions budget levels that are both ambitious and predictable. Acting too hastily will result in abrupt and disruptive changes akin to the changes many people in Aotearoa experienced from the economic reforms in the 1980s. Delaying action carries the risk of a sharper and more disruptive transition later, locking in emissions intensive infrastructure that could become stranded and contribute to more severe climate change.

15 A key part of intergenerational equity is ensuring sustainable prosperity over the long term. To ensure sustainable prosperity, we have not only considered the need to reduce emissions as quickly as possible, but also the need to set future generations up with the resilience and ability to make continual and lasting emissions reductions over the long term.

16 This means not only passing on to future generations an Aotearoa that is low emissions, but also an Aotearoa with a productive economy where people are well, healthy and have jobs that are environmentally and socially sustainable.

8.2 The benefits, costs and savings from meeting emissions budgets

17 We looked at opportunities, benefits, costs and risks of the actions that would need to be taken to meet our recommended emissions budget levels. We have sought to recommend emissions budget levels that can be met by making the most of the opportunities and benefits, while minimising the costs and risks over time.

18 We received a number of submissions concerned about the economic costs of our emissions budgets. Some submitters commented that the estimated impact on GDP was lower than they expected and lower than previous estimates. Some submitters were concerned that costs would fall disproportionately on particular sectors of the economy or groups of people in Aotearoa. Other submitters emphasised the need to consider the cost of inaction, the benefits to health and that acting now would save money later.

8.2.1 Costs and savings from the energy transition

19 There will be costs associated with meeting our recommended emissions budgets. Across the economy and society, businesses and individuals will need to look at their emissions and make changes to reduce them.

20 However, in many cases the investments made now will more than pay for themselves in the long term. Such investments include those in energy efficiency, electric vehicles (EVs), renewable electricity generation, and improving on-farm efficiency.

21 Delaying these investments would result in greater cost to the economy and society. There is also an opportunity now for increased investment to stimulate the economy and support the post COVID-19 recovery.

A decarbonised energy system can provide cost savings

22 We have assessed the costs and savings of some of the key actions that can be taken to decarbonise the energy system. These assessments are based on the rate of uptake of these actions in the demonstration path (outlined in more detail in *Chapter 7: Demonstrating emissions budgets are achievable).*

23 This analysis looks at the costs of transitioning across three key areas: road transport, space and water heating, and food processing. We have focused on these areas as they are large sources of current emissions in Aotearoa and are likely to require some of the most significant transitions from fossil to renewable energy. Together, these areas account for around three-quarters of the reductions in long-lived gas emissions by 2035 under the demonstration path.

24 Our analysis estimates the costs incurred in each year from capital investments in vehicles, boilers and appliances, use of fuel and electricity, maintenance, and other associated costs. We have compared these estimates against the current policy reference case, where the uptake of these actions would occur more slowly. This allows us to show where there could be costs and where there could be savings from taking these actions over time.

25 Overall, we find that substantial additional investment will be required over the coming decades, but this is likely to be outweighed by even larger future cost savings. This is demonstrated in Figure 8.1. There are costs over the next decade or so. Beyond this, the savings outweigh the costs as avoided expenditure on fossil fuels outweighs the additional capital costs and expenditure on electricity and biofuels. By the 2040s, Aotearoa would be saving around $2 billion each year (the solid black line in the figure).

26 The figures presented here consider only fuel-switching measures. They exclude the effects of energy efficiency improvements, mode shift and reduced travel demand in the demonstration path. We expect these to deliver further economic benefits, potentially more than doubling the net cost savings in the long term. However, a complete picture would need to consider wider implications such as transport infrastructure investment, which we have not been able to do.

27 The numbers above exclude the monetised value of emissions reductions. In Figure 8.1, the grey dotted area shows the avoided emissions costs if valued at the emissions values used in our modelling of the demonstration path (see *Chapter 7: Demonstrating emissions budgets are achievable Box 7.1: Emissions values* for more information). The black dashed line in the figure shows how the overall costs would change if avoided emissions costs were included.

28 The positive values (above the horizontal axis) in these figures (Figure 8.1, 8.2, 8.3, 8.4) indicate that the demonstration path would impose an additional cost above the Current Policy Reference case. Negative values (below the horizontal axis) indicate that the demonstration path would represent a cost saving relative to the Current Policy Reference case.

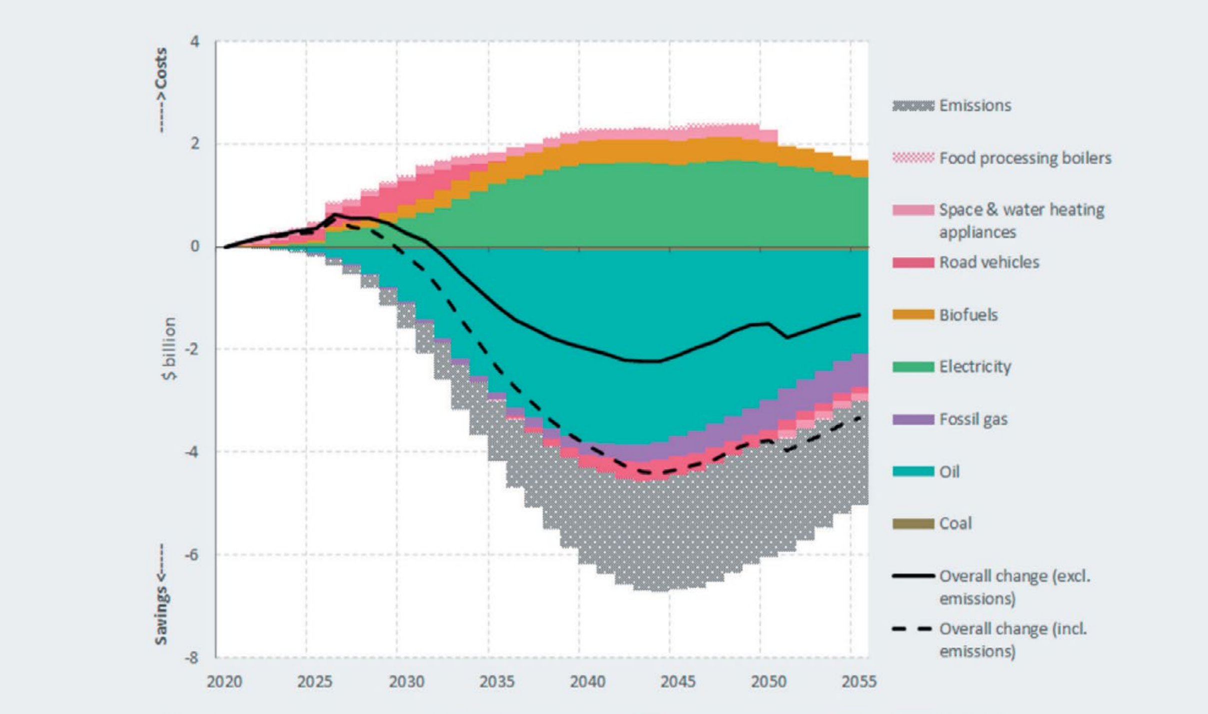


Figure 8.1: Projected annual increase and decrease in costs from fuel switching across the road transport, buildings and food processing sectors in the demonstration path compared to the current policy reference. This excludes the effects of improved energy efficiency, mode shift and reduced travel demand.
Source: ENZ modelling

Electrifying road transport could start to deliver cost savings within a decade

29 Our analysis finds Aotearoa will save money if businesses and individuals decarbonise by electrifying transport. This accounts for most of the overall cost savings shown in Figure 8.1 above.

30 Figure 8.2 shows a more detailed breakdown of the various cost elements for road transport under the demonstration path compared to the Current Policy Reference case. Again, this does not include the effect of reduced road travel from greater walking and cycling, use of public transport, use of rail and coastal shipping, working from home, or other changes to demand. These mode shifts could lead to large additional cost savings, particularly through reducing the number of cars that Aotearoa imports.

31 Electrifying the vehicle fleet will require increased capital expenditure on vehicles, investment in electricity supply and distribution and charging infrastructure. However, our analysis indicates that these capital costs will be more than offset by savings in petrol and diesel use, along with lower maintenance costs. Our analysis suggests that annual cost savings will exceed the additional costs incurred by around 2030 under the demonstration path. Contributing to this is our assumption that the capital cost of EVs will continue to fall, with electric cars becoming cheaper than a petrol equivalent by 2031.

32 Our analysis indicates that biofuels will remain more expensive than fossil fuels. This would lead to an increase in fuel costs, but these costs would be small relative to the cost savings from electrification.

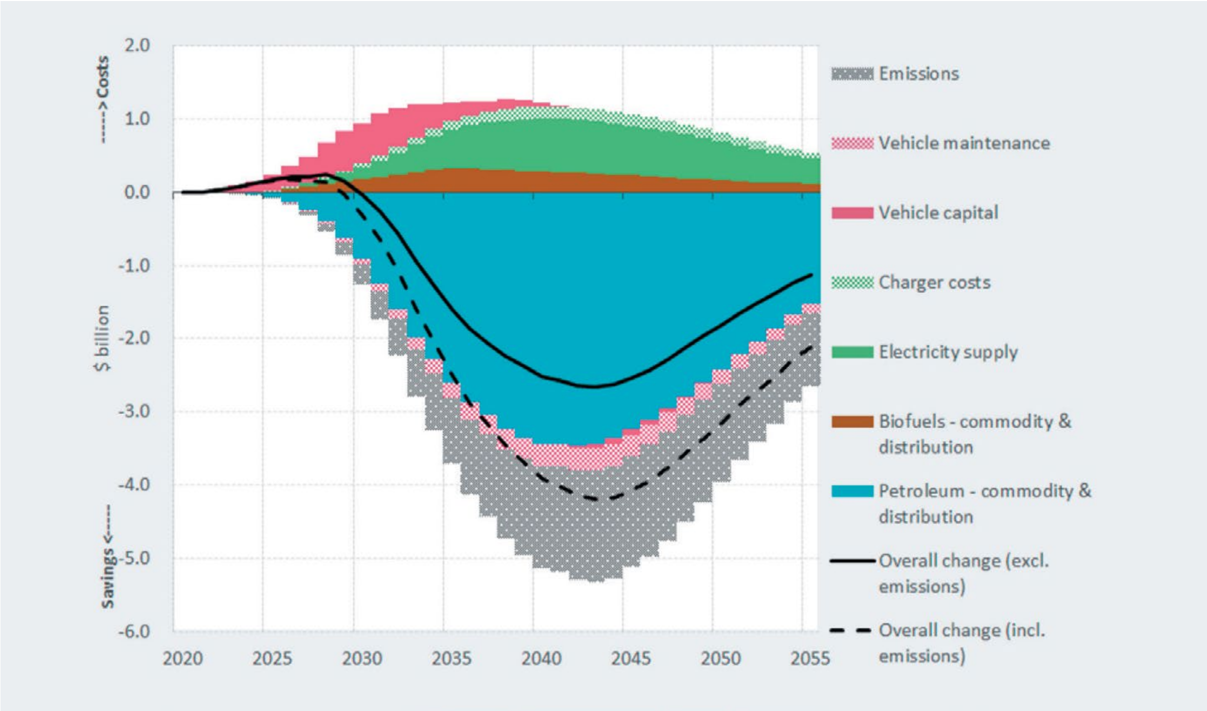


Figure 8.2: The projected increase and decrease in different elements of road transport costs in the demonstration path compared to the current policy reference, excluding the effects of mode shift and reduced travel demand

Source: ENZ modelling

Switching to electric space and water heating could deliver cost savings but there are transitional costs

33 In the demonstration path, fossil gas and LPG space and water heating systems are phased out and replaced with electricity by 2050. Our analysis finds that this would incur a net cost averaging around $200 million per year out to 2050, excluding the emissions reduction benefits (Figure 8.3).

34 We estimate that electric heating systems are slightly cheaper than a fossil gas system today in new buildings, but the costs of converting an existing building to electric would be substantial. This is particularly due to 'make-good' costs to properties from removing fossil gas appliances and making repairs to the property.

35 While substantial, these are one-off transitional costs. As Figure 8.3 shows, after 2050 once all the conversions are completed, annual costs are lower. We therefore find that similar to road transport, the transition to electric heating would ultimately lead to lower costs, but this point will take longer to arrive.

36 We have tested whether delaying the transition from fossil gas and LPG to electricity would improve the economic costs to Aotearoa. However, our analysis indicates that this would end up costing Aotearoa more over the long term as the post-transition benefits are delayed.

37 The effects of energy efficiency improvements assumed in the demonstration path are not included here, but our analysis indicates there is potential for these to substantially offset the transitional costs.

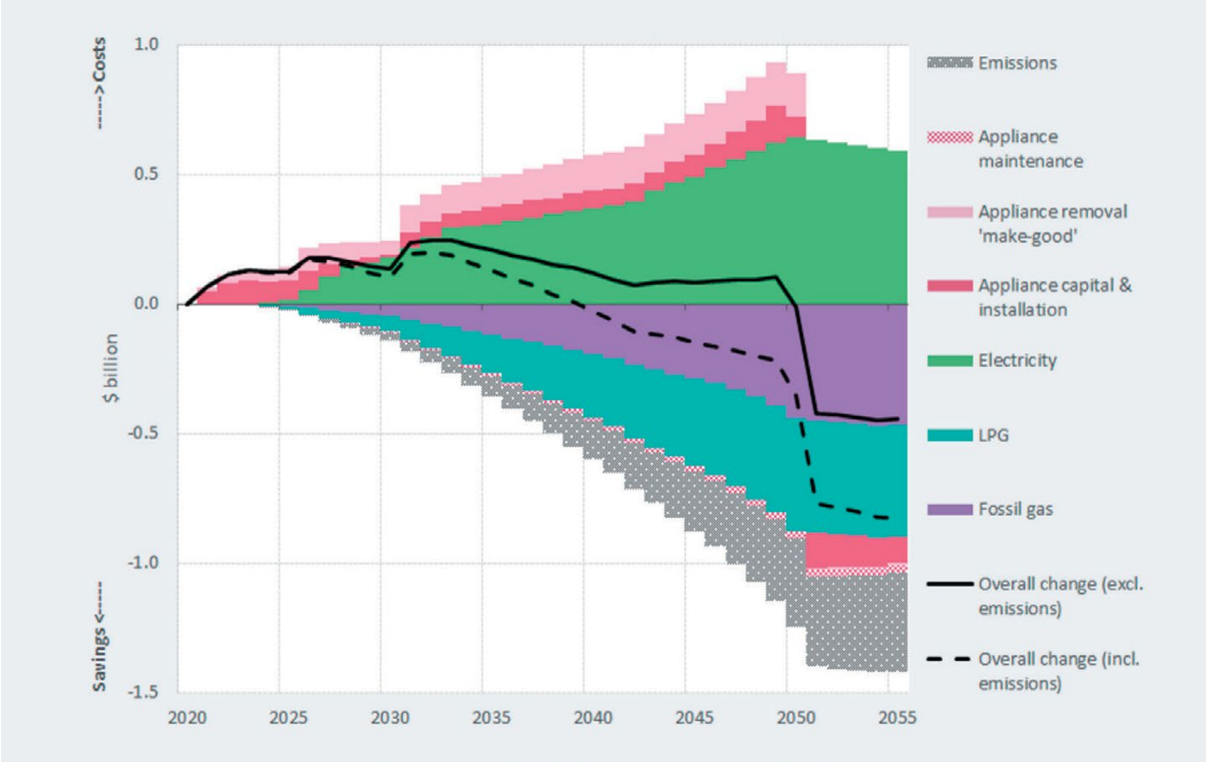


Figure 8.3: The projected increase and decrease in different elements of space and water heating costs for homes and businesses in the demonstration path compared to the current policy reference, excluding energy efficiency improvements. Under our modelling all space and water heating in buildings is assumed to be electrified by 2050. There is a net cost of the transition while this happens due to the costs of converting existing building, but once complete there will be overall net savings from the transition.

Source: ENZ modelling

Switching to biomass and electric heat in food processing will incur costs

38 The demonstration path sees a full transition away from using coal, fossil gas and diesel to generate heat in the food processing sector by 2050. Figure 8.4 shows that this leads to costs on the order of $200 million per year by 2035, largely due to higher fuel costs. This is because, unlike for EVs or space and water heating, conversion to a biomass or electrode boiler means using a more expensive fuel without any significant energy efficiency gain.

39 Again, this does not include the effect of further efficiency improvements assumed in the demonstration path, through measures such as improved heat recovery and heat pump integration. These would lead to significant fuel savings and could reduce overall costs, but there is uncertainty around the installation costs which are likely to be highly site-specific.

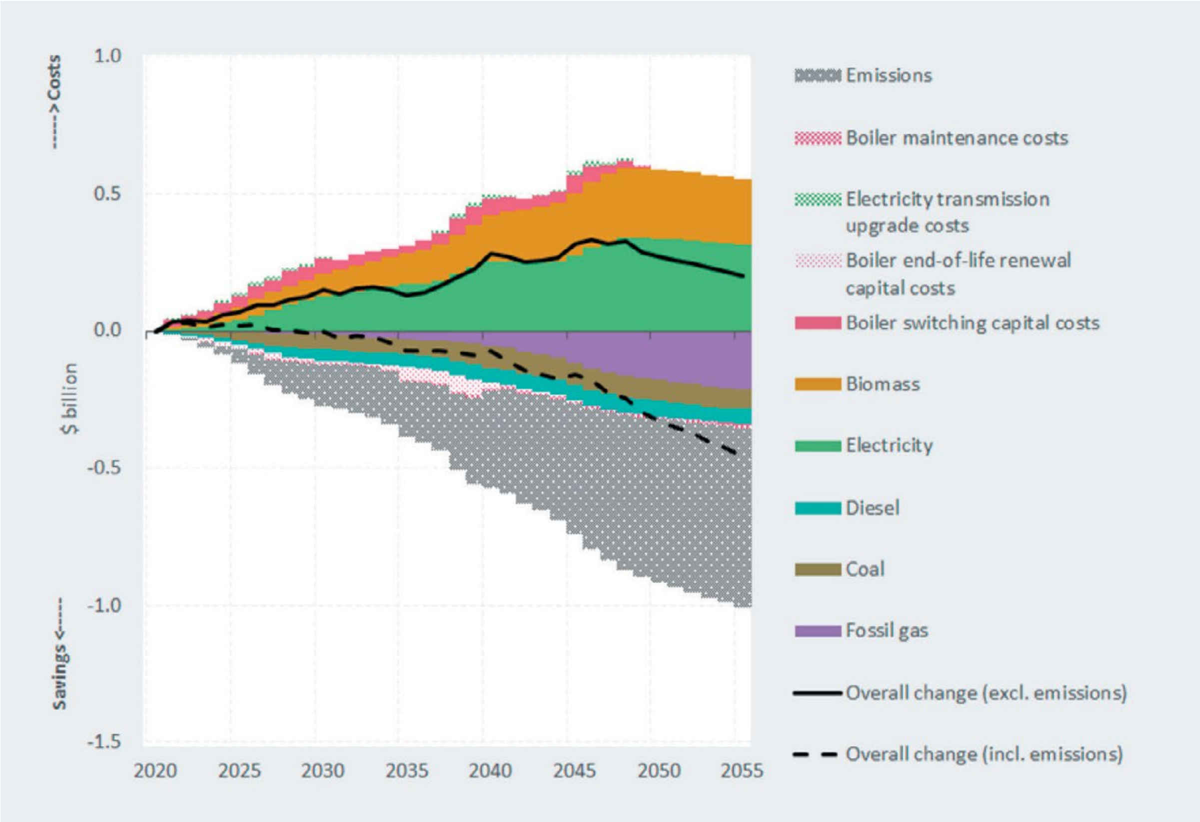


Figure 8.4: The projected increase and decrease in different elements of process heat costs for the food processing sector in the demonstration path compared to the current policy reference, excluding the effects of improved energy efficiency

Source: ENZ modelling

8.2.2 The economy will continue to grow

40 How the economy grows as Aotearoa transitions to a climate-resilient, low-emissions economy will depend on how quickly Aotearoa acts, the costs to transition and the action from the rest of the world.

41 With the technologies and practice changes available to Aotearoa, our modelling suggests that what Aotearoa produces and exports for the most part would not need to change significantly to meet our recommended emissions budget levels. However, some sectors such as mining and fossil gas would reduce production significantly.

42 We have modelled the potential overall impacts on the economy using a macroeconomic model built for the Climate Change Commission (the Commission), C-PLAN. This model is described in *Chapter 4: Evidence and models.* This assessment looks only at the impact of meeting the domestic emissions budgets. It does not include the impact of meeting the Nationally Determined Contribution, which could include international purchases of offshore mitigation.

43 In our *2021 Draft Advice for Consultation*, we assessed that the overall reduction to GDP, compared to a future without further policy action, would be less than 1.1% in 2035 and less than 1% in 2050. In response to feedback, we have further explored how sensitive this assessment is to the dependence on key emissions reductions options.

44 We have assessed, based on our modelling and other analysis, that our recommended emissions budgets are achievable at an overall reduction to the level of GDP in 2035 of around 0.5%. This considers only the mitigation costs associated with meeting the budgets and is not a cost-benefit analysis. It does not consider the significant co-benefits of action or the costs of delaying action (see Section 8.2.3). GDP also does not measure the impacts on wellbeing.

45 Our economic modelling indicates the economy would continue to grow under our recommended emissions budgets. Under current policy settings, GDP is projected to grow to $388 billion by 2035 and $487 billion by 2050. Whereas meeting our recommended emissions budgets through the demonstration path would result in GDP growing to about $386 billion by 2035 and would put Aotearoa on track for GDP to grow to $481 billion by 2050.

46 Our modelling shows that meeting the 2050 targets at lower cost to the economy relies on the successful roll out of EVs and improving the emissions efficiency of agricultural production so that production can be largely maintained. The overall impact to GDP would be higher – potentially reducing GDP by up to 1% in 2035 – if these key measures are not successfully rolled out.

47 EV technology is available now, and policy can be designed to remove barriers to speed up their roll out. Opportunities to improve on-farm performance are also available now, and achievable by farmers over time, with policy and programmes to address barriers.

48 Looking out to 2050 is more uncertain. There is more opportunity for currently emerging technologies, such as green hydrogen and methane inhibitors or vaccines, to play a role. We assess that the overall impact to GDP in 2050 would be a reduction of around 1.2%. However, the overall impact to GDP in 2050 could be a reduction of up to 2.3% if Aotearoa fails to deploy EVs and improve agricultural emissions efficiency at adequate rates.

49 This potential impact on GDP is significantly lower than what was estimated by the Government when the 2050 emissions reduction targets (2050 targets) were set. There are a number of reasons for this:

- Technology costs are reducing faster than previously projected.
- Climate policy and other factors have evolved since the last estimates, so the baseline as to what would occur under current policy settings has changed.
- The C-PLAN model has been specifically designed for modelling climate policy and has an improved representation of key emissions reduction technologies.
- We have worked to calibrate and align C-PLAN with our bottom-up scenario analysis so that, while there are differences, there is much closer alignment than seen in earlier work.

50 Our findings are in line with international estimates, such as those by the United Kingdom Committee on Climate Change and the European Commission. In fact, some assessments suggest that the transition may increase GDP (see *Chapter 15: How we earn our way in the world* of the *2021 Supporting Evidence* for more detail).

51 International experience shows that estimated costs are often overstated because technologies improve faster than expected. Internationally, the cost of deploying technology to meet emissions reduction targets is decreasing faster than expected. As a result, countries like the UK have re-assessed cost estimates of greenhouse gas emissions targets downwards over time.

52 The economy will continue to experience external shocks over time. The COVID-19 pandemic is an example of this. While these can be difficult times, they also provide opportunities to bring forward investment that stimulates the economy and accelerates the climate transition.

Box 8.2: Sensitivity Analysis in C-PLAN

We have tested how sensitive the C-PLAN GDP results are to some key uncertainties in the economy. These include the international oil price, international emissions prices, Aotearoa population and GDP projections, and potential closing dates for the Methanex methanol plant and the Tiwai Point aluminium smelter. Note that we test the changes to population and GDP growth together as a single sensitivity because the change in projected GDP is partly driven by higher or lower population growth.

When testing these sensitivities, we are looking at how the changed input assumption(s) affect the modelled impact on GDP from meeting the recommended emissions budgets. This is the difference in GDP between the demonstration path and the Current Policy Reference case.

The level of GDP under the Current Policy Reference case is an input assumption, rather than something that is generated by the model. This reference GDP path is held constant across the sensitivity tests – except for in the ‘population and GDP’ test where we are deliberately testing the effect of lower or higher future growth rates. This method allows us to isolate the change in the impact of meeting our recommended emissions budgets in each sensitivity test.

While some of the sensitivity tests do affect the modelled impact on GDP, the effect is generally within about 0.6 percentage points (Figure 8.5).

Halving or doubling the international emissions price has a very small effect. Changing the potential closing dates for Methanex and Tiwai Point aluminium smelter also has a very small effect, including in a scenario where the smelter does not close before 2050.

Reducing the oil price from about $70/barrel to about $40/barrel increases the impact on GDP by about 0.15 percentage points in 2050. This means the difference in GDP between the demonstration path and the Current Policy Reference case is larger.

If population and GDP are about 10% higher in the Current Policy Reference case, then the impact on GDP of meeting the budgets increases by about 0.6 percentage points. However, note that the absolute level of GDP in this sensitivity would still be around 9% higher than projected in our main scenario.

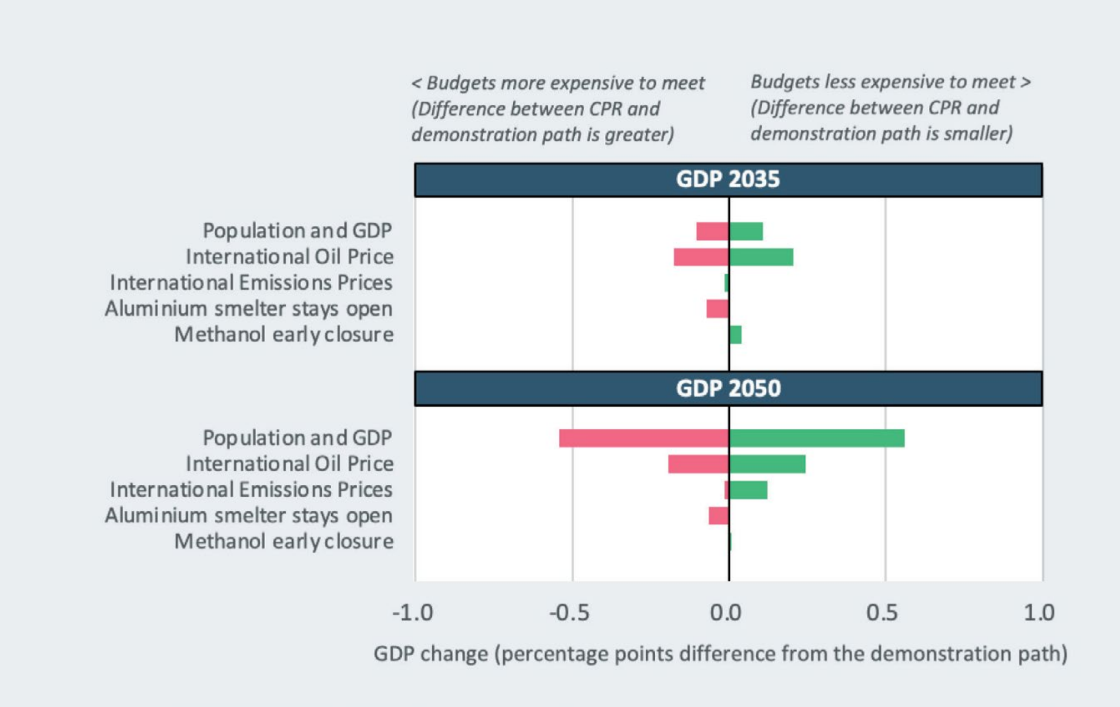


Figure 8.5: The impact on GDP – the difference in GDP between the demonstration path and the Current Policy Reference (CPR) case – of various sensitivity tests

Source: C-PLAN modelling

8.2.3 The benefits and opportunities of meeting emissions budgets are significant

53 International and domestic research suggests there are significant co-benefits to reducing emissions in the more immediate term. Benefits to health and health equity, productivity and incomes all tip the balance further in favour of acting earlier to reduce emissions. Health improvements from warmer drier homes, less air pollution, and from walking and cycling, reduce the burden on the health system. Section 8.6.1 outlines these benefits in more detail.

54 There are also opportunities for businesses taking the lead in reducing emissions. Creating new low-emissions products and services could open up opportunities in new markets and could add value to our exports. The flipside is the risk of businesses losing access to international markets if Aotearoa does not take timely action to reduce emissions.

55 The pace at which the world acts to reduce emissions, will also define how much climate change Aotearoa and other countries will need to adapt to. While there are estimates of the damages from more severe climate change, there is a growing body of research showing that these estimates significantly underestimate the true cost. This is because it is challenging to quantify many of the most serious consequences of climate change as they lie outside of human experience. However, these risks provide a compelling reason for the world to work together to reduce emissions.

56 Our assessment of the impact on GDP provides some useful insights but it does not include these benefits and opportunities, nor the costs related to not acting. It is difficult to fully quantify the benefits of action on the economy and society with any accuracy as there is significant uncertainty in how and when the benefits will be realised.

8.2.4 The impacts will not be evenly felt

57 The overall impact on GDP from meeting our recommended emissions budgets is small relative to the size of the whole economy. There will be significant benefits from the transition. However, opportunities, benefits, challenges, and inevitable costs will not be evenly felt across society. Some sectors of society will experience greater impacts, both positive and negative.

58 Distributional impacts can be managed if the Government puts in place policies to support those most disadvantaged and least able to adjust, and to ensure a fair, inclusive, and equitable transition. The direction of policy is discussed in more detail in *Chapter 20: Policy direction for a fair, inclusive and equitable transition.*

59 The following sections look in more detail at how the benefits and costs may be distributed across different groups of people, and how we can ensure that costs do not fall disproportionately on the groups of people who are the most vulnerable and least able to adjust.

8.3 How the transition could impact businesses and industries

60 Aotearoa has built up thriving industries that have provided New Zealanders with livelihoods and been significant contributors to our economy. Our country benefits from people working the land, with the food and fibre sector being a major employer and exporter of goods.

61 Mining, oil and gas, aluminium, cement, oil refining, and pulp and paper have been important for regional economic development, providing many people with jobs. People built these industries without knowledge of the impacts of their emissions, and the industries have helped Aotearoa thrive, providing us with the products people rely on in their everyday lives.

62 Many businesses in Aotearoa are connected to the global economy and compete in international markets. This provides opportunities and risks. We have heard from people who run businesses that they want to transition. But to do so, they need stable and predictable policy to allow them to plan, and an even playing field to compete on.

63 Meeting our recommended emissions budgets provides opportunities for businesses to develop new low-emissions products and services. Climate change is a material financial risk and investors are increasingly taking account of it, including through financial reporting in line with the Task Force on Climate-related Financial Disclosures. Businesses are responding to consumer demand for low-emissions products, are increasingly looking at emissions across their supply chains and requiring their suppliers to reduce emissions.

64 A number of Aotearoa businesses involved in the Climate Leaders Coalition have committed to setting public emissions reduction targets in line with the Paris Agreement's global 2°C goal. These businesses can also commit to a higher pledge in line with the global 1.5°C effort. Collectively, these businesses represent about 60% of Aotearoa emissions, more than a third of private sector GDP, and employ about 180,000 people.

65 Our emissions budgets are paced such that businesses have time to plan, invest and innovate. This provides some level of predictability about the transition and helps to avoid unnecessary costs. It means that businesses can replace assets – such as coal boilers, gas appliances and internal combustion engine (ICE) cars – with low-emissions alternatives when they reach the end of their useful life.

66 Businesses that rely heavily on fossil fuels will have to find alternative low-emissions ways of doing business, pivot into new areas or they may also face closure. In these cases, Aotearoa needs to think about the people working in those sectors and how to support them through change (see Section 8.7).

67 Transitioning too quickly could increase costs for businesses that are able to transition and reduce their competitiveness. It will be important to monitor global markets and actions by competitors to understand the impacts. This is an important ongoing task for the Commission.

68 The flipside is that a delayed transition could result in businesses missing out on opportunities, losing some social licence and as a result losing access to some markets or to investment. A delayed but more disruptive transition later could see businesses left with stranded assets.

8.3.1 Businesses in the food and fibre sector

69 As part of the climate transition, people who run farm businesses will need to reduce on-farm biogenic methane and nitrous oxide emissions, and businesses involved in food processing will need to reduce carbon dioxide emissions from transport and processing plants. Pasture-based agriculture in Aotearoa has one of the lowest emissions footprints in the world.

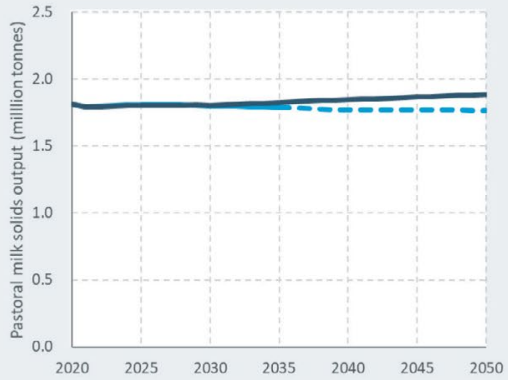
70 There is good reason to believe that production in Aotearoa will be competitive in a low-emissions future where meat and dairy products are still consumed. However, delayed action could affect the country's trading position and businesses could lose market access as global markets increasingly seek low-emissions goods and synthetic proteins.

71 Our analysis shows that the food and fibre sector can meet our recommended emissions budgets without reducing production (Figure 8.6). However, 20,000 to 30,000 farm businesses will need to change on-farm management practices and take up new technology as it becomes available. Some farmers are already making these changes. Many more are working towards them but will need to push these changes further. As prices are set by international markets, it may be challenging for the food and fibre sector to pass on costs of making these changes to consumers.

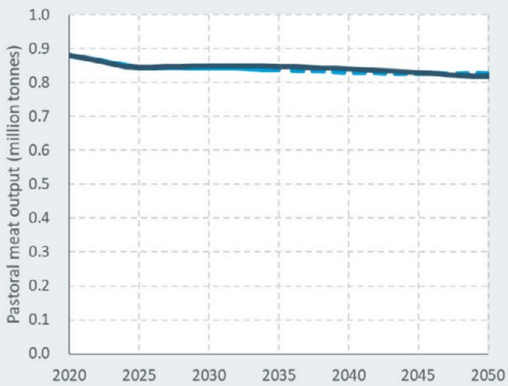
72 We consider that the food and fibre sector's role in meeting our recommended emissions budgets is manageable. However, it will require farmers to make significant changes, and so will need government support and incentives.

73 Making these changes will require skilled farm management and high-quality data. Well informed and trained farm advisers will need to work closely with farm managers to achieve this. Research and development will be needed into new technologies like a methane inhibitor and vaccine. Systems for deploying such technologies when they become available will benefit the sector and the economy. The direction of policy for enabling this is discussed in *Chapter 17: Policy direction for agriculture.*

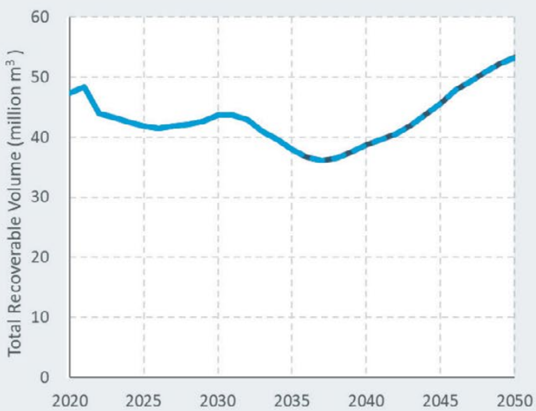
Milk solids output



Sheep and beef meat output



Forestry output



Demonstration path Demonstration path after 2035 Current Policy Reference

Figure 8.6: The change in output of milk solids, sheep and beef meat and forestry that would occur in the demonstration path over the first three emissions budgets and out to 2050

Source: Commission modelling

8.3.2 Business in the energy sector

74 Energy is a vital part of New Zealanders' day-to-day lives. As well as people using energy at home and to power vehicles, businesses use energy to produce goods that are used in Aotearoa and sold around the world.

75 Meeting our recommended emissions budgets requires Aotearoa to transform its energy system.

76 The energy system is interconnected, so the changes that are made cannot be thought about in isolation. This interconnectedness means there are challenges to reducing fossil gas supply while it still plays an important role. These challenges can have impacts on employment and infrastructure use.

77 The transformation in the energy system will impact businesses that currently use fossil fuels. Some of these businesses may be able to switch to low-emissions alternatives, or pivot their businesses into new areas.

78 However, several industries that are large employers in regions around the country and are fundamental to the economy have fewer options for decarbonising. Aotearoa needs to make key strategic decisions about the future of these industries (see *Chapter 15: Policy direction for energy, industry and buildings*).

79 Electricity generation will need to significantly increase to meet industry and transport needs. In the demonstration path in *Chapter 7: Demonstrating emissions budgets are achievable*, annual electricity generation would need to increase by around 20% over 2018 levels by 2035. Wind and solar generation and biomass would need to expand at a faster rate than expected under current policy settings to meet the country's energy needs and replace coal and fossil gas (Figure 8.7).

80 Electricity generators, Transpower and lines companies will need skilled workers and faster planning processes to deliver this expansion. There are also opportunities for entrepreneurs and independent generators with the new technologies available, such as batteries, and new digital tools.

81 The Government needs to ensure the electricity system can reliably generate enough supply as Aotearoa shifts away from fossil fuels and increases dependency on electricity generation. Currently, fossil gas and coal provide this security of supply, particularly at peak times and in dry years when hydro lake levels are low. Relying on electricity to meet much of the country's transport, heating, cooking and industry needs carries risk in a nation exposed to natural hazards and other potential disruptions.

82 Aotearoa currently relies on imported oil for products like petrol and diesel, exposing the country to oil price volatility. Moving to domestic sources of energy for transport would reduce the country's reliance on oil imports. However, there could be some risks with relying heavily on electricity as a major source of energy – having a diverse range of energy sources increases resilience.

83 The Government needs to work with those involved in the energy system to manage the risk around affordability and security of supply as a result of moving to a low-emissions energy system. Decarbonising energy will need to be prioritised over the more expensive task of completely removing emissions from the electricity system.

84 The Government is currently investigating options for managing dry year risk under the NZ Battery project, including the proposed Lake Onslow pumped hydro scheme and alternative storage options. The aim is to provide a large amount of storage capacity to manage the risk of dry years where hydro lake levels are low. This project could displace the requirement for thermal generation and achieve an abrupt decarbonisation of the electricity sector. Any solution for managing the dry year risk could be expensive.

85 Other actions to increase resilience of the electricity grid and the system include building new generation in the North Island, reinforcing the transmission and distribution infrastructure, deploying new technologies such as batteries, and diversifying into new fuels such as biofuels and hydrogen that boost energy security.

86 All of this will need to be considered when developing a long-term national energy strategy, which is discussed in more detail in *Chapter 15: Policy direction for energy, industry and buildings*.

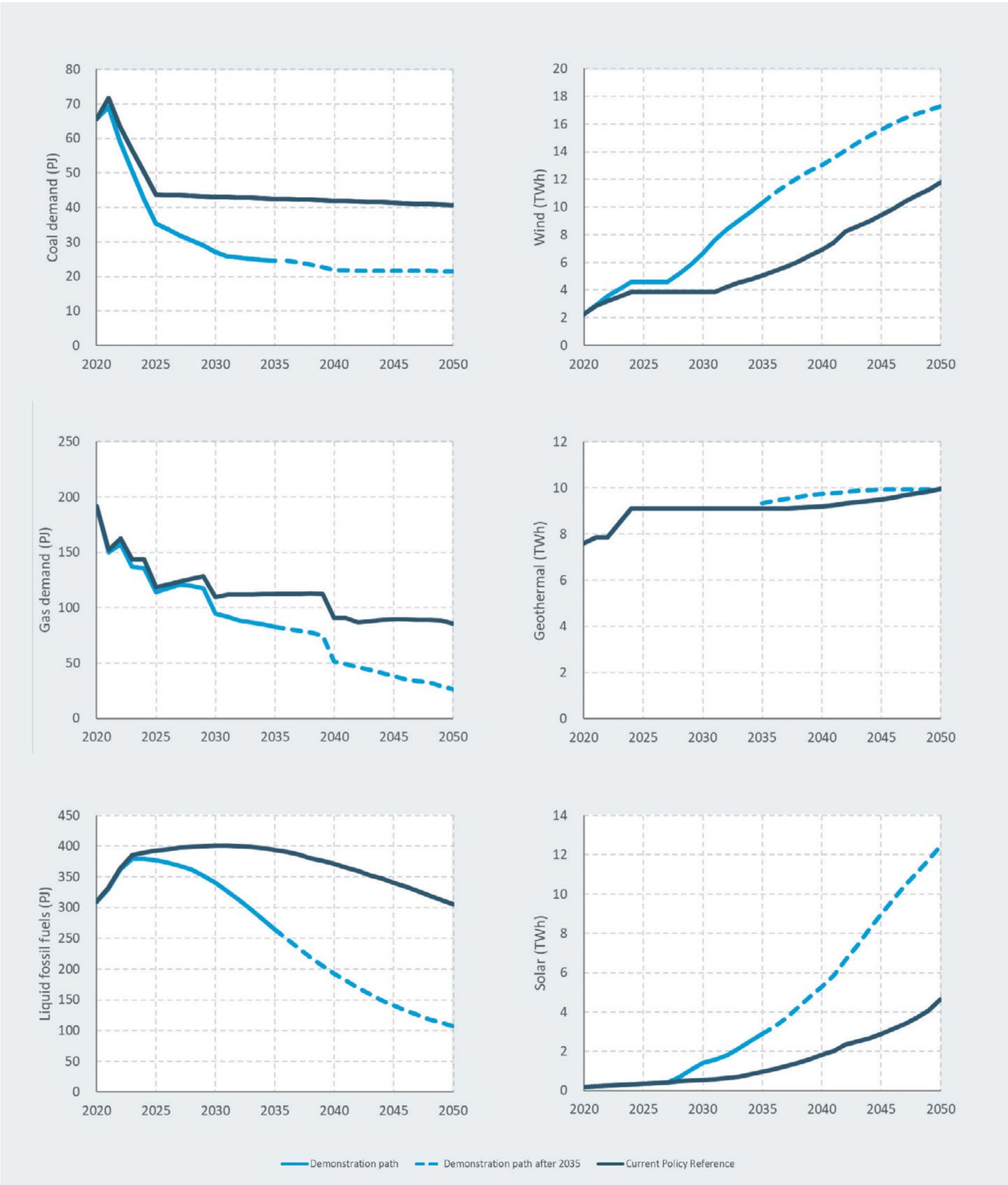


Figure 8.7: The changes in demand for coal, fossil gas and liquid fossil fuels (in PJ), and in geothermal, wind and solar generation (in TWh) that would occur in the demonstration path over the first three emissions budgets and out to 2050

Source: Commission analysis.

8.3.3 Small business

87 Businesses with fewer than 20 employees make up about 97% of Aotearoa businesses. They contribute about 30% of employment and more than 25% of GDP. They play a crucial role in the economy, especially in supply chains and supporting larger exporting businesses. Many have been particularly affected by the COVID-19 pandemic.

88 Small businesses tend to be more vulnerable to change. The people running small businesses have limited time and resources to adjust to higher costs. Small businesses that work closely with large businesses in hard-to-abate sectors may be particularly impacted by our recommended emissions budgets.

89 Our recommended emissions budget levels and the transition to a low-emissions economy will affect all small businesses in some way. Most of this would come via electricity, fossil gas and transport prices.

90 Wholesale electricity prices will vary depending on supply and demand, and other factors, over the next decade. See Section 8.6.2 for more discussion on wholesale electricity prices. Businesses could make savings by improving their energy and fuel efficiency.

91 However, small businesses such as restaurants, cafes and bars that use fossil gas for cooking will need to move to lower-emissions solutions, such as biogas and electrification. We have recommended emissions budgets on the basis that businesses could replace fossil gas appliances at the end of their natural lifetime.

92 There will also be opportunities for new small businesses in the new clean technology industry. These new businesses will need an enabling regulatory environment.

93 In most cases, these impacts will be manageable. However, the ability for small businesses to respond, adapt and innovate will depend on information and support, skills and capability, access to capital, and how well the transition is signalled and planned.

94 By signalling early the changes that are needed, the Government will give people running small businesses time to respond. This will allow them to replace assets such as vehicles or gas appliances with low-emissions options on normal replacement cycles, reducing the cost to those businesses.

95 The Government will also need to understand the barriers that people in small businesses face, and tailor policy to encourage behaviour change (see *Chapter 13: Policy direction that cuts across sectors).*

8.3.4 Emissions leakage

96 Emissions leakage is a risk created by the uneven implementation of climate policies around the world.

97 Emissions pricing or other policies aimed at reducing emissions may increase costs for emissions intensive businesses and cause them to lose market share to international competitors that do not face similar costs. If this causes production and investment to shift in a way that increases global emissions, it would be counter to the intended effect of the policy, as Aotearoa would be exporting emissions rather than reducing them.

98 During consultation, some submitters expressed concern that the pace of our proposed emissions budgets could impact their competitiveness and result in emissions leakage.

99 In Aotearoa, emissions leakage risk is currently managed by providing potentially affected industrial activities with free allocation of units under the New Zealand Emissions Trading Scheme (NZ ETS). This substantially reduces the cost of the NZ ETS for these businesses. It is also expected that when biogenic methane and nitrous oxide emissions are priced, agricultural activities will receive a high level of free allocation that is likely to protect against emissions leakage. *Chapter 15: How we earn our way in the world* of the *2021 Supporting Evidence* goes into the issue of emissions leakage in more detail.

100 Providing free allocation is similar to what is done in other countries that have emissions pricing. It has been found to be effective – studies have been unable to find evidence of substantial emissions leakage caused by these pricing schemes. We are therefore confident that emissions leakage risk can be addressed, so is not a reason to shy away from reducing emissions.

101 Over time as budget levels step down it may be necessary to look at other tools for addressing emissions leakage risk. Options for the longer term include consumption charges, product standards, and border carbon adjustments. However, these would need to be considered carefully as they may come with challenges – particularly around how consistent they are with international trade rules.

102 It is important to recognise that climate action can benefit competitiveness too. While it is unlikely that there will be a uniform price on carbon across the world in the foreseeable future, markets can shift much faster than government policy. Customers are increasingly interested in the environmental credentials of the products they buy. This is partly driven by institutional investors pushing companies to reduce their supply chain emissions. This trend could well shrink the market for emissions intensive products in future.

103 Emissions leakage risk will also decrease as more countries adopt ambitious targets to reduce emissions and policies to achieve them.

104 The Commission will be doing further analysis on emissions leakage. In relation to agriculture, we will consider the risk of emissions leakage when providing advice on the level of assistance that should be provided to participants in the agricultural emissions pricing system. We expect to provide this advice in 2022.

105 We will also advise on the phase out of industrial free allocation in the NZ ETS. Industrial free allocation phase-out rates could be slowed down or sped up depending on whether an ongoing and substantial risk of emissions leakage becomes evident. The emissions associated with a slower phase-out rate would then have to be compensated for by making further emissions reductions in other sectors.

106 Policies other than emissions pricing can also contribute to emissions leakage risk. In our ongoing role in advising on policy direction and monitoring the emissions reduction plan, we will look at the design of policies with a view to minimise or otherwise manage emissions leakage risks.

8.4 Specific challenges for Māori-collectives and Māori in the workforce

107 Regardless of the level at which emissions budgets are set, there are specific challenges for Māori-collectives and Māori in the workforce that the Government will need to address.

8.4.1 Māori-collectives

108 The Māori economy (Box 8.3) represents $69 billion or more in assets and is growing.

109 Collectively, Māori own about $24 billion in primary sector assets. Māori own 50% of the country's fishing quota, 40% of forestry, 30% of its lamb production, 30% of its sheep and beef production, 10% of its dairy production and 10% of kiwifruit production. The majority of the Māori economy sits outside the primary sector, and includes property, private equity, financial assets, tourism, geothermal energy, and technology and innovation.

Box 8.3: The Māori economy

The term 'Māori Economy' captures a broad range of inputs which includes Iwi entities, Māori trusts and incorporations, Māori Authorities, Māori self-employed, and Māori employers. For the purposes of this report, we refer only to the component of the Māori economy comprised of Māori-collectives (definable by Iwi and hapū entities (such as PSGEs), Māori trusts and incorporations, and Māori Authorities).

As noted previously, in addition to whenua Māori being managed in accordance with tikanga and whakapapa, it is also subject to various legislation and regulations, which are often at conflict with Māori cultural values. Whenua Māori and associated operations account for a significant portion of the Māori-collectives' asset base. For this reason, and because whenua Māori has been the target of numerous government initiatives over the years, Māori-collectives are heavily invested in primary industries (forestry, fisheries, agriculture), and tourism.

110 Although Māori freehold land is estimated to comprise about 1.4 million hectares in Aotearoa, nearly 60% of all Māori freehold land is considered marginal land (land use capabilities of 6, 7 and 8) and many parcels of Māori land are small and fragmented.

111 Disruptions to ownership, governance and land management have led to Māori collectively-owned land being underutilised. The Ministry for Business, Innovation and Employment estimates that one third of Māori land has potential for development or increased utility.

112 For our recommended emissions budgets to be fair, inclusive and equitable for Iwi/Māori, the Government will need to consider the different priorities and historic inequities that Iwi/Māori face. The unjust acquisition and confiscation of Māori land, restrictive land management legislation, intervention by Crown officials or Crown appointed Trustees, and a significantly reduced population due to introduced diseases, left Māori alienated and disenfranchised.

113 By the mid-twentieth century, land that remained in Māori ownership was typically unproductive or the original owners had lost control – for example, by being locked into perpetual leases or under Crown-imposed management.

114 As an example of the impact of this, a significant amount of Māori collectively-owned land is locked up in production forestry. This is the case, for example, for Central North Island Forest, Lake Taupō Forest Trust, Lake Rotoaira Forest Trust. The Government will need to ensure that the policies it puts in place do not compound historic injustices, existing barriers or place disproportionate restrictions on Iwi/Māori.

115 Iwi/Māori need to be able to exercise their rangatiratanga and mana motuhake to make decisions on how to use or develop their land to meet their collective and culturally driven aspirations and needs. We heard through engagement that some Māori-collectives have received forested land through Te Tiriti o Waitangi/The Treaty of Waitangi settlements. If these forests were established before 1990, they are encumbered with a deforestation liability. However, Māori-collectives may have alternative aspirations for the use of their culturally significant land such as papakāinga development.

116 Consideration should also be given to any policies that could disadvantage Māori-collectives operating in the agriculture sector. When agricultural emissions are priced, free allocation should be provided in a way that does not disadvantage operators who were already managing resources in alignment with their kaitiaki values.

117 In addition, some Māori-collectives may not operate intensively due to insufficient resources or being precluded from exercising their decision-making functions as a result of historic arrangements, such as perpetual leases. These Māori-collectives should also not be disadvantaged. Any approach that uses grandparenting – such as free allocation based on existing land use – is likely to be problematic.

118 Approaches such as grandparenting have the potential to compound historic grievances, particularly for Iwi with limited resources. This could also add complexity for Iwi where redress assets are returned through a range of settlement entities. Potentially this can limit the ability for Iwi to exercise their rangatiratanga under Te Tiriti o Waitangi/The Treaty of Waitangi.

119 Access to reliable information and quality advice is a key enabler to enhance participation for Māori-collectives and ensure equitable outcomes. Establishing an emissions profile for Māori-collectives will improve their ability to manage and monitor emissions within their takiwā in the context of their broader social, cultural, economic and environmental objectives.

120 These barriers will need to be addressed to enable Māori to fully participate in climate action, and ensure that Māori-collectives, businesses and workers are not disadvantaged. Any additional costs arising from climate policy could result in additional barriers for continued Māori economic development which support Iwi/Māori wellbeing outcomes.

121 Iwi/Māori feedback from submissions stressed that outcomes will be inequitable for Iwi/Māori if existing barriers inhibiting Māori economic development and cultural vitality, which have flow-through effects to social and environmental wellbeing, are not factored into policy design and decision making.

122 These issues are explored in more detail in *Chapter 19: Policy direction for an equitable transition for Iwi/Māori.*

8.4.2 Māori in the workforce

123 Māori individuals could experience more job change as a result of our recommended emissions budgets. In 2018, Māori in the workforce held about 16% of jobs. Our modelling suggests that Māori make up about 20% of those who gain jobs and about 13% of those who lose jobs across the first three emissions budget periods. However, Māori who need to retrain or learn new skills as employment changes may be particularly impacted.

124 BERL has estimated that the current income gap for Māori is $2.6 billion per year, equating to $140 less income per person per week for the working age Māori population. Over half of the working Māori population are in lower skilled jobs, and almost half are in jobs that have a high risk of being replaced by automation.

125 The employment impacts on Māori can be managed through targeted policy. The Crown-Māori Economic Development Strategy, He kai kei aku ringa, already has a goal of growing the future Māori workforce into higher-wage, higher-skilled jobs.

126 Iwi/Māori feedback from submissions emphasised the need to grow skilled employment to ensure a level playing field so that Māori are not faced with reduced employment or low-skilled employment as a result of our emissions budgets.

127 Education and training developed by Māori for Māori will be important for reducing existing inequities, as research indicates that current education and training providers are not serving Māori well.

8.5 How the transition could affect different regions and communities

128 In our consultation, councils and economic development agencies highlighted the need to understand the regional impacts of our recommended emissions budgets. Submitters also outlined concerns that communities could be impacted if there was significant land-use change away from pastoral farming into forestry.

8.5.1 Impacts on different regions

129 While the cost to the Aotearoa economy of our recommended emissions budgets is expected to be small, these costs will be distributed differently from region to region. How each region is impacted depends on the structure of its economy, its emissions profile, and its ability to adapt and plan for the transition to a low-emissions economy.

130 Some regions and communities of Aotearoa will be more affected by the climate transition than others. Communities that are reliant on high-emissions industries may see the closure of large businesses that provide significant employment for the community. This would have a big impact as major job losses at a local level can lead to entire communities being left vulnerable and dislocated. It is also important to consider how regions are connected, as an impact in one region could have flow on impacts to a neighbouring region.

131 Several of the key hard-to-abate sectors are located in specific regions of the country. Aluminium is manufactured in Southland, methanol in Taranaki, pulp and paper in the Bay of Plenty, cement and oil refining in Northland.

132 The structure of a region's economy has a big impact on its emissions, and therefore its exposure to policies put in place to meet our recommended emissions budgets. Regions that are reliant on primary industries, such as Taranaki, Southland, Waikato, and the West Coast, could be more exposed.

Regional employment

133 Regions like Taranaki and the West Coast will be affected by the transition away from coal, oil, and fossil gas. Other regions could be affected by the closure of hard-to-abate industries, such as the closure of Tiwai Point aluminium smelter in Southland. This will have particular impacts on employment.

134 We used our DIM-E model to examine the expected regional employment effects of our recommended emissions budgets. This models where job change could occur with net job change being the difference between job growth and job decline. Job decline does not necessarily mean that individuals would lose their jobs, as some of the change can occur through natural attrition.

135 Overall, our DIM-E modelling estimates that most regions would experience net job gain over the three emissions budget periods compared to what would occur under current policy settings. However, Taranaki and the West Coast would experience net job loss over the three emissions budget periods (Figure 8.8). This is likely driven by the concentration of jobs in the oil, fossil gas, and mining sectors in these two regions (see Section 8.7.1). However, the extent of net job loss for the region would be less than for these sectors because the model estimates that there will be job growth in other sectors in these regions.

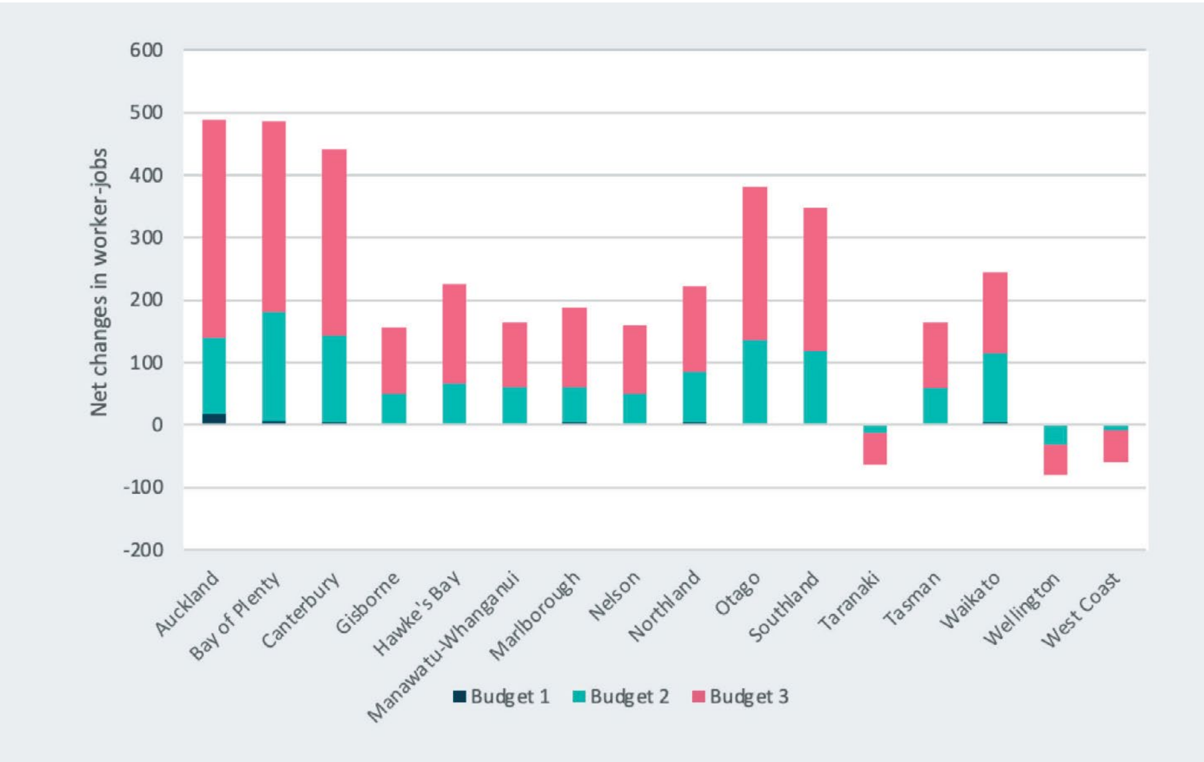


Figure 8.8: The overall net change in jobs that our modelling estimates could occur in each region under the demonstration path relative to the Current Policy Reference case

Source: DIM-E simulation results

Regions' ability to transition

136 The size and structure of a region's economy also indicates how able it is to adjust to the transition. Some regions will have a greater ability to adjust than others. Larger and wealthier regions are likely to have more resources to plan for the transition. Other regions may need more support.

137 Localised transition planning will be needed in areas where there is significant employment in emissions intensive sectors. Transition planning should support regional economic diversification and could look to create new industries, based on the skills, resources, and aspirations of the local community and Iwi/hapū.

8.5.2 Impacts of land-use change on communities

138 Increasing the amount of native and exotic forest – afforestation – could play a role in helping achieve the country's emissions budgets and emissions reduction targets.

139 The impacts of any afforestation will depend on the scale, pace, and species of trees that are grown, the purpose for which the trees are grown, the type of land that is afforested, and the land use that is displaced.

140 Under current policy settings, the scale of afforestation that is expected to occur would in large part be driven by the emissions price in the NZ ETS. Other financial incentives, such as the One Billion Trees programme, and land and commodity prices, would also play their part.

141 Current policy settings and sector infrastructure heavily favour the planting of exotic *Pinus radiata* over other species. Increasing emissions prices would also incentivise greater establishment of permanent exotic carbon forestry.

142 We heard throughout our engagement and consultation about the concern that whole farms could be planted in exotic forests, either for production forestry or permanent carbon forestry. This could have negative impacts on rural communities and provincial centres that are reliant on the food and fibre industry for employment. This would include not only those working on the land, but also those involved in transporting and processing food and fibre products, and providing services to rural communities.

143 There are different estimates of the number of jobs provided across the value chain from a hectare of sheep and beef farming, production forestry, and permanent carbon forestry. The number of jobs in forestry and sheep and beef farming vary by time and location, and depend on the type of forestry. It is therefore difficult to compare the relative employment from each of these different land uses.

144 However, wholesale or large conversions of sheep and beef farmland to forestry would affect communities and reduce employment in the immediate area, as previous experience shows that forestry-related work is likely to be more concentrated in larger rural towns, particularly those involved in processing.

145 We have factored the potential impact on communities and the wider food and fibre sector from afforestation into our emissions budgets analysis. This is in line with our principle to focus on decarbonising the economy to ensure that Aotearoa can sustain net zero long-lived greenhouse gas emissions beyond 2050.

146 The impact on communities from afforestation can be managed through policy.

147 Constraining the price incentive for afforestation through the NZ ETS could help limit the overall scale of afforestation, including permanent exotic forests. However, it would not determine where this afforestation would occur, or remedy the relative disincentive for native species.

148 Managing where afforestation happens would likely require a regulatory approach, through planning rules or alternative interventions that place restrictions on land-use change.

149 Capacity-building and advisory services for landowners focused on integrating trees or forestry onto farms rather than wholesale land-use change could also limit the impacts of afforestation. This could be facilitated by developing carbon monitoring systems that allow for tracking and rewarding additional sequestration from smaller or dispersed areas of trees.

150 Pests will be a major issue when establishing new forests and maintaining existing forests, as they often eat seedlings and young trees. This can completely destroy newly established forests and compromise the long-term health of existing forests. Managing or eradicating pests will likely be labour intensive in the absence of large advances in technology.

151 Changing the balance of incentives for exotic versus native afforestation would also alter the impact on rural communities and the broader food and fibre sector. Establishing native forests might generate fewer jobs than exotic production forestry, particularly if the land is left to revert to natives rather than being planted, and if there is no intention to selectively harvest.

152 However, native afforestation could be suitable for areas of less-productive land where exotic afforestation is inappropriate. It would therefore not come at the expense of other economic activity.

153 Less productive land could be afforested with little impact on farming productivity or employment. Many sheep and beef farms have areas of land that are steep and susceptible to erosion. These areas could be particularly suitable for forests that would not be clear-fell harvested. This would also include Crown owned land.

154 The Biological Emissions Reference Group estimated that approximately 6% of hill country sheep and beef farms could be afforested without negatively affecting production. This equates to approximately 250,000 hectares. Recent studies put the total potential area of highly erodible land that could be suitable for forests across the country at 1,200,000 to 1,400,000 hectares. Other studies estimate that there might be 740,000 hectares that could naturally regenerate if pests are managed.

155 Efforts could also be made to promote a native forest industry, probably using selective harvesting techniques. This could have particular relevance for Iwi/Māori. Native afforestation could be incentivised by extending grant schemes such as One Billion Trees or by developing ecosystem services payment schemes that could reward the other environmental benefits of native forests.

156 Policies for managing the scale of afforestation, whether it is exotic or natives, and where afforestation occurs are discussed further in *Chapter 18: Policy direction for forests and other carbon stocks.*

8.6 How the transition could affect different households, their health, cost of living and access to transport

157 This section looks at the impact of our recommended emissions budget levels on households and communities. It considers the benefits to health and health equity, how households' energy and petrol bills might change, and impacts on New Zealanders' ability to get around.

158 We heard from some submitters during consultation that there are risks that the low-emissions transition will exacerbate inequities already experienced by many people in socioeconomically disadvantaged groups – including Māori and Pacific communities, low-income New Zealanders, women, and people with disabilities. These groups are also often hit the hardest in recessions.

159 In our assessment, we found that some households could bear more cost and benefit less from our recommended emissions budgets. Those on lower incomes, the elderly, people with disabilities, some Māori and Pasifika households, or those that live in remote areas could be disproportionately impacted despite benefiting the most from low-emissions technologies and practices. However, this could be managed through targeted policy.

8.6.1 Health benefits from action on climate change

160 Many of the actions Aotearoa could take to address climate change will have broader health benefits for people. People will benefit from warmer, drier homes, better air quality, and from walking and cycling more. These benefits are significant and immediate. They can help to improve the quality of life of current and future generations, reduce the burden on the health system, and improve productivity. The benefits add to the case for strong action to reduce emissions.

161 Global action to reduce emissions would also reduce negative health impacts from a changing climate. The health system could see effects such as increased heat stress from warmer temperatures and temperature extremes, changing patterns of infectious disease, and adverse mental health impacts. The health impacts of climate change would be unlikely to be spread evenly across the population, with more people in vulnerable groups being more exposed.

Benefits of warmer, drier homes

162 Warmer, drier homes and improved house design could improve people's health and improve health equity. Warmer, drier homes can have significant health benefits for those people on low incomes, including increased comfort, reduced time off school or work, fewer GP visits, fewer hospital admissions for circulatory and respiratory illnesses, reduced pharmaceutical costs, and reduced mortality.

163 A cohort of Aotearoa researchers evaluated the Warm Up New Zealand programme and found that low-income households received greater health benefits from installing insulation than higher income households. This is because those on higher incomes are more able to afford to live in higher quality homes. The evaluation found that low-income households saved on average $818 each per year in health costs after insulation was installed, compared to $227 for higher income households. The health benefits were found to be significantly greater than any potential bill savings.

Benefits from reduced air pollution

164 New Zealanders will benefit from less respiratory and cardiovascular illness by moving away from burning fossil fuels. Petrol and diesel vehicles, fossil gas heaters and stoves, and fossil fuel powered industry all contribute to indoor and outdoor air pollution.

165 Modelling carried out for the Health Research Council of New Zealand, Ministry for the Environment, Ministry of Transport and Waka Kotahi found that the social cost of air pollution is significant – it is estimated to cost Aotearoa $4.28 billion every year. Of this, 22% is attributed to pollution from vehicles, equating to $940 million.

166 In 2013, researchers at Utrecht University in the Netherlands reviewed 41 scientific studies and found that children are 42% more likely to develop asthma if they live in a home that uses fossil gas for cooking. Another study of over 12,000 households in Australia attributes 12% of childhood asthma to fossil gas cooking in the home. Adequate ventilation can reduce but not eliminate this risk.

167 Indoor air pollution from using fossil gas for heating or cooking can disproportionately impact people in lower income households, who may not be able to afford to properly maintain fossil gas appliances and are proportionately more likely to rent homes that use older fossil gas appliances.

Benefits from increased walking and cycling

168 New Zealanders will benefit from increased fitness by using cars less and walking and cycling more. This can lead to less chronic disease and improved overall wellbeing. Modelling by researchers at the University of Otago, University of Melbourne, and University of Oxford suggests that switching from short car journeys to a combination of walking and cycling improves people's health, reduces emissions and reduces costs for the healthcare system.

169 Over the lifetime of the current Aotearoa population, these savings could be in the order of NZ$127 million if 25% of trips under 1km were switched to walking, or up to NZ$2.1 billion if all trips under 1km were switched to walking and all trips between 1 and 5km were switched to cycling.

170 More detail on the health benefits can be found in *Chapter 16: Households and communities* of our *2021 Supporting Evidence.*

8.6.2 Electricity bills are unlikely to change due to emissions budgets

171 Our analysis suggests that our recommended emissions budgets are unlikely to increase overall household electricity bills for heating, cooking, and lighting.

172 However, exactly how household electricity bills could change is highly uncertain, and depends on both electricity prices and household electricity demand. The price that consumers pay for electricity covers the cost of generating the electricity as well as the lines and infrastructure that distribute it. There are also taxes, profit margins and other costs which contribute to an electricity bill (Figure 8.9).

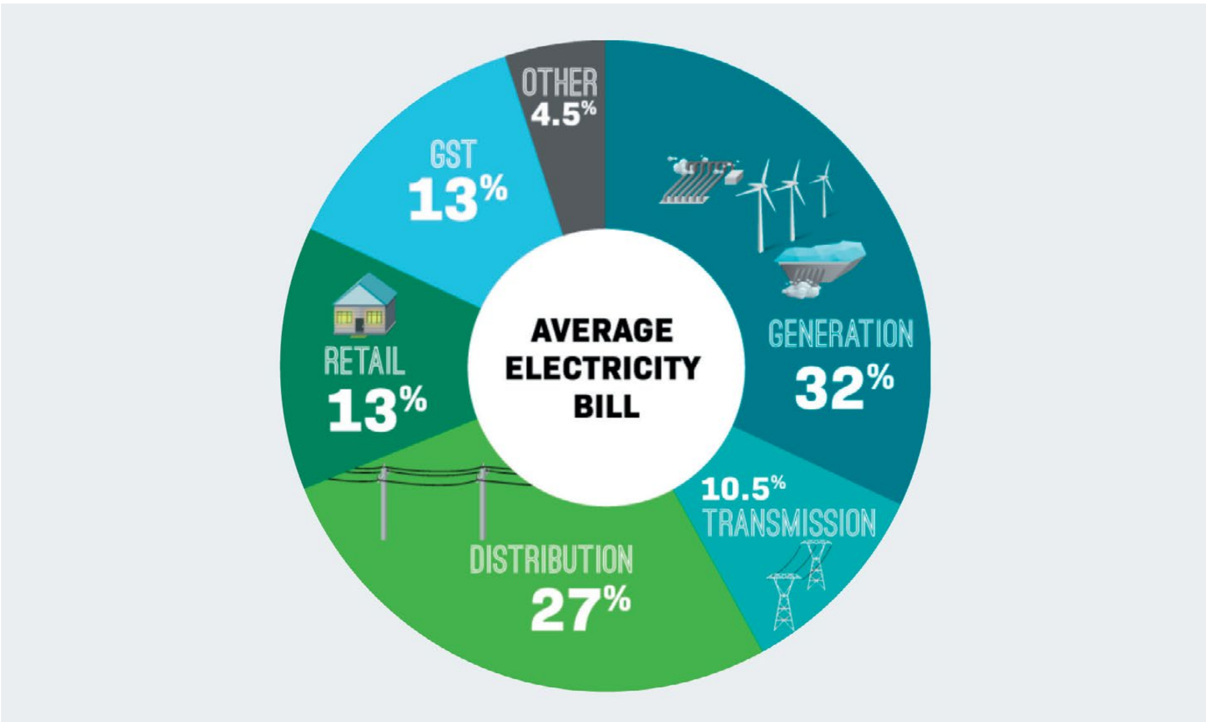


Figure 8.9: The typical cost components of an electricity bill today
Source: Electricity Authority

Wholesale electricity prices are expected to vary year-to-year

173 Electricity prices vary due to a range of factors beyond climate policy, such as a consumer's demand, the weather, supply and demand of fossil gas, and pricing structures.

174 We used the EMarket model to understand how wholesale prices might evolve under the demonstration path. The model electricity price reflects the balance of supply and demand, the cost of operating existing generation and the new generation that needs to be built. This corresponds to the generation part of Figure 8.9 above – only one component of the household bill.

175 Our modelling suggests that, by taking action to meet our recommended emissions budgets, wholesale electricity prices across the country would continue to vary from year to year, depending on inflows into the hydro lakes. Prices start relatively higher, reflecting 2021 market conditions of low hydro storage and a shortage of fossil gas.

176 Over the next few years, the displacement of baseload fossil gas generation with lower cost wind and geothermal would reduce the average price. The assumed closure of the Tiwai Point aluminium smelter at the end of 2024 causes a further suppression of the price. The modelling suggests that the average wholesale price would eventually stabilise at around $70-$80/MWh (Figure 8.10) – this price covers the costs of building new generation to match the growth in electricity demand.

177 We carried out sensitivity analysis to test the uncertainty in wholesale electricity prices. We tested a sensitivity where the Tiwai Point aluminium smelter remains open and one where fossil gas prices are higher.

178 Our modelling estimates that, if the smelter was to continue operating beyond 2024, the average wholesale price would be around $20/MWh higher, compared to the demonstration path, from about 2025 to 2035 (Figure 8.10). The higher price would occur as more renewable electricity generation would need to be built to meet the growth in demand.

179 In the fossil gas price sensitivity, we assumed that fossil gas prices increase by 20% by 2030. Our modelling suggests this would have a minimal effect on the wholesale electricity price (Figure 8.10). This is because much of the fossil gas generation that currently runs would have been displaced by renewable generation by 2025.

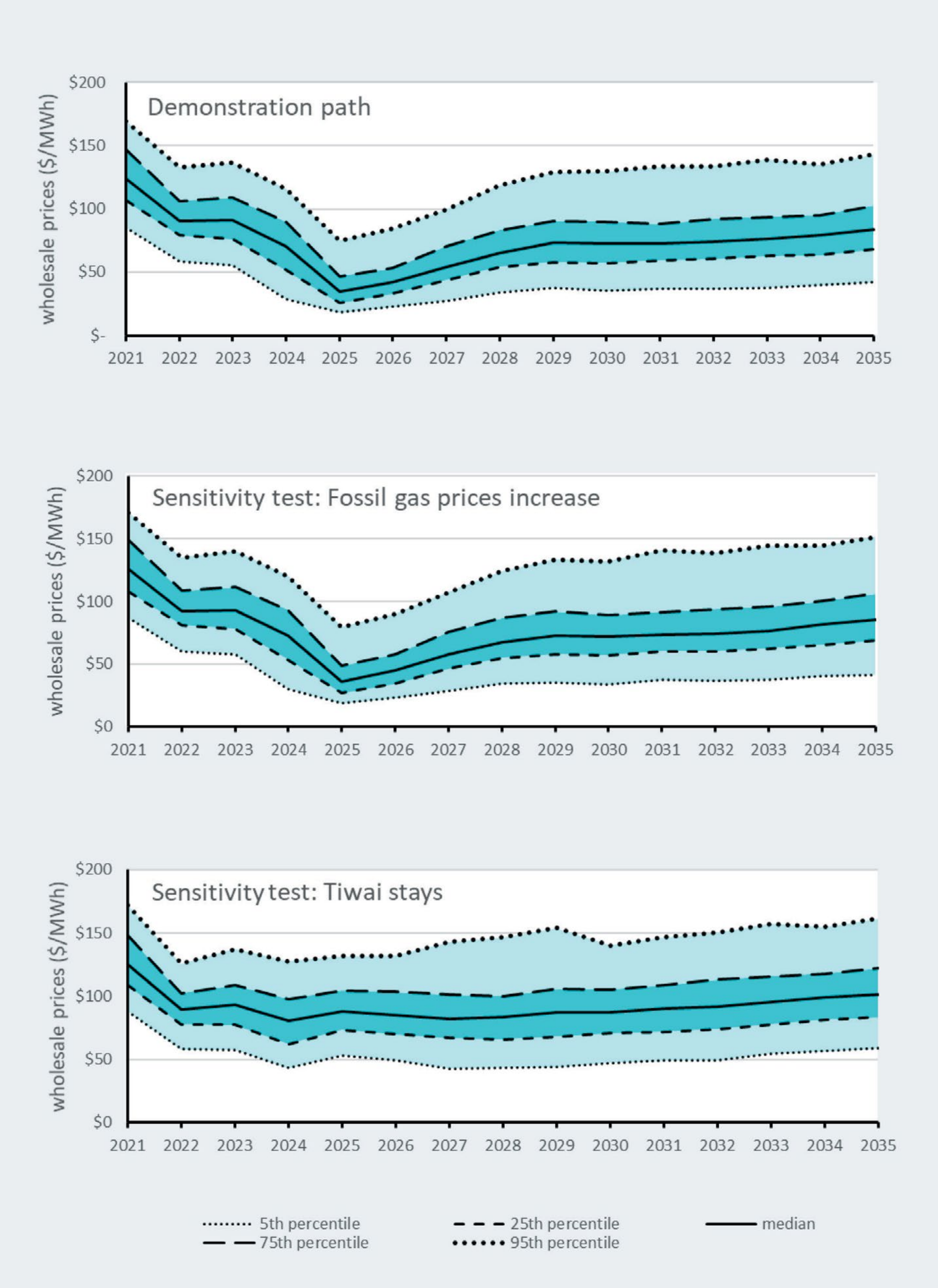


Figure 8.10: Modelled wholesale electricity prices in real dollars in the demonstration path and for two sensitivity tests. The annual variation shows the impact of inflows into the hydro lakes
Source: Commission analysis

180 Wholesale electricity prices are only one component of a household electricity bill. Electricity retailers would see these wholesale prices and determine how to pass these costs onto households – they often do this in a way that removes the day-to-day, month-to-month, and year-to-year variability.

181 Household electricity bills are also affected by changes in transmission and distribution costs. Figure 8.9 shows these make up a significant proportion of the bill for households, as well as for businesses and industrial consumers. Household bills could be significantly impacted by any changes in the cost of the transmission and distribution infrastructure and how those costs are allocated – for example, as a result of government changes to electricity pricing structures.

Electricity prices vary around the country

182 Our recommended emissions budgets are unlikely to change regional electricity prices beyond the level of regional variation that already exists. However, there are numerous factors outside those in our emissions budgets that make future electricity prices highly uncertain.

183 Households' electricity bills vary from region to region, and even within regions. Different areas already face varying electricity prices. For example, electricity pricing surveys show that households in Kerikeri and the West Coast pay more for electricity than the national average. There can be as much as a 50% variation between regions.

184 This reflects the cost of not only generating electricity, but also transmitting and distributing it. Smaller communities and communities further away from where electricity is generated often pay higher prices. Lines companies have fixed costs that they need to recover from their consumers. Having a smaller base of consumers to recover network costs from, like in Kerikeri and the West Coast, means these charges may be higher than more populous areas or areas with different pricing structures that incentivise consumers to reduce how much electricity they use at peak times.

185 Average household electricity demand varies across Aotearoa and depends on things like climatic conditions, level of home heating, and whether the household uses fossil gas, electricity, or wood for heating. For example, the average household electricity consumption is twice as much in Queenstown as in Westport.

Electricity bills will reduce from improving energy efficiency

186 Household electricity bills also depend on demand. Households that make energy efficiency improvements may be able to use less electricity or improve the level of comfort in their homes. Households can increase energy efficiency by, for example, switching to heat pumps, or installing insulation or LED lightbulbs.

187 Efficiency improvements can also reduce electricity use at peak times – in the mornings, evenings and in winter. Reducing demand at peak times helps the entire energy system as there is less need to upgrade electricity lines, which can reduce costs for all households. Scaling these benefits would require technologies for demand response, and innovative business and pricing models. Electricity pricing incentives, such as low-cost night rates, combined with smart charging technology could be effective.

188 Household electricity bills could also increase if a household purchases an EV. However, overall household energy bills could decrease if that EV is replacing a petrol car.

Some households may need support

189 Lower-income households, some Māori and Pasifika households, elderly, and people with disabilities will benefit more from making energy efficiency improvements. These groups are more likely to live in older, poorly insulated homes, and would therefore benefit more from cost savings, or improved health from being able to use savings for additional heating.

190 The impact on lower-income households can be managed through policy. Government will need to assist those on lower incomes with the upfront cost for energy efficiency improvements.

191 The Government's Warmer Kiwi Homes programme continues to provide funding to those on low incomes who own their own home to install insulation or more efficient heating. The Government has also introduced healthy home standards for rental homes that include standards for insulation and heating.

192 Continued intervention will be needed to ensure that lower-income households can access these benefits. The Government will need to assess whether the existing programmes are delivering at an appropriate pace and scale, and consider whether these programmes have broader impacts on rental prices and affordability.

193 *Chapter 20: Policy direction for a fair, inclusive and equitable transition* considers the direction of policy in this space.

8.6.3 Fossil gas bills are likely to increase from emissions budgets

194 Households that use fossil gas for heating and cooking are likely to see an increase in their fossil gas bills as a result of our recommended emissions budgets. The impact of our emissions budgets could increase the average household gas bill in 2035 by up to $300 a year for homes with reticulated fossil gas and liquified petroleum gas.

195 However, fossil gas prices are hard to predict as the fossil gas industry is at the beginning of a transition. This introduces considerable uncertainty into future fossil gas prices. The fossil gas transition story has many facets – these are discussed in *Chapter 5: Recommended emissions budgets* and *Chapter 15: Policy direction for energy, industry and buildings.*

196 The transition away from fossil gas may mean that, over time, many households would benefit from replacing fossil gas appliances. The costs could come if households were to replace fossil gas appliances before the end of their useful life. There are also other costs associated with removing fossil gas pipelines into a home, additional wiring or changes to electricity meter boards, and the associated building work.

197 Households could reduce costs by not installing new fossil gas appliances, and replacing existing fossil gas appliances with low-emissions alternatives when the appliance comes to the end of its life. We have specifically factored replacing appliances at the end of their useful life into our analysis of emissions budgets to avoid unnecessary cost.

Some households may need support

198 The impact on households of increasing fossil gas bills can be managed through the pace of the transition away from fossil gas and through policy.

199 Analysis for the Electricity Price Review shows that those on higher incomes are more likely to use fossil gas. However, in policy design, the Government will need to pay particular attention to low-income households that use fossil gas, and may not have the money for the upfront conversion cost, or may rent homes with fossil gas appliances or heating.

200 Landlords who own properties with fossil gas appliances may not have any incentive to replace them with lower emissions, low cost options, as they would not benefit from the savings in running costs. There may be some efficiencies and cost savings from replacing old fossil gas heating systems with modern electric systems.

201 Portable fossil gas heaters are still used by some households in Aotearoa. They are used proportionately more in the North Island, particularly in Gisborne and Northland. These heaters tend to be used by lower-income households due to the low upfront cost and the ease of budgeting for heating bills.

202 Portable fossil gas heaters contribute to mouldy homes and cause health problems. Although the number of these heaters is decreasing, replacing them with more efficient low-emissions options will take continued government support. However, this will flow through to healthier households and less burden on the health system.

8.6.4 Fuel costs and access to transport

203 Transport is crucial to our livelihoods, wellbeing and economy. It connects us to our families, allows us to participate in wider society, and ensures we can access work, education, healthcare, supermarkets, banks, and activities.

204 The current system in Aotearoa tends to prioritise travel by car and disadvantages those people who do not have easy access to vehicles. This may include some of the country's youth, older people, people with disabilities, Māori, Pasifika, and low-income communities.

Petrol and diesel costs are likely to increase

205 Improving fuel efficiency, a shift to EVs and more public transport, walking and cycling will all be important parts of meeting our recommended emissions budgets.

206 Our modelling indicates petrol and diesel prices could increase by up to 30 cents per litre in 2035 as a result of our recommended emissions budgets. The average household may expect to see transport costs increase, including increases in the cost of petrol and vehicle maintenance.

Increasing transport bills can be offset

207 However, there are ways to offset this increase. Households could purchase more fuel-efficient cars or walk, cycle, use public transport, or work from home more.

208 In 2035, our modelling indicates that households which replace an ICE car with an electric one could save more than $1,300 a year. This is because EVs are already cheaper to run, and will become cheaper to buy than an ICE vehicle in the future. Although electricity bills will increase, the total household energy bill will decrease for households with EVs. The total private vehicle and energy costs for households with and without an EVs are shown in Figure 8.11.

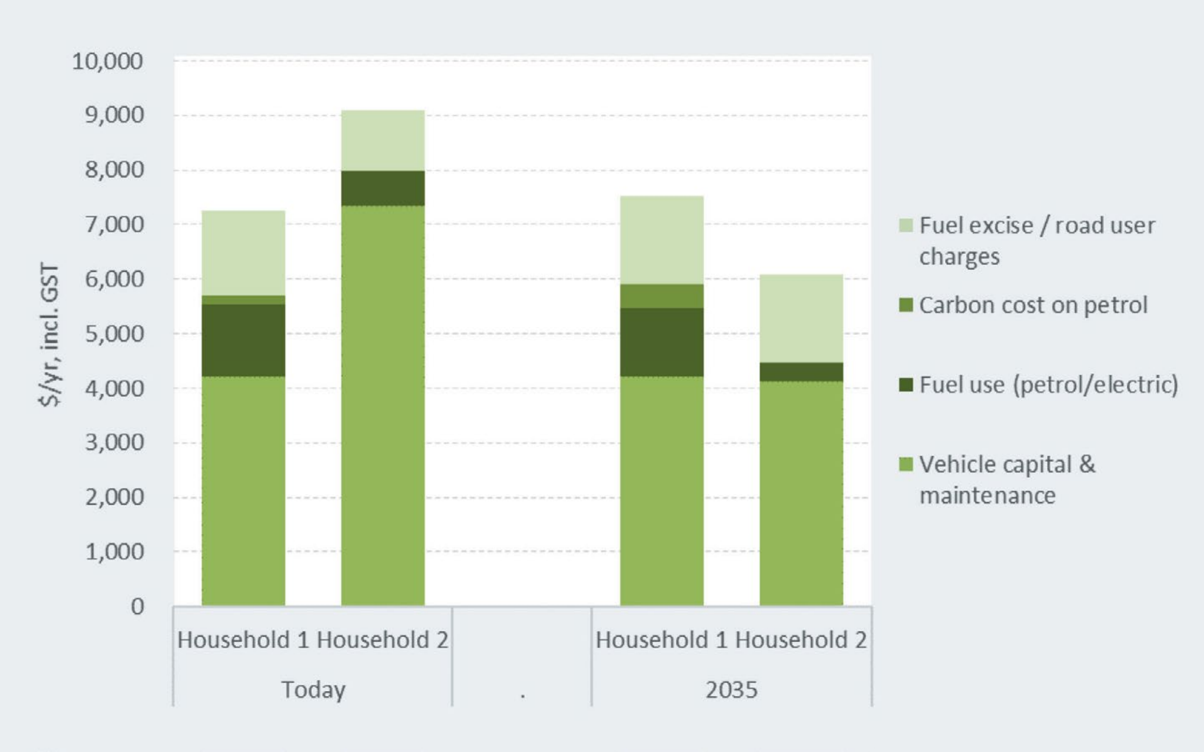


Figure 8.11: Average annual vehicle and fuels costs under the demonstration path. Household 1 has an ICE vehicle and household 2 has an EV

Source: Commission analysis

Ensuring New Zealanders have access to transport

209 Lower-income households may be less able to afford an EV than wealthier households due to the upfront costs. Currently the cheapest second-hand EVs still cost over $10,000. It may also be challenging for those who cannot charge an EV at home, for example people living in apartments.

210 We have heard throughout our engagement and consultation that this challenge is particularly relevant for people with disabilities who often rely on a vehicle to get around, and for some Māori households who are disproportionately represented among those with low incomes.

211 Access to transport is a particular issue for some Māori. Transport is hugely important for Māori to connect to their whānau, haukāinga, and tūrangawaewae. About a quarter of Māori in Aotearoa live in Auckland. However, many have whakapapa connections outside of Auckland and may need to travel long distances to participate in Iwi, hapū, and whānau activities and events. Some Māori households are large or intergenerational and require larger vehicles. Transport, particularly utes, is also a key enabler for the haukāinga to collect resources and provide services to the marae.

212 Some people and businesses have specific transport needs that the transition will need to address. Farmers, contractors and other people in rural communities need vehicles that can carry heavy loads or access rugged or remote locations. Single- or double-cab utes, farm bikes and quad bikes are an essential part of farming and rural landscapes. Cost-effective and low-emissions solutions for these vehicles are available now, or will be in the next few years.

Some households may need support

213 The Government will need to provide proactive, targeted support to ensure that New Zealanders have access to transport. This will need to help lower-income households reap the benefits of EVs and bring down costs. Policies that encourage a second-hand EV market, car sharing and leasing, and support to purchase an EV or electric bike could help.

214 More public transport, walking and cycling will have a positive impact, particularly on those who live in cities and larger urban areas. Central and local government will need to provide more and better transport options to increase access to transport for people with disabilities, on low incomes, or with large families. Currently public transport is not always a realistic option for people with disabilities and many therefore rely on cars. Good policy and planning will be needed to ensure that transport systems are integrated and accessible.

215 Submitters on our consultation also noted the importance of integrating transport into urban form. It will be important that central and local government factor this into their planning and decision-making.

8.7 How the transition could affect employment

216 There will be inevitable changes to employment and jobs as Aotearoa moves towards a low-emissions society. This will flow through to the skillsets that are needed.

217 Transition to a low-emissions economy may see the closure of large businesses. Some of these businesses may be located in specific regions around the country and provide significant employment for the community. Closing could have a big impact on these communities. Some affected workers may have the mobility and means to acquire new jobs in other industries and regions. Others may not.

218 Rio Tinto has announced the Tiwai Point aluminium smelter will close. Other emissions-intensive industries and large employers have also announced strategic reviews. There are many reasons for such industry closures besides climate change policy. Rio Tinto cited energy costs and a challenging aluminium outlook. Closure, resizing or repurposing of these industries would have an impact on those people who work there.

219 There will also be industries that grow and new industries that emerge as part of the transition. There will be more opportunities for jobs in the circular economy and bioeconomy, in new industries such as hydrogen, in renewable electricity as transport and process heat are electrified, in energy efficiency and home energy audits, and advisory services for managing emissions on farms.

220 The following sections consider how employment could change in different sectors, and the impacts on different population groups. It also outlines at a high level the types of skillsets that will be needed in the jobs that emerge as part of the transition.

221 In response to feedback from consultation, we have carried out additional analysis on jobs, particularly the jobs that could be gained as a result of climate action. This analysis draws on results from modelling, as well as analysis by others.

222 We commissioned a new model called the Distributional Impacts Microsimulation for Employment (DIM-E) to provide information on the jobs that could be gained and lost as a result of the climate transition. The DIM-E model can only tell us about sectors already existing, however new sectors will emerge as part of the transition. The DIM-E model draws on data from Stats NZ (see Box 8.4 for the disclaimers).

223 We also draw on analysis from the results of ENZ modelling. The ENZ model provides more technological and sectoral detail than the C-PLAN and DIM-E models, including on some emerging sectors (see *Chapter 4: Evidence and models* for more detail on our models). A more detailed description of what is included in the ENZ model can be found in *Chapter 11: Where are we currently heading* of our *2021 Supporting Evidence*.

Box 8.4: Disclaimers for output produced from Stats NZ data

Disclaimer for output produced from Stats NZ surveys or Census data:

Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers.

Disclaimer for output produced from the IDI and/or LBD:

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) and/or Longitudinal Business Database (LBD) which is carefully managed by Stats NZ. For more information, please visit https://www.stats.govt.nz/integrated-data/.

Disclaimer for Inland Revenue tax data:

The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

8.7.1 There will be fewer jobs in fossil fuel sectors

224 The coal mining and oil and gas sectors, and the services that support them, will be impacted by the transition away from fossil fuels. This would particularly affect Taranaki and the West Coast where most of these jobs are located.

225 Our recommended emissions budgets could see fossil gas and oil production reduce by about 60% by 2035 relative to 2019, compared to 40% under current policy settings.

226 Our DIM-E modelling indicates there would be about 500 fewer jobs in these fossil fuel sectors by 2035 under the policy settings we have now. Taking action to meet our recommended emissions budgets would result in about 1400 fewer jobs in these sectors by 2035 – an additional 1,000 fewer jobs compared to under current policy settings (see Figure 8.12).

227 This does not include the approximately 270 workers at Methanex. Like most businesses, Methanex will consider a variety of factors when making decisions about the future of their production facilities. Methanex recently announced that they would mothball one of their three methanol production facilities due to insecure gas supply. This would result in 75 permanent workers losing their jobs.

228 Many of the workers in the oil and gas sector are highly skilled and therefore have high paying jobs. Their skillsets include engineering, earth sciences, surveying and logistics. These skillsets could be valuable in other sectors, including sectors emerging as part of the transition to a low-emissions economy.

229 Changes in how we use fossil gas will also flow through to those working in gasfitting. In 2019/2020, there were about 5,700 licensed gasfitters in Aotearoa. Most gasfitters also work in plumbing, so the number of jobs that could be impacted by the climate transition is difficult to predict.

230 We heard through consultation that while the use of fossil gas needs to reduce over time, gasfitting skillsets will be important for maintaining and potentially decommissioning the existing fossil gas infrastructure, and for building up low-emissions hydrogen and biogas industries. There is a risk that the skillsets to do this could disappear if the number of people entering gasfitting apprenticeships reduces.

231 Gasfitting apprenticeships are 5 years. New training and certification would need to be developed for new low-emissions gases, particularly for hydrogen given its different chemical properties. Before developing any training on new low-emissions gases, the gasfitting industry would need more certainty about the technologies coming along and what those technologies would be used for.

Figure 8.12: The average annual change in employment in the fossil gas, oil and coal sectors in each emissions budget period under the current policy reference case and the demonstration path
Source: DIM-E simulation results

8.7.2 There will be fewer motor mechanics

232 Motor mechanics will also be impacted by changes in the transport sector, including the uptake of EVs and the shift to more walking, cycling and public transport. EVs require less maintenance as they have fewer parts, and do not need oil changes or spark plugs to be replaced. They also have less wear on brakes due to regenerative braking, but have more wear on tyres as they are heavier.

233 In 2018, there were about 17,700 motor mechanics across Aotearoa. Under current policy settings, the number of mechanics would need to increase to 20,300 – 20,800 as the population grows and more vehicles are on the road.

234 Our recommended emissions budgets could see the number of mechanics reduce from about 17,700 in 2018 to 15,400 – 16,800 by 2035. This would mean that there would be 900 – 2,300 fewer motor mechanics in 2035 compared to in 2018. This is based on a simplified assumption that all mechanics maintain light passenger and commercial vehicles. As a result, this is likely to overestimate the job impact.

235 While these numbers help to provide some indication, there are a number of things that are not factored in. This does not factor in the potential impact of disruptive technologies such as self-driving cars, which could impact the size of the fleet in Aotearoa.

236 Mechanics are already upskilling as cars are increasingly becoming more complex, incorporating new technologies, computers, and software. Mechanics will need further upskilling for maintaining and repairing EVs given the electrical systems and different drivetrain.

237 Beyond car maintenance, there are also likely to be new jobs in refurbishing and recycling batteries. There is unlikely to be any change in the number of jobs in car manufacturing as Aotearoa imports vehicles. Depending on where the market goes, there may be a new market retrofitting existing vehicles with electric drivetrains.

8.7.3 There will be more jobs in renewable electricity

238 New jobs will be created in renewable electricity. Renewable electricity generation will need to increase to meet our recommended emissions budgets. This could include a build of about 13 TWh of new renewable electricity generation to replace fossil generation and meet the increased demand from electrifying transport and process heat. Transpower and lines companies would also need to invest to transmit and distribute more electricity around the country.

239 More than 8,000 New Zealanders currently work in electricity generation, transmission, and distribution. These New Zealanders are highly skilled workers with specialised skills in areas such as electrical engineering, energy trading, pricing, sales, system design, demand management, network operations, maintenance and regulatory compliance. The industry is facing challenges as the current workforce is aging.

240 Transpower estimates that thousands more highly skilled workers will be needed in the electricity sector by 2035 to meet increasing electricity demand. Part of this will be from increased demand as transport and process heat are electrified. These jobs would be over and above replacing workers who retire in the coming years. As technology advances, the sector will increasingly need workers with skills in technological and digital innovation, automation, data science and artificial intelligence.

241 Many of these jobs will be outside the main centres, particularly in building new generation, distributed generation and distribution lines.

8.7.4 There will be more jobs in energy efficiency

242 New jobs could also be generated in energy efficiency. This was an area that the Government identified for stimulus spending as part of the COVID-19 economic response.

243 The Green Building Council estimates that more than 1,000 jobs could be generated by bringing 120,000 Aotearoa homes up to healthy standards – by installing insulation and more efficient heating.

244 According to the 2018 census, there are more than 1.8 million homes in Aotearoa. The BRANZ 2015 House Condition Survey estimates that 830,000 houses in Aotearoa have sub-optimal roof and/or floor insulation, so the potential for improving insulation and heating is significant.

245 As well as creating new jobs, improving insulation and heating in homes can deliver immediate health benefits and reduce health inequities, particularly for people on low incomes (see Section 8.6.1).

246 There are also employment opportunities in creating more energy efficient commercial buildings and improving the efficiency of appliances.

8.7.5 There will be more jobs in the waste sector

247 Meeting our recommended emissions budgets requires us to reduce, reuse and recycle our waste.

248 New jobs could be created by reusing and recovering waste materials that would otherwise go to landfill. For every job in landfilling, 2 to 4 jobs could be created in resource recovery.

249 An assessment of the impacts of amendments to the waste levy in Aotearoa found that increasing the levy and expanding it to cover additional waste streams would create new jobs. Diverting about half a million tonnes of waste away from landfill between 2020 and 2023 could result in 230 to 345 new jobs. These jobs would be created around the country.

8.7.6 There could be changes in the types of jobs in the food and fibre sector

250 Our recommended emissions budgets are likely to see some changes to the types of jobs in the food and fibre sector.

251 Farmers will need to change their farm management practices to improve efficiency while maintaining production to meet our recommended emissions budgets. As a result, farmers may reduce stocking rates, meaning that less labour may be needed on-farm.

252 However, there will be new jobs in advising farmers on how to change farm management practices in a way that optimises business, climate and other environmental outcomes. Making such changes are complex. These would be highly skilled jobs and the number of people working as farm advisers would need to be increased quickly.

253 The number of jobs in meat and milk processing would be unlikely to change significantly if our recommended emissions budgets were met while maintaining milk and meat production.

8.7.7 How land-use changes will affect jobs

254 Our recommended emissions budgets would see less land-use change from sheep and beef to forestry than under current policy settings. This is because we have put a focus on meeting emissions budgets by reducing gross emissions, and reducing the use of forest offsets, to ensure Aotearoa is able to meet and sustain net zero long-lived gases beyond 2050.

255 There were about 19,000 people employed in sheep, beef and grain farming in 2014 – the base year for our DIM-E modelling. Under current policy settings, our modelling estimates there could be about 3,000 fewer jobs in sheep, beef and grain farming by 2035. However, taking actions to meet our recommended emissions budgets could result in 2,600 fewer jobs in the sector by 2035 – 400 fewer job losses than would occur under current policy settings (Figure 8.13).

256 The potential for land-use change from pastoral farming to horticulture and arable is small at the moment, but has potential for growth. Land-use change to horticulture could increase the number of available jobs as horticulture is more intensive and generally requires more workers per hectare. However, many horticultural jobs are seasonal and as a result the sector experiences labour shortages. There are also opportunities for new jobs in food processing, for example in the proposed oat milk plant in Southland.

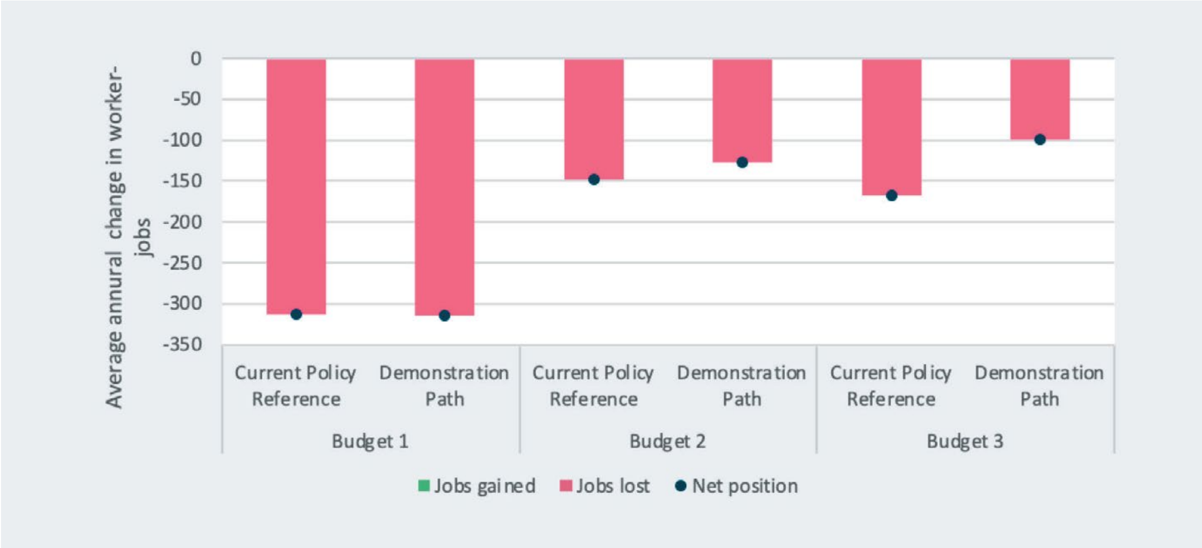


Figure 8.13: The average annual change in employment in sheep, beef and grain farming in each emissions budget period under the Current Policy Reference case and demonstration path
Source: DIM-E simulation results

8.7.8 There could be more jobs in native afforestation

257 Native afforestation will be needed to meet our recommended emissions budgets. Permanent native forests absorb carbon more slowly but will continue to do so for centuries until they reach maturity. As a result, carbon removals from new permanent native forests can be used to offset long-lived gas emissions in sectors with limited opportunities to reduce emissions from 2050. For instance, this could include offsetting nitrous oxide emissions from agriculture and residual industrial process emissions.

258 There is an opportunity to develop a native forestry industry in Aotearoa. Meeting our recommended emissions budgets could see close to 300,000 hectares of new native forests from 2021 to 2035. This would generate jobs throughout the country, particularly in nurseries to supply seedlings, labour for planting, fencing, pest control, and support and technical advice. Establishing and managing native forests could be more labour intensive than exotic forests. Native forests also create opportunities for jobs in honey, recreation and ecotourism, and forest-based pharmaceuticals.

8.7.9 There could be more jobs in bioenergy and the bioeconomy

259 Bioenergy will play an important role in meeting our recommended emissions budgets – both in the form of biomass and biofuels. To ensure the increase in bioenergy is feasible, we considered how much wood waste would be available in Aotearoa and could be used. However, other feedstocks, such as tallow for biofuels, and imported bioenergy could also be used.

260 Producing energy from biomass is much more labour intensive than conventional fuels. Much of the work is in growing the feedstock – work that is already happening in Aotearoa given we are considering using only existing wood waste. However, there would be new jobs in recovering forest and wood waste, transporting it and processing it ready to be used.

261 Much of the wood grown in Aotearoa is exported as raw logs. There are also opportunities to add value by processing wood in Aotearoa, which would create jobs.

8.7.10 It is hard to predict what will happen in hard-to-abate industrial sectors

262 Some industries face particular challenges when it comes to reducing emissions, such as cement and steel. These industries are large employers in regions around the country and are fundamental to the economy, but solutions for decarbonising these industries are further off. Some of these industries have announced strategic reviews, citing many reasons besides climate policy. There are key strategic decisions that need to be made about the future of these industries. The outcome of these decisions will impact jobs.

263 In our ENZ modelling, we assume that Tiwai Point aluminium smelter closes all potlines by the end of 2024 in line with Rio Tinto's recent announcements. The smelter's closure would see about 1,000 direct job losses in Southland between now and the end of 2024. Any job gains from lower wholesale electricity prices could be spread across the country.

264 For other hard-to-abate sectors, it is hard to predict. In our ENZ modelling, we assume that steel and cement production is unchanged. However, these industries may face other challenges outside of addressing climate change. As of September 2020, New Zealand Steel employed about 1,400 workers, but they announced there could be 150-200 job losses after a strategic review.

265 Methanol production, wood, dairy and meat processing are discussed in earlier sections of this Chapter.

8.7.11 It is hard to predict what jobs will eventuate from the hydrogen industry

266 Hydrogen is an emerging industry. It is highly uncertain what role hydrogen will play and therefore how many jobs could be created in the hydrogen industry. The number of jobs, skillsets needed and where those jobs are located will depend on how large the industry becomes, how hydrogen is used, and the role hydrogen plays compared to other fuels including electricity.

267 There is potential for the hydrogen industry to need mechanical skillsets if hydrogen was used in heavy trucks, engineering skillsets if hydrogen boilers were installed, and gas fitting if hydrogen was blended into pipelines.

8.7.12 How different population groups are impacted by job change

268 Some population groups will experience more employment impacts than others from our recommended emissions budgets. The exact impacts will depend on how the Government chooses to meet our recommended emissions budgets and the policies they put in place.

269 We are able to look at some of this impact using the DIM-E model. However, we must also consider existing inequities in employment for different population groups. For example, some population groups already experience higher unemployment rates than others (Table 8.1).

270 The impact on Māori in the workforce is discussed in Section 8.4.

Pacific peoples

271 Pacific peoples currently disproportionately face higher unemployment, underutilisation and earn less than the national average (Table 8.1).

272 Our modelling suggests that Pacific peoples could disproportionately experience greater job change as a result of our emissions budgets. Our analysis suggests that Pacific peoples make up about 8% of those who gain jobs from the transition and about 7% of those who lose jobs from the transition. Overall, there are more job gains than job losses for Pacific peoples across all three emissions budget periods.

Age groups

273 Our modelling suggests young people would see net job gain as a result of our recommended emissions budgets. People aged between 15-24 make up about 18% of job gains over the three emissions budget periods. Older workers, particularly over the age of 45, would be disproportionately impacted by job change.

Women

274 Our modelling of employment flows, from our recommended emissions budgets, indicates that men may be more affected by the transition than women. This is because the industries that are most affected by the transition tend to employ more men. However, both women and men are likely to experience a net gain in jobs by 2050 compared to what they may experience under current policy settings.

275 In Aotearoa, women are disproportionately underutilised in employment and earn less (Table 8.1). Historically, there is evidence showing that women are more negatively affected during economic change.

276 Our modelling also does not capture the dynamics that could occur as employment changes. For example, the flow on impacts to women as men move out of high emissions industries and seek new work. This was a problem in the UK in the 1980s and 1990s – many women were displaced from manufacturing jobs as men who lost jobs in coal sought out new work. Additionally, women had to take on the 'double burden' of paid work as well as unpaid care work.

People with disabilities

277 Our modelling does not address the impact of employment changes on people with disabilities. However, any changes to jobs could have disproportionate impacts on people with disabilities. This is because people with disabilities are more likely to face poor employment outcomes, as they are less likely to be in work or education, and are more likely to be unemployed, underutilised and earn less than people who don't have a disability (Table 8.1).

Table 8.1: Key labour market indicators in Aotearoa in 2019/2020

	All young people (aged 15-24 years) (%) *	50 and over (%) *	Māori (%) *	Pacific peoples (%) *	Women (%) *	People with disabilities (%) **	National average (%)*
Employment rate	55.8	54.8	62.7	60.2	62.4	39.0	67.3
Not in education, employment or training (NEET) rate	12.3	NA	19.1	18.0	13.3	43.2	12.3
Unemployment rate	12.0	2.3	8.3	8.2	4.7	10.0	4.4
Underutilisation rate	29.5^	8.2^	18.3	16.2	13.8	22.7	11.4
2020 Median weekly wages ($) ***	575	978	999	954	924	400	1040

* Annual average quarterly data from Households Labour Force Survey, Stats NZ

** Labour market statistics (disability), December 2020 quarter

*** Based on Labour Market Statistics (Income) 2020 NZ Stats

^ Values obtained from Households Labour Force Survey, March 2021 quarter. 50 and over is for 55+ age bracket

8.7.13 How we manage the impact on jobs

278 The previous sections show that there will be more jobs available in some areas and fewer jobs in others as a result of our emissions budgets. In the early years, this may result in job losses. Some population groups will be more impacted by these employment changes, particularly people in groups that already face inequity in employment.

279 For later emissions budgets, there will be less job loss, as young workers entering the workforce go into different occupations.

280 Much of the change will occur gradually over the next 15 years. Some of the workers in these industries will retire over this time. However, there will be workers that may need support to transition into new areas of work.

281 Given the aging population in Aotearoa, there may be particular challenges to ensuring that the new industries that emerge as a result of the transition can get enough workers with the necessary skillsets.

282 In addition, there will be further disruption to the way we work, as we see more use of data science, digitalisation, automation, robotics, artificial intelligence, and machine learning.

283 Changes to employment are inevitable as a result of our recommended emissions budgets. However, these changes are manageable with good planning and support.

284 Transition planning will be vital for ensuring that the changes ahead are well signalled and that policies and programmes are put in place to support workers who need to move into new lower-emissions areas of work.

285 A nimble and responsive education system will also be critical for setting New Zealanders up with the skills – particularly engineering and technical skills – that will be needed in growing and new low-emissions industries.

286 The direction of policy needed to deliver the skillsets and support workers through the transition is described in *Chapter 20: Policy direction for a fair, inclusive and equitable transition*.

8.8 Environmental impacts

287 Moving to low-emissions technologies and changing land practices to meet our recommended emissions budgets would also bring broader environmental impacts.

288 The move to EVs, greater electricity use, and improved fuel efficiency would result in improvements to air quality, and the associated health benefits. Many submitters raised concerns about the total impact of EVs on the environment. This is because although EVs are low emissions, they are not zero emissions. The EV total supply chain (from cradle to grave) is extensive, including the extraction of raw materials, the battery manufacture, vehicle manufacture and shipping.

289 Evidence shows that the lifecycle cost of an EV on the environment in comparison to an ICE vehicle is significantly reduced. The lifecycle cost of an EV on the environment is expected to decrease further as countries move towards more renewable electricity generation, battery technology continues to improve, and global efforts to reduce emissions from EV supply chains increase.

290 An EV used in Aotearoa would emit about 60% fewer emissions over its full life cycle than petrol vehicles, even when you take into account raw material extraction, battery manufacture, vehicle manufacture and shipping. Studies have found that the total amount of energy used during the entire life cycle of the vehicle (cumulative energy demand) was around 40% less for EVs than for petrol and diesel vehicles. Both figures will improve as Aotearoa phases out the use of fossil fuels for electricity generation and global efforts to reduce emissions from EV supply chains increase.

291 Many technologies important in the transition to a low-emissions economy – including wind turbines, solar panels, and batteries – require mineral and metal inputs. How these minerals and metals are sourced, recycled and disposed of could have negative environmental impacts here and overseas. There could be opportunities for innovation in repurposing and recycling these materials.

292 These technologies can have high embodied emissions due to the energy requirements to produce some of these inputs. Additionally, when these technologies reach the end of their life, it can be difficult to dispose of them as they are not easily recycled. Supply chains will need to be carefully managed and Aotearoa needs to ensure it has access to the latest advances internationally to reduce the adverse environmental impacts. The need for a circular economy is discussed in *Chapter 13: Policy direction that cuts across sectors*.

293 Building new small or large hydroelectric dams could help provide flexible capacity to meet peak electricity demand. Pumped hydro schemes would also provide capacity in dry years where hydro lake levels are low. However, such schemes could have substantial landscape and ecological impacts. Flooding large areas of land for water storage could impact water flows downriver of the scheme. This could be to the detriment of nationally significant wetlands, archaeological sites, habitats for endemic bird and fish species, and in some cases endangered or threatened species. Hydro dams can also obstruct native freshwater fish from migrating up and down rivers.

294 Building new hydroelectric dams or expanding existing assets could be part of our response to meet emissions budgets and targets, even though our modelling does not overtly include new hydroelectric assets.

295 Practice changes – such as careful balancing of stocking rates, pasture management and supplementary feed – could reduce emissions on farms and bring co-benefits to water quality and soil health. The scope for practice change and associated co-benefits depends on the farm, the farm's specific climate and soil conditions, the current management system, and the advice and skills that farm businesses could draw on.

296 Afforestation could also improve biodiversity, water quality and soil health, and reduce erosion if the right type of tree is planted in the right place at the right time. While pine forests can increase biodiversity, including for rare native species such as kiwi and falcons, native forests in Aotearoa host thousands of species, hundreds of which are threatened.

297 Native vegetation on farms can also provide large connected networks that can serve as stepping stones for birds that disperse tree seeds. Pest control, and fencing out grazing and browsing animals, would be important for improving biodiversity and enhancing carbon stocks as pests compromise the health of forests both by directly browsing trees and by killing birds that distribute seeds.

298 Land-use change from dairy to horticulture on flatter and more productive land could reduce biogenic methane emissions per hectare. However, it could also cause water quality to deteriorate due to the increased use of fertiliser, and consequential nitrogen and sediment losses.

299 Nutrient losses would vary depending on the crop, the site, weather conditions, the soil's physical and chemical properties, and how the land is managed. Increasing the area of horticulture could also increase water demand in Aotearoa. In light of the physical impacts of climate change, this increased need for water would need to be weighed up when considering converting to horticulture as a climate action.

300 Reducing how much waste is generated and recovered means that landfills will take longer to fill up, potentially reducing the number of landfills needed in the future. Increasing landfill gas capture at legacy and non-municipal landfills could also lessen the negative impacts on air quality and leaching.

301 There could also be environmental impacts associated with decommissioning industries that close as a result of the transition to low emissions.

302 Our recommended emissions budgets can therefore bring environmental co-benefits such as improved air, freshwater and biodiversity. There are also some negative environmental impacts that will need to be managed. Innovation in repurposing and recycling materials will help to address some of these impacts.

8.9 How emissions budgets could impact government taxation and spending

303 Our emissions budgets will also impact government taxation and spending. For example, revenue from fuel excise duties and road user charges, which are ring fenced to be spent on land transport, will change over time. This is routinely monitored by the Government. The same would occur for the Waste Levy, which is put back into waste minimisation projects, as the amount of waste reduces over time. Reducing oil and fossil gas production in Aotearoa will also result in less tax revenue and will affect the balance of exports as less oil is exported.

304 The NZ ETS will generate income for the Government from selling emissions units. The income generated will depend on the volume of units sold, and the market price for units. The Government estimates this could equate to at least $3.1 billion over the next five years under current settings. The Government has options for how to spend these proceeds, including putting them back into climate change projects.

305 Government spending on social assistance for workers and families, and for health could also be affected. The impact on this spending will depend on the transition strategy the Government puts in place, the pace of the transition, and how well the Government plans and signals the transition.

306 These changes to Government taxation and spending are manageable, however the Government will need to plan for this.

Chapter 9

Te Whāinga – Te Whakaheke Tukunga Hauwaro ki te 1.5°C
Contributing to limiting warming to 1.5°C

Summary

Limiting warming requires a global effort with each country playing its part by meeting its international climate change commitments to reduce emissions. Global ambition is increasing with many of the world's largest emitters committing to strengthened climate targets.

The domestic emissions reduction targets for Aotearoa are set at a level the Government has judged to be in line with contributing to global efforts to limit warming to 1.5°C. This is a requirement under the Climate Change Response Act (the Act). To make sure the Climate Change Commission's (the Commission's) budgets are compatible with this, we have carried out a detailed assessment.

Our assessment of how the recommended budgets contribute to the global 1.5°C effort:

We have considered two components when assessing whether our emissions budgets are compatible with the global 1.5°C effort.

1. We looked at whether the emissions budgets are compatible with the 2050 emissions reduction targets. The country's carbon dioxide and methane targets were set by the government as our domestic contribution to the 1.5°C global effort.
2. We looked at how the emissions reductions for the different greenhouse gases in our work compare to the Intergovernmental Panel on Climate Change (IPCC) 1.5 °C pathways. We looked at the relative reductions and global trajectories for the different greenhouse gases in the IPCC's work, drew out the key features, and then applied these in the Aotearoa context.

The Commission's analysis shows our recommended emissions budgets put Aotearoa on track to reach net-zero carbon dioxide emissions by 2038. This is ahead of the range in the IPCC pathways of 2045-2055. The recommended budgets also put us on track to reach net zero for all long-lived greenhouse gases before 2050.

The reductions in agricultural methane for our emissions budgets put Aotearoa just outside the IPCC's interquartile range for 2030. However, by 2050 we consider it is likely Aotearoa will be within the interquartile range.

The Act sets targets for reductions in total biogenic methane, this includes biogenic methane emissions from waste as well as agriculture. Our analysis shows Aotearoa has an opportunity to significantly reduce emissions from waste. This would lead to a reduction of total biogenic methane between 2010 and 2030 of 12%, which is within the IPCC range.

Our recommended budgets see reductions in nitrous oxide between 2010 and 2030 of 3%, which is inside the IPCC's interquartile range. This path also puts nitrous oxide reductions on track to reach the lower emissions end of the IPCC interquartile range by 2050.

Changes in our final advice

This is a new chapter in our final advice. It answers questions that were raised during consultation about the contribution of Aotearoa to the global 1.5°C effort.

Introduction

1 When the Government passed the Climate Change Response (Zero Carbon) Amendment Act (the Act) in 2019, one of the purposes of the new Act was to:

> *Provide a framework by which New Zealand can ... contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels.*

2 The Act sets out the domestic 2050 emissions reduction targets (2050 targets). The 2050 targets in the legislation were set at a level that the Government viewed to be in line with limiting the global average temperature increase to 1.5°C above pre-industrial levels (global 1.5°C effort).

3 In setting these 2050 targets, the Government drew on the Intergovernmental Panel on Climate Change (IPCC) *Special Report on Global Warming of 1.5°C* released in 2018. Through the 2050 targets set in the Act, Parliament has set the direction for what domestic contribution Aotearoa will make to the global 1.5°C effort.

4 This chapter outlines the science of the different greenhouse gases, the global emissions reductions modelled as compatible with the global 1.5°C effort, and our assessment of how our recommended emissions budgets are compatible with contributing to that effort.

Box 9.1: Emissions budgets and the Nationally Determined Contribution

During consultation, we received feedback from submitters asking how we could conclude that our draft emissions budgets aligned with contributing to the global 1.5°C effort while concluding that the Nationally Determined Contribution (NDC) under the Paris Agreement did not.

The 2050 targets in the Act were drawn from the work of the IPCC and were set by the Government as our domestic contribution to the global 1.5°C effort. Emissions budgets must set Aotearoa on a path to meet the 2050 targets, must be achievable and focus on domestic actions. There are a broad range of factors outlined in the Act that we must consider in recommending emissions budgets – factors that do not always pull in the same direction.

The NDC is different from emissions budgets in that it can involve both domestic action and contributing to action overseas (offshore mitigation). Emissions budgets represent only part of the total contribution Aotearoa makes to limiting warming. As offshore mitigation can be included in the NDC, the difficulty of reducing emissions within Aotearoa is less relevant to assessing the NDC, but remains a mandatory consideration for emissions budgets under the Act.

The NDC is also a successor to previous international emissions commitments the government has made and so the assessment of budgets and the NDC start from different points. *Chapter 22: Factors relevant to the Government's decision on the level of the Nationally Determined Contribution* describes these differences further.

9.1 The science of the different greenhouse gases

5 The impact a particular greenhouse gas has on the climate depends on two key factors – its ability to absorb heat energy on a molecule-by-molecule basis, and how much of it there is in the atmosphere. This impact can be expressed as the 'radiative forcing' of that greenhouse gas. Radiative forcing is a measure of how much a gas is driving the changes in the global climate.

6 Carbon dioxide is responsible for the majority of human-driven warming to date.

7 Carbon dioxide is the most important greenhouse gas produced by human activities. It has the ability to absorb a wide range of radiated energy. It is also very long lived, meaning that carbon dioxide released today will still be causing warming centuries or millennia into the future. It is the greenhouse gas the world is emitting the most of, and which has the highest concentration in the atmosphere.

8 Methane is the second most important greenhouse gas and is responsible for around a sixth of human-caused warming that has occured to date.

9 Molecule for molecule, methane emissions have a much greater warming effect in the atmosphere than carbon dioxide. However, methane is a short-lived greenhouse gas. It has an intense warming effect for the first few decades after it is emitted, but this effect dissipates as methane breaks down in the atmosphere.

10 Methane's properties mean it has a different effect on warming, which is an important factor when considering global and domestic pathways for reducing emissions.

11 In our analysis of how Aotearoa could achieve our recommended emissions budgets, we have applied a split-gas framework that takes into account methane's different properties. This is consistent with the approach taken by the Act. This avoids the use of metrics to compare methane with other greenhouse gases or trade off effort across the different greenhouse gases.

Box 9.2: The carbon and nitrogen cycles

Carbon dioxide, methane and nitrous oxide are produced as part of global chemical cycles. These gases can be produced naturally or as a result of human activities that are driving climate change and are the focus of mitigation efforts.

Carbon exists in many different forms and is found in vast amounts in soils and rocks, and in plants and animals. Physical processes like the weathering of rocks and volcanos, and the biological processes of photosynthesis and respiration lead to this carbon cycling in and out of the atmosphere as carbon dioxide. The burning of fossil fuels and forests also releases carbon dioxide into the atmosphere. Human activities are releasing carbon dioxide into the atmosphere more than 100 times faster than from natural processes, and it is the resulting increased concentration of carbon dioxide in the atmosphere since the industrial revolution that is the primary driver of climate change.

Methane is also part of the carbon cycle. It can come from fossil fuel sources, such as leaking from coal mines or fossil gas fields. It can also come from biogenic processes like the rotting of vegetation and as a by-product of digestion in animals – particularly ruminants such as cattle, sheep and goats.

This biogenic methane can be thought of as a loop in the carbon cycle that begins and ends with carbon dioxide in the atmosphere.

The natural process of grass growth uses photosynthesis to take up carbon dioxide from the atmosphere and converts it into plant tissues. Some of the grass will be eaten by animals and ultimately returned to the atmosphere either rapidly (through respiration and urine or dung) or over a few years (as products and carcasses eventually decay).

However, when the grass is eaten by ruminants some of the carbon is converted to methane by microbes in the rumen and expelled to the atmosphere. This methane eventually decays back to carbon dioxide after 12-20 years. Whether it is produced through the breakdown of plant material or from ruminant livestock, methane production is an intrinsic part of food production. The increase in biogenic methane concentration in the atmosphere is closely linked to increased food production to feed a growing human population.

Nitrous oxide is formed as part of the nitrogen cycle. Nitrogen is one of the most common elements on Earth. Most of it is locked up in the atmosphere as nitrogen gas, which plants and animals can't use. To become available, nitrogen needs to be converted into different forms like ammonium, a process known as nitrogen fixation. The two most common ways this happens are lightning and conversion by soil bacteria.

Animals get nitrogen by feeding on plants, and use it to build proteins and tissues and grow. Any excess nitrogen is excreted in urine and dung in the form of urea. This urea is then broken down by soil bacteria and can follow one of three paths:

- Some of the nitrogen is taken up again by plants
- Some of the nitrogen is converted to highly soluble nitrate, which can be washed off into waterways or leach down through soil into groundwater
- A small amount of the nitrogen is converted into nitrous oxide and emitted into the atmosphere

As with biogenic methane, the increase in nitrous oxide concentration in the atmosphere is closely linked to increased food production to feed a growing human population.

For more details, see *Chapter 7: Reducing emissions from agriculture* of the *2021 Supporting Evidence.*

12 Nitrous oxide is a much more powerful greenhouse gas in the atmosphere than carbon dioxide on a molecule-by-molecule basis and is also relatively long-lived in the atmosphere. However, nitrous oxide is emitted at a rate that is much lower than carbon dioxide or methane. As a result, it contributes less to human-driven warming – around 6% of the warming to date.

13 Other greenhouse gases include small levels of synthetic gases such as hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. Some of these synthetic gases have very powerful warming effects.

14 Continuing to emit long-lived gases, like carbon dioxide and nitrous oxide, results in these gases accumulating in the atmosphere. They are effectively being added faster than they are being removed. Therefore, a constant rate of carbon dioxide and nitrous oxide emissions, year to year, leads to growing concentrations and more warming. Emissions of long-lived gases need to drop to zero to stop adding to warming.

15 Methane breaks down at a faster rate, and a constant rate of emissions will stabilise within about 50 years. Because methane does not accumulate to the same extent as long-lived gases, its emissions do not need to reduce all the way to zero for them to stop adding to global warming.

16 Figure 9.1 shows how the current rates of emissions of carbon dioxide, methane and nitrous oxide from Aotearoa each year would contribute to warming over two hundred years. Given current annual emissions, methane emissions cause the most warming over the first few decades. However, because methane breaks down more quickly, the longer lasting warming from carbon dioxide dominates beyond that. See *Chapter 1: The science of climate change* of the *2021 Supporting Evidence* for more details.

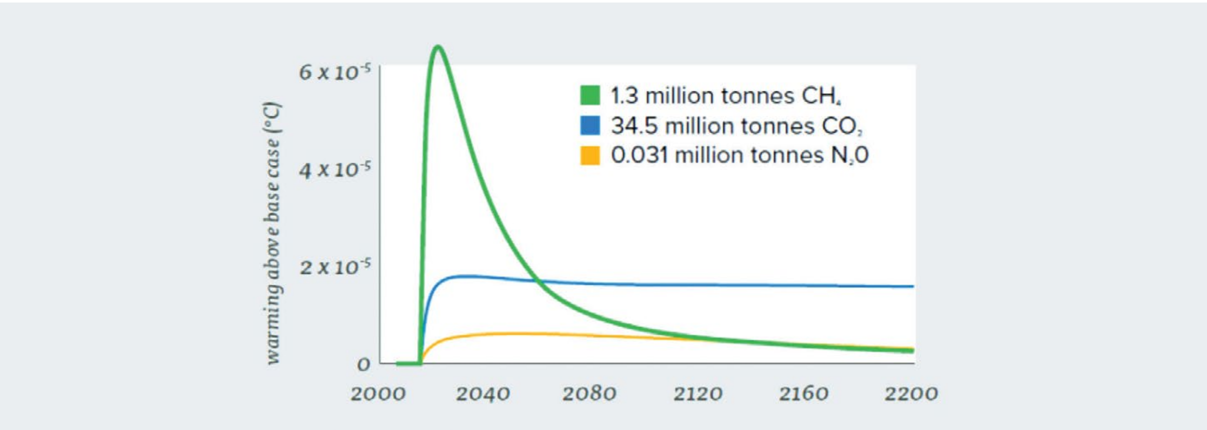


Figure 9.1: The effect of the country's yearly emissions of carbon dioxide, methane and nitrous oxide on warming. Note: This figure is based on 2016 emissions in Aotearoa

Source: Interim Climate Change Committee.

17 The total warming impact of each greenhouse gas over time depends on current emissions rates as well as past emissions of that gas and how much is still in the atmosphere. The New Zealand Agricultural Greenhouse Gas Research Centre has estimated that Aotearoa has contributed close to 0.3% of the 1°C warming that has occurred since pre-industrial times. This historic contribution Aotearoa made to warming came from a mix of carbon dioxide released when native forests were first cleared and ongoing emissions of carbon dioxide from fossil fuel use, methane and nitrous oxide (Figure 9.2).

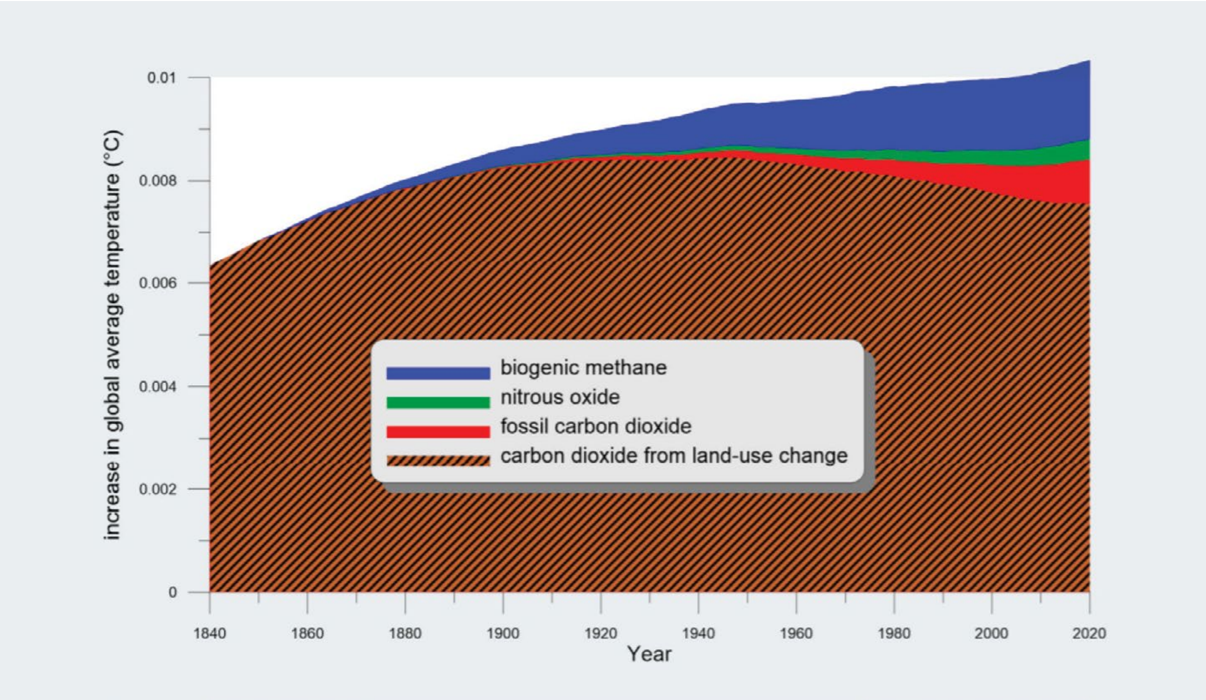


Figure 9.2: The contribution Aotearoa made to warming since 1840

Source: New Zealand Agricultural Greenhouse Gas Research Centre.

9.2 Global efforts to limit warming to 1.5°C

18 One of the central objectives of the Paris Agreement is for countries to contribute to "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."

19 Assessments of the current global effort show that the world is not on track to meet the Paris Agreement's temperature goals. The 2020 United Nations Environment Programme Emissions Gap report warns that warming will increase to around 3°C this century based on current pledges.

20 Reducing emissions requires a global effort – each country needs to do its part under the Paris Agreement. More and more countries are strengthening their international climate change commitments, particularly in the lead up to the next international climate change conference in November 2021. In the last 18 months, many of the world's largest emitters have already stated they would move to more ambitious emissions targets (Figure 9.3).

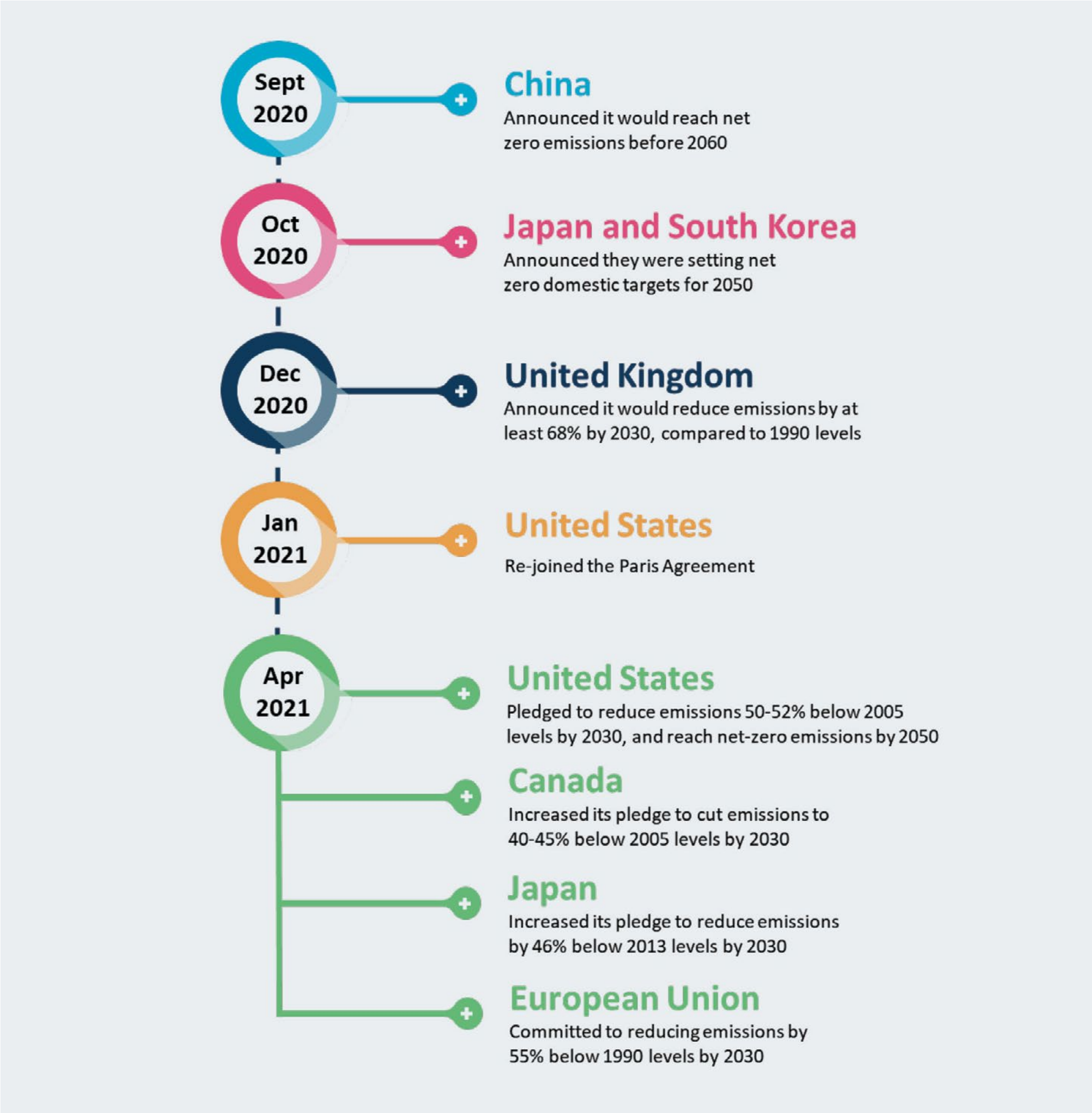


Figure 9.3: Increased climate change commitments since late 2020

21 The Climate Change Commission (the Commission) takes a systems view of Aotearoa and its place internationally. The world needs to minimise climate change and its impacts, but the Commission also collectively needs to consider broader wellbeing factors like eradicating poverty, safeguarding food security and addressing other environmental outcomes. These considerations are important in the context of reducing emissions, but also in considering the need to adapt to more severe and costly impacts of climate change if the world does not act to reduce emissions.

22 When making judgements about trade-offs, careful consideration needs to be given to where to concentrate efforts, and how the impacts and consequences are spread across countries, people, place, and time. These judgements must be made from an Aotearoa perspective, taking a te ao Māori view, and must consider environment, economy, society, and the broader wellbeing of Aotearoa.

9.3 Global 1.5°C compatible pathways

23 The IPCC has outlined a number of different global pathways that have a likely (50-66%) chance of limiting warming to within 1.5°C above pre-industrial levels. These pathways are drawn from peer-reviewed modelling studies. They are not based solely on atmospheric science, but also on the ease and costs of reducing emissions of different greenhouse gases across sectors, and consider a range of socio-economic scenarios.

24 Under these global pathways, different greenhouse gases reduce at different rates. They also rely on emissions removal technologies, such as bioenergy with carbon capture and storage or afforestation, to varying degrees. Within all these pathways, limiting warming to 1.5°C requires the world to rapidly reduce emissions of all greenhouse gases between now and 2030. Slower reductions are then needed out to the end of the century.

25 All these 1.5°C compatible pathways show:

- Net emissions of carbon dioxide and other greenhouse gases peaking in the 2020s, then rapidly reducing through the 2030s and 2040s.
- Emissions of methane reducing substantially through the next 20 years, but not reaching zero by 2050 or 2100, due to the short-lived nature of the gas and the difficulty of eliminating methane emissions from food production.
- Emissions of nitrous oxide peaking in the 2020s and then reducing, but not reducing to zero due to the difficulty of eliminating nitrous oxide emissions from food production.
- Gross emissions of long-lived greenhouse gases reducing to near zero by 2050.

26 Most of these 1.5°C compatible pathways show:

- Some remaining emissions in 2050 from hard-to-abate sectors. This includes things like carbon dioxide from cement manufacturing. As a result, emissions removals are required to ensure emissions reach, and remain at, net zero.
- Carbon dioxide being removed from the atmosphere on an ongoing basis, beyond what is needed to keep emissions at net zero, to bring temperatures back below 1.5°C above pre-industrial levels after a temporarily overshoot.

27 It is often said that global emissions must halve by 2030 from 2010 levels to limit warming to within 1.5°C above pre-industrial levels. This is a useful rule of thumb, but is a simplification of the actual emissions reductions assessed by the IPCC. In the global 1.5°C pathways, net carbon dioxide emissions are modelled to reduce by around 50% by 2030. Emissions of other gases are modelled to reduce more slowly.

28 The global IPCC pathways provide useful insights for considering how our recommended emissions budgets contribute to the global 1.5°C effort. However, the pathways represent global averages and do not set out prescriptive pathways for individual nations. There is no 'right way' to reduce emissions. Care needs to be taken when applying the IPCC pathways to Aotearoa for three key reasons:

- Many of the emissions reduction opportunities that will be most important for the world will not be as important in Aotearoa given our major sources of emissions. For example, globally, coal power generation accounts for a much larger share of emissions and it is here that the sharpest early reductions in the IPCC pathways occur. Most electricity generation in Aotearoa however is already renewable, so this large reduction opportunity does not exist for Aotearoa.
- The IPCC pathways group the emissions of the individual gases in different ways to those in the Act. For example, the IPCC assessed reductions in methane from agriculture, while emissions budgets are set for biogenic methane.

- The IPCC pathways are set relative to a 2010 base year, while the targets in the Act are set relative to 2017.

29 There are questions about whether it is still possible for the world to limit warming to 1.5°C. The longer countries wait to act, the harder it gets, with greater reliance placed on emissions removal technologies that are not currently available. Towards the end of 2021 the IPCC will release its sixth assessment report which will provide the most up-to-date science on this question.

9.4 Assessing how our emissions budgets contribute to the global 1.5°C effort

30 We have considered two components when assessing whether our emissions budgets are compatible with contributing to the global 1.5°C effort.

31 The first and most relevant is whether the emissions budgets are compatible with the 2050 targets in the Act. This is because the 2050 targets were drawn from the work of the IPCC and were set by the government as our domestic contribution to the global 1.5°C effort.

32 Our modelling shows that the emissions budgets set us on a track to meet the 2050 targets, both for long-lived gases and biogenic methane.

33 As an additional consideration, we have also looked at how the emissions reductions for the different gases in the demonstration path compare to those in the IPCC's pathways. These are not directly comparable so we look at the relative reductions and global trajectories for the different gases in the IPCC pathways, draw out the key features, and then apply these in the Aotearoa context.

34 Table 9.1 shows the percentage reductions in net carbon dioxide, agricultural methane and nitrous oxide between 2010 and 2030 from the IPCC's pathways. The table also shows the reductions in these gases over the same period that the demonstration path would achieve. For a detailed explanation of the IPCC range used here see *Chapter 22: Factors relevant to setting the level of the Nationally Determined Contribution* and Chapter 1 of the *2021 Supporting Evidence.*

Table 9.1: Reductions in emissions between 2010 and 2030, by gas, in IPCC pathways and in our demonstration path. The reductions for net carbon dioxide are calculated using a gross-net approach. See Chapter 3: How to measure progress of the 2021 Supporting Evidence for more detail on this approach and the basis for its use. We have used the 'interquartile range' of the IPCC's pathways. The interquartile range represents the middle 50% of modelled reductions. This gives a more conservative, but also more likely, range for the emissions reductions that are needed.

	Percentage change between 2010 and 2030	
	IPCC	**Demonstration path**
Net carbon dioxide emissions	-40 to -58 %	-55 %
Agricultural methane emissions	-11 to -30 %	-8 %
Total biogenic methane	-	-12 %
Agricultural nitrous oxide emissions	+3 to -21 %	-3 %

Source: IPCC – Special Report on 1.5°C, Summary for Policymakers, Table SPM.3b. Integrated Assessment Modelling Consortium data, hosted by IIASA.

9.4.1 Net carbon dioxide

35 Carbon removals by forests are a major opportunity to reduce net emissions in Aotearoa. Figure 9.4 shows the scale of carbon removals by forests in comparison to gross emissions of carbon dioxide in the demonstration path. Under the internationally agreed accounting rules, all emissions from deforestation are included, as are carbon removals from forest planted after 1989. This is different to the 2010 base year used in the IPCC pathways. However, by 2030 almost all of the forest removals are from forest planted after 2010, so the effect of the different base year is negligible.

36 Figure 9.4 shows that Aotearoa reaches net-zero carbon dioxide emissions by 2038, ahead of the range in the IPCC pathways of 2045-2055.

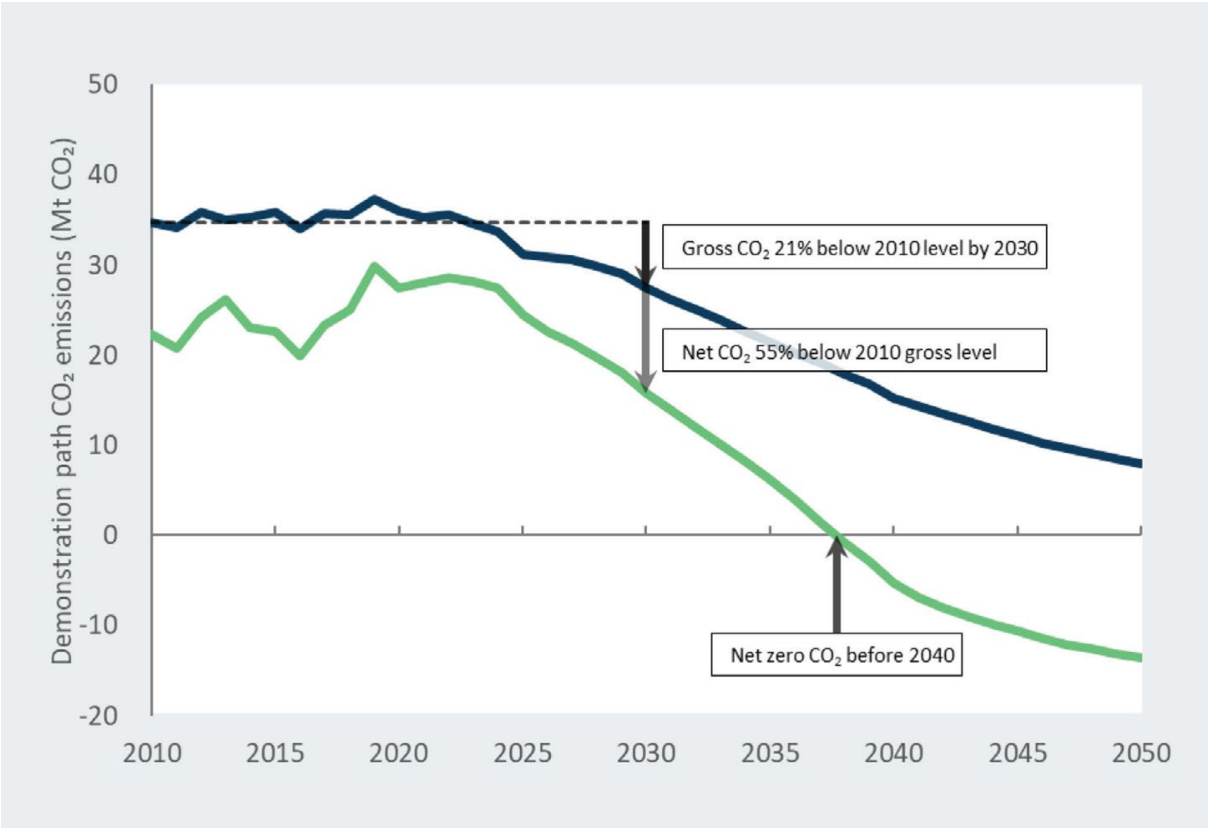


Figure 9.4: Gross and net carbon dioxide emissions under the demonstration path between 2010 and 2050

Source: Commission Analysis

9.4.2 Biogenic methane

37 Figure 9.5 shows that the reductions in agricultural methane in the demonstration path for our emissions budgets put us just outside the IPCC's interquartile range at 2030. Figure 9.5 also shows that our most conservative scenario puts us on track to be within the IPCC interquartile range by 2050. Our most ambitious scenario puts us on track outperform the IPCC range.

38 The Act sets targets for reductions in biogenic methane, rather than just agricultural methane. Our analysis has shown Aotearoa can make large reductions in biogenic methane emissions from waste. If reductions from waste are included, our demonstration path would lead to reductions in total biogenic methane between 2010 and 2030 of 12%.

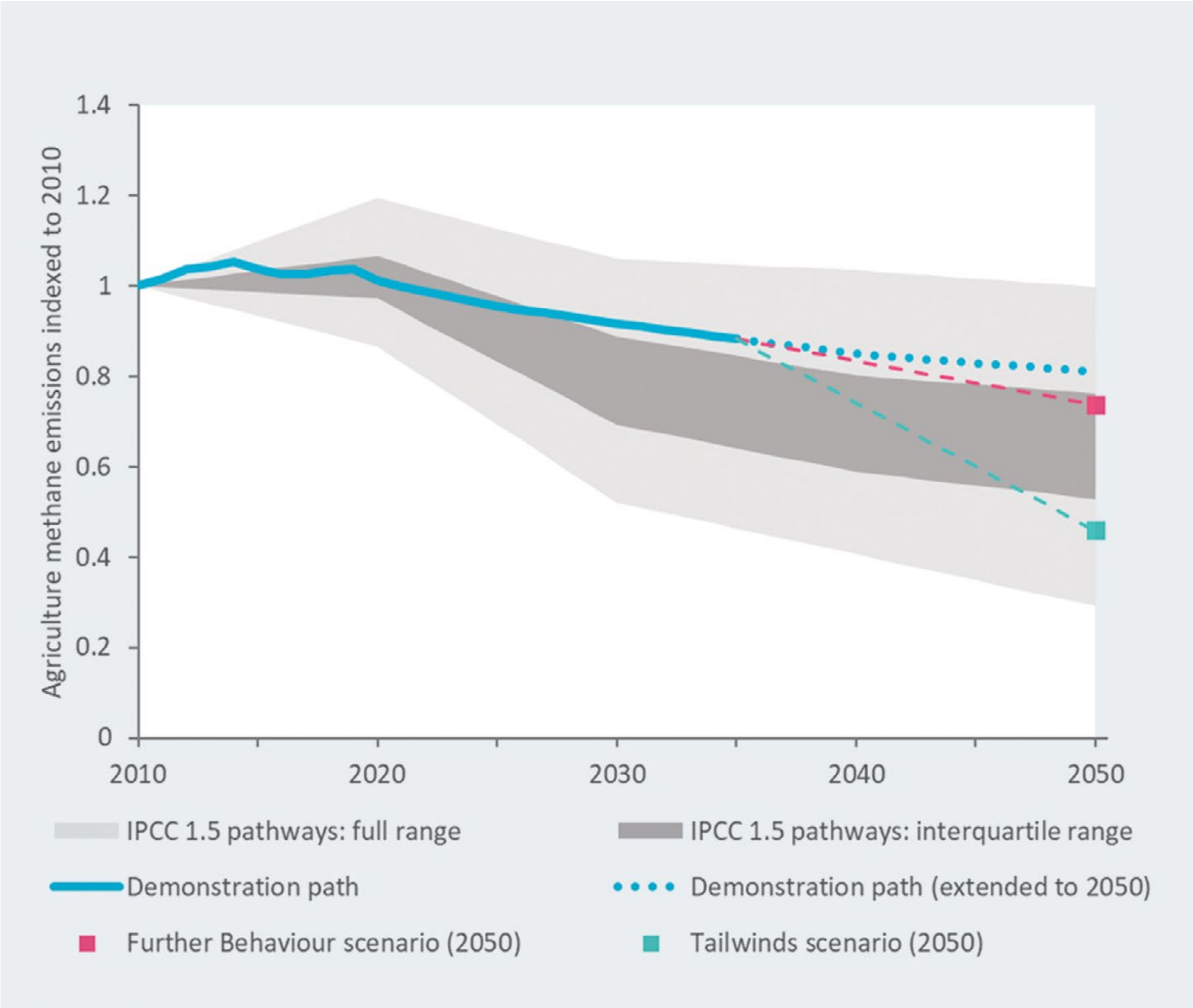


Figure 9.5: Reductions in agricultural methane in the demonstration path for the first three emissions budgets. Also shown are the modelled reductions in agricultural methane in 2050 under our Further Behaviour and Tailwinds scenarios.

Source: Commission Analysis

9.4.3 Nitrous oxide

39 The demonstration path sees reductions in nitrous oxide between 2010 and 2030 of 3%, which is inside the IPCC's interquartile range. This path also puts nitrous oxide reductions on track to reach the lower emissions end of the IPCC interquartile range by 2050.

9.5 Overall domestic contribution to the global 1.5°C effort

40 Overall, our assessment is that our recommended emissions budgets are compatible with the 2050 targets and the requirements of the Act, and with contributing to the global effort to limit warming to 1.5°C above preindustrial levels.

41 The Commission will have an ongoing role reviewing the 2050 targets in the future to make sure that the targets remain compatible with contributing to the global 1.5°C effort in light of changing global circumstances and new knowledge.

Chapter 10

Ngā Ture – Hei pouārahi i ngā whāinga tahua tukunga hauwaro me ngā paetutuki 2050
Rules for measuring progress towards emissions budgets and 2050 targets

Summary

As part of its role, the Commission has a responsibility to monitor progress towards meeting the emissions budgets and the 2050 target. To do this, we have developed and recommended accounting rules.

Our priority is to ensure accuracy and integrity in accounting and reporting. We want to make sure Aotearoa is responsible for its emissions and can track genuine gains.

We have made several choices to achieve this. This chapter outlines these choices and explains how the Commission has developed its rules for measuring progress. These rules have also been used in developing our recommended emissions budgets.

Greenhouse gas accounting – consumption or production based?

One of the most fundamental choices in greenhouse gas accounting is whether to calculate emissions on a production or a consumption basis. We have chosen production-based accounting, using the Greenhouse Gas (GHG) Inventory, because the Inventory provides the most comprehensive and robust emissions estimates for Aotearoa.

We have heard feedback that we should be using consumption-based accounting. This has been considered but consumption-based emissions estimates do not cover important emissions sources and sinks such as forests and are just being developed for Aotearoa. We recognise the usefulness of applying a consumption lens to think about emissions so have recommended that consumption-based emissions estimates continue to be prepared and continually improved, as a complement to the GHG Inventory.

Accounting for land emissions

It is important to adopt a robust approach for accounting for land-based emissions, because of forests' role as a sink and source of emissions in Aotearoa. There are two frameworks to choose from – an activity-based or a land-based approach.

The Commission has recommended a modified activity-based approach, including averaging for post-1989 forests. This focuses on the impact people's decisions have on emissions now and into the future, rather than rewarding or penalising decisions made in the past. It is the same as the approach that will be used in the first Nationally Determined Contribution (NDC) for Aotearoa.

We have a large area of forests that produce timber in Aotearoa, which are cut down at regular intervals. Averaging accounting provides steady and predictable emissions estimates for these forests that reflect their enduring, long-term effect on carbon stocks, rather than temporary fluctuations.

Future work to improve accounting for land emissions

We recommend that the Government improve accounting in the future. This should include developing methods to extend accounting to carbon emissions and removals by peat soils, small lots of trees and vegetation; sound and transparent methods to account for voluntary mitigation and offsetting claims; and improving accounting for harvested wood products.

Changes in our final advice

We have strengthened our advice on further work the Government should do to improve accounting. We heard strong support for this from a range of submitters.

Based on interest from stakeholders, we have also included more explanation of how we have considered emissions from international transport, and outlined the Commission's view of how method updates to the GHG Inventory should be addressed when assessing progress towards meeting emissions budgets.

Introduction

1 'Rules for measuring progress' refers to the system of accounting for greenhouse gas emissions that will be used to track the progress Aotearoa makes towards emissions budgets and the 2050 emissions reductions targets (2050 targets).

2 In Aotearoa, various emissions accounting methods are already in use, for example to prepare *New Zealand's Greenhouse Gas Inventory* (the GHG Inventory), to track the Nationally Determined Contribution (NDC) and other targets, and to produce emissions accounts that align with economic statistics. Our task is to determine which of these existing methods are best suited for setting emissions budgets and deliver the 2050 targets.

3 In this chapter, we first outline our role and approach to thinking about accounting for emissions budgets and the 2050 targets. We then discuss accounting choices related to:

- Production- and consumption-based emissions estimates.
- Accounting for land emissions. By 'land emissions', we mean emissions and removals from land sources and sinks such as forests, vegetation, soils, and wetlands. This does not include any direct agricultural emissions such as those from livestock or fertiliser.
- Voluntary offsetting and carbon neutral claims.

4 Many submissions noted that greenhouse gas emissions accounting is a complex and unfamiliar topic. Nevertheless, there was strong support for ensuring that emissions budgets are accounted for with integrity and in a way that holds Aotearoa responsible for its emissions.

10.1 Greenhouse gas accounting for emissions reduction targets

5 The methods used to calculate and attribute the amount of greenhouse gases emitted or removed from the atmosphere over time are a critical component of effective climate policy. Robust and accurate emissions accounting is essential for:

- setting emissions reduction targets
- monitoring and evaluating progress towards meeting targets
- judging compliance at the end of a target period

6 A key purpose of the emissions reduction targets that countries set themselves is to drive actions to reduce human impacts on the climate. The accounting methods for these targets need to deliver useful data to inform emissions reduction efforts, and influence which reduction activities are prioritised. This link to policy and to driving behaviour change is why emissions accounting for targets may differ from the methods used for national greenhouse gas inventories.

10.1.1 Our role

7 We must advise on the rules that should apply to measuring progress towards meeting emissions budgets and the 2050 targets. Our recommended accounting rules have been used to develop the recommended emissions budgets. We will also use them to report on the Government's progress towards emissions budgets, starting in 2024.

8 This advice relates to the first three emissions budgets, covering 2022-2035. In 2024, we will advise on the fourth emissions budget covering 2036-2040. At that time, we will have the opportunity to revise our recommendations on accounting for the second and third emissions budgets, if this is warranted by developments in knowledge or accounting methods.

10.1.2 Objective and principles to guide accounting choices

9 We have examined the accounting rules for emissions budgets from a first principles basis. To do this, we have set a high-level objective for emissions budget and 2050 targets accounting:

> *A robust, transparent accounting system that tracks genuine environmental gains while balancing completeness with practicality.*

10 We have also defined a set of principles underneath the high-level objective, to provide guidance on how to reach this goal. The principles help ensure we take a coherent approach to the range of issues covered by target accounting.

11 Accounting for emissions budgets and the 2050 targets should:

1. seek to cover all material human caused emissions sources and sinks;
2. be grounded in robust science and evidence;
3. send a clear signal for climate action;
4. be accurate and reduce uncertainty as far as practicable;
5. be transparent, practical and acceptable; and
6. be consistent and maintain the integrity of the targets.

12 Together, the objective and principles provide a framework to allow options and trade-offs to be understood and to inform decisions about accounting rules, including where the principles need to be balanced against each other. For more information on the reasoning for and meaning of each principle, see *Chapter 3: How to measure progress* in the *2021 Supporting Evidence*.

10.2 Production- or consumption-based greenhouse gas accounting

13 One of the most fundamental choices in greenhouse gas accounting is whether to calculate emissions on a production or a consumption basis.

14 Until now, production-based accounting has been the only option for tracking the country's emissions. In 2020 consumption-based emissions estimates were produced by StatsNZ for the first time. We have assessed these two approaches using the objective and principles for accounting set out above.

15 Our advice is that production-based estimates are more suitable for accounting for emissions budgets and the 2050 targets.

16 The production approach records emissions at the point where human activity causes their release to the atmosphere. It attributes the emissions to the original producer of the emission, for example a manufacturing plant burning coal in a boiler. Production-based accounting is the standard method used by countries for setting and tracking emissions reduction targets, and it is used to compile the national inventory for Aotearoa.

17 The consumption approach accounts for emissions 'embodied' in a good or service that result from the entire supply chain required to produce that good or service for final use. For example, in the case of vehicle transport, this approach would record all the emissions produced from making the materials, such as the metals, and from the assembly of a car, as well as the emissions from fossil fuel combustion generated when the car is driven. Under the consumption approach, Aotearoa would not be responsible for the emissions embodied in the goods it exports but would be responsible for those embodied in imports.

18 The consumption emissions estimates for Aotearoa are at an early stage of development and have significant downsides. These include:

- Lower coverage of material sources and sinks. The consumption estimates exclude land emissions, due to the technical difficulty and lack of methods for attributing land emissions to industry sectors and final use.
- Accuracy and uncertainty are negatively affected by assumptions made about emissions embedded in imports from other countries. For example, StatsNZ calculates the consumption estimates assuming imports have the same emissions content as outputs of the same industry in Aotearoa.
- Lack of an internationally agreed standard for calculating and reporting consumption emissions. This would make it difficult to compare the country's targets and progress in reducing emissions against those of other countries.
- Using consumption-based emissions estimates for accounting would differ from the analysis used to set the 2050 targets. This could undermine the integrity of the targets.

19 These challenges make the consumption estimates unsuitable for use as the basis for accounting for emissions budgets and the 2050 targets at this time.

20 We acknowledge, however, the strong interest in consumption emissions and consumption-based approaches expressed in submissions. Many submitters thought consumption-based emissions estimates give a truer representation of the overall impact of emissions caused by Aotearoa, and were more useful to inform consumption decisions, particularly by individuals.

21 We have taken on board this feedback by more strongly incorporating a consumption lens into our advice on policy direction. For example, we have included specific recommendations on increasing the circularity of the economy, on the bioeconomy and on buildings and urban form in our advice on the direction of policy for the emissions reduction plan.

22 We have also strengthened our recommendation on rules for measuring progress to more clearly highlight that consumption-based emissions estimates should continue to be prepared and continually improved. They are a useful complement to the national inventory. We intend to monitor and use them to provide insights into the wider impact Aotearoa has on global emissions, carbon-intensive supply chains and trade flows.

10.3 Accounting for land emissions

23 We need to decide on a framework for land emissions accounting, given the significance of these emissions for Aotearoa. Given the role forests can play meeting the net zero target in 2050 and beyond, a fit-for-purpose accounting framework is key.

24 There are two frameworks for land emissions accounting currently used in Aotearoa:

1. a 'land-based' approach that uses 'stock change' accounting for both pre-1990 and post-1989 forests (see Box 10.1). This is used in the GHG Inventory for UNFCCC reporting; or
2. a modified 'activity-based' approach that uses 'averaging' accounting for post-1989 forests. This is used in the country's NDC.

25 For the definition of a forest in greenhouse gas accounting in Aotearoa see *Chapter 3: How to measure progress* of the *2021 Supporting Evidence*. Smaller areas of trees not meeting the forest definition are mostly accounted for as biomass on grasslands or croplands.

10.3.1 A land-based approach, as used in the national inventory

26 'Land-based' accounting aims to cover all emissions and removals from soil, trees, plants, biomass, and wood products. Emissions and removals by forests are reported in a way that corresponds to tree growth, harvest and deforestation – known as stock change accounting. By trying to record emissions and removals when they occur, it gives a truer representation of 'what the atmosphere sees'.

10.3.2 A modified activity-based approach, as used in the NDC

27 This accounting approach uses a smaller subset of activities and land types than the land-based approach. It focuses on significant sources and sinks whose emissions can be most affected by changes to people's behaviour now. It does this by filtering out the effects of past actions, such as regrowth of previously harvested native forests.

28 This approach will be used for the country's first NDC. The NDC will account for land areas and uses corresponding to the *afforestation, reforestation, deforestation* and *forest management* activities accounted for in the country's 2020 target covering the second commitment period of the Kyoto Protocol, 2013-2020. It is not yet known if the NDC will include the land areas or uses related to the activities of *cropland management, grazing land management, revegetation* or *wetland drainage and rewetting*.

29 The NDC will use 'averaging' to account for afforestation and reforestation of post-1989 forests. This approach smooths out the cyclical peaks and troughs in emissions due to harvesting of post-1989 exotic production forests. It does this by accounting for removals only up until the forests reach their long-term average carbon stock. This occurs around 23 years after planting for a production pine forest on a 28-year rotation (if harvested wood products are included). Averaging focuses on the long-term effect of these forests on carbon stocks.

Box 10.1: Pre-1990 and Post-1989 forests

The country's activity-based target accounting has given rise to two broad classifications for forests:

- **Post-1989** forests are those established after 31 December 1989.
- **Pre-1990** forests are those established before 1 January 1990.

These classifications are due to the 1990 base year Aotearoa agreed to in the Kyoto Protocol. Activities occurring from 1990 onwards are 'additional' rather than business as usual.

In this approach, only emissions and removals due to additional human activities are counted. This means that emissions from *deforestation* are counted for all forests, but removals from *afforestation* and *reforestation* are only counted for post-1989 forests. *Forest management* aims to track the impact on emissions from changed management of pre-1990 forests.

The 1990 base year has been devolved into policy through the New Zealand Emissions Trading Scheme (NZ ETS). It contributes to a sense of unfairness among pre-1990 forest owners, including Iwi/Māori. This is because there is a deforestation liability constraining land-use change, but no reward for forest growth. This outcome results from the approach's focus on behaviour change now, rather than penalising or rewarding past actions.

With this approach, there is still some potential for flexibility and recognition of pre-1990 forests:

- *Forest management* in theory enables counting of increased carbon stocks due to improved management. However, this is difficult to do robustly and has not yet been devolved from target accounting into the country's policies.
- Both target accounting and NZ ETS rules allow avoidance of deforestation liabilities if an equivalent forest is planted elsewhere.
- Emissions reduction policies for forests should broadly match target accounting, so costs sit with emitters rather than taxpayers. However, there is scope for policies to differ from target accounting. These differences can be justified for reasons of practicality or by other policy goals, if the benefits of doing so outweigh the cost to the taxpayer. In this context, consideration could be given to:
  - encouraging improved management of pre-1990 forests, even if enhanced carbon storage is not counted for targets, or
  - providing more flexibility for Māori owned land to avoid locking in historical disadvantages.

Finally, averaging reduces the differences between the two forest types. Under averaging, post-1989 forests that reach the long-term average carbon stock are treated similarly to pre-1990 forests, as further business as usual growth and harvesting are not accounted for.

10.3.3 Assessment of the land emissions accounting frameworks

30 Overall, we consider that the NDC's modified activity-based framework for land emissions accounting, with a 1990 base year and 'averaging' for post-1989 forests, is a more suitable accounting approach for measuring progress towards emissions budgets and the 2050 targets.

31 We assessed the two options outlined previously against our accounting principles, with key differences discussed below. A full analysis is provided in the *Chapter 3: How to measure progress* of the *2021 Supporting Evidence.*

32 **Coverage of material emissions sources and sinks:** The land-based approach's main advantage is that it covers more sources and sinks than the modified activity-based NDC approach. The NDC currently only includes forest-related activities, although its scope could be expanded.

33 **Sending a clear signal for climate action:** The land-based approach performs worse against this principle than the modified activity-based approach, primarily due to its use of stock-change accounting for forests. This results in significant fluctuations in net emissions due to harvest cycles. These are temporary and obscure underlying, more enduring trends, confusing policy and price signals about the action needed. These fluctuations also make it easier to reach net zero but difficult to maintain it after 2050. As shown in Figure 10.1, government projections indicate that after a peak in removals around 2050, harvesting would cause forestry emissions to increase. In the NDC's modified activity-based accounting, averaging smooths out the fluctuations. This makes it clear that Aotearoa needs to plant new forests and reduce deforestation to contribute to longer-term emissions reductions.

34 **Consistent and maintains integrity of targets:** Activity-based accounting is consistent with the analysis that informed the 2050 targets. Using land-based accounting would reduce the effort to achieve the targets, undermining the commitment made when it was set.

35 **Accuracy and reducing uncertainty:** The land-based approach results in emissions estimates with higher overall uncertainty. Reasons for this include: having to combine carbon stock gains and losses, each with their own uncertainty, to determine net change; estimating uncertain factors related to the management of production forests such as harvest age and area; and including some land areas with highly uncertain emissions factors such as wetlands. As an example, pre-1990 production forests introduced uncertainty of ±61.4% into the inventory land emissions estimates for 2019. Netting off significant amounts of land emissions with high uncertainties against gross emissions with much lower uncertainties is problematic.

36 A number of submitters queried our conclusion to recommend the modified activity-based accounting framework for land emissions. This was mainly on the basis that it leaves out several emissions sources and sinks. We recognise that this is a disadvantage of the recommended approach, but do not think it outweighs the land-based approach's significant disadvantage of stock-change accounting for forests, particularly for exotic production forests. The coverage of the modified activity-based approach can also be expanded. We comment on future work for this purpose in *Section 10.5* and have also included direction to the Government in our recommendation about improving land emissions accounting.

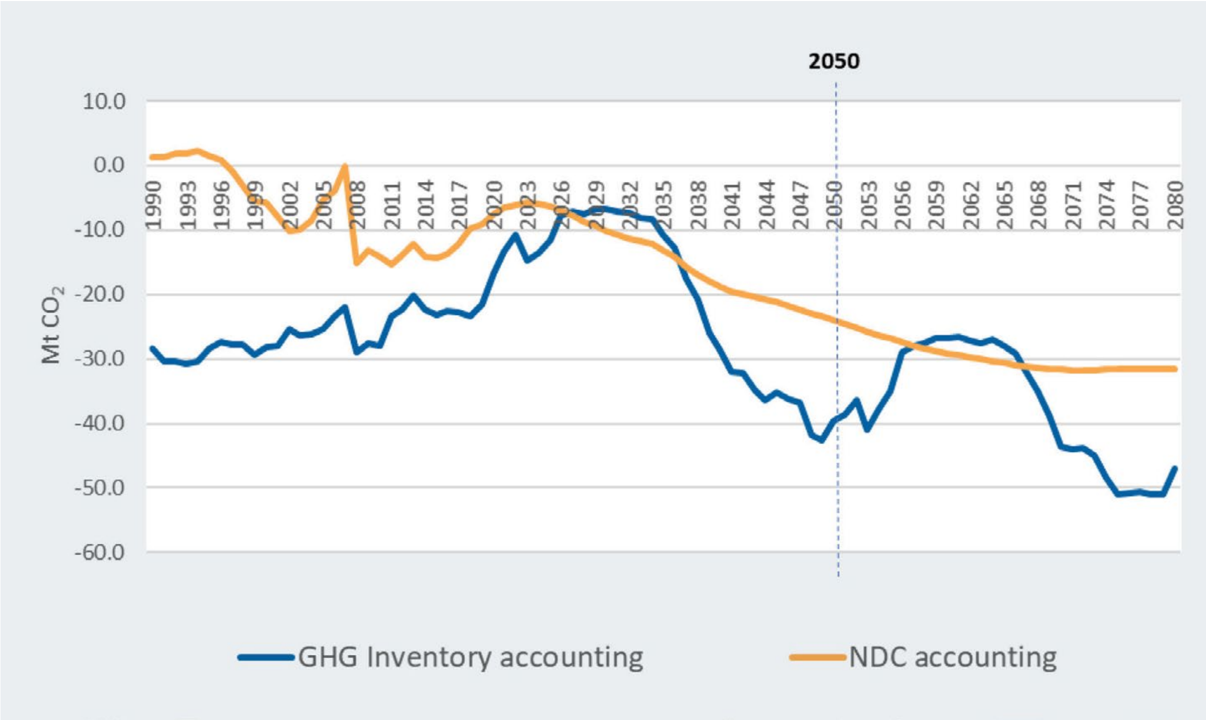


Figure 10.1: Comparison of national forest net emissions using New Zealand's Greenhouse Gas Inventory (stock change) and NDC (averaging) accounting.

Source: MPI October 2020 updated 'with existing measures' projection, $35 emissions price

10.4 Detailed choices within the modified activity-based accounting framework

37 We have assessed detailed elements of the NDC accounting approach to identify if it is fit for purpose for emissions budget accounting. This assessment is summarised below.

38 The NDC accounting is not yet fully defined. It may not be confirmed until late 2024 when Aotearoa is due to submit its first *Biennial Transparency Report* under the Paris Agreement. This incomplete definition limits what we can consider for this first package of advice. It is not feasible to use some elements of the NDC accounting approach in accounting for emissions budgets as we do not currently have enough information on how they work, or they do not yet exist.

10.4.1 Forest management

39 *Forest management* is the part of the NDC accounting system where the impact on carbon stocks of management practices affecting pre-1990 forests is counted. It is accounted for by estimating additional emissions and removals in pre-1990 forests above or below business as usual due to changes in forest management. It involves setting a reference level, based on a future projection of what would have happened with no change in management. Using counterfactual projections such as this has inherent accuracy and uncertainty challenges, with risks of both over- and under-estimation.

40 The Government has not yet defined the reference level that will be used for the NDC. We have been unable to assess how risks will be managed and how the reference level lines up against our accounting principles. This means we cannot include *forest management* in emissions budget accounting now. We will revisit this in 2024 to consider its inclusion in updated advice for the second and third emissions budgets.

41 Despite this limitation, we value the management of pre-1990 forests to enhance carbon stocks and deliver other benefits such as biodiversity. We urge the Government to encourage better management of these forests (see *Chapter 18: Policy direction for forests and other carbon stocks*), even if the carbon impacts are not accounted for in emissions budgets.

10.4.2 Harvested wood products

42 When a forest is harvested, some of the carbon is stored for a time in wood products, not released into the atmosphere immediately. Harvested wood products (HWPs) is the part of the accounting system that captures this effect and the benefit of using timber in the built environment.

43 HWPs for post-1989 forests are likely to be incorporated into averaging through adjusting the long-term average carbon stock. HWPs for pre-1990 forests are likely to be accounted for in the forest management reference level. As forest management cannot be included in emissions budget accounting now, there is no practical way to account for HWPs for pre-1990 forests in emissions budgets either.

10.4.3 Carbon equivalent forests

44 This provision allows pre-1990 forests that meet specified conditions to be converted to another land use without being classified as deforestation, if a new forest that would reach an equivalent carbon stock is planted elsewhere. We have not identified material integrity risks with this provision.

10.4.4 Natural disturbances

45 The country's first NDC will include a 'natural disturbances' provision to manage risks of natural events radically affecting land emissions. The provision can be invoked after a natural disturbance, e.g. a volcanic eruption, to allow the emissions from the disturbance to be excluded from accounting.

46 The provision is expected to follow the Intergovernmental Panel on Climate Change's (IPCC's) *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol,* but the details of how it will work are not yet clear. The risks of adopting the provision for emissions budgets before knowing the rules can be managed, as we can control whether it is invoked through our annual monitoring reports.

10.5 Future work on accounting for land emissions

47 In accounting for land emissions, the options available to us are limited to the methods that are used by government now. We must take the emissions data already produced by other government agencies, as the Commission does not have capability to produce these statistics itself.

48 In considering the rules for measuring progress and feedback from submitters, we identified scope to improve government accounting methods. We have revised our recommendation to provide more direction to the government on this. The identified improvements would improve land emissions estimates and enable us to better consider new options when we revisit advice on accounting in 2024, as part of providing advice on the fourth emissions budget.

49 First, government should consider how to appropriately account for the effect of using biomass for energy on the lifetime of carbon stored in forests and wood products. This was raised in some submissions, with questions about whether using biomass for energy actually reduces emissions compared to burning fossil fuels like natural gas, or if bioenergy is really carbon neutral.

50 Increasing the use of biomass, such as harvest residues and pulp logs, for biofuels can reduce carbon stored in above ground biomass or in the harvested wood products pool. This still leads to an overall emissions reduction as the emissions from avoided fossil fuel use are larger and longer lasting than the increase in forest and wood product emissions. Nevertheless, these effects should be factored into the emissions accounting for forests.

51 A second area for further work is looking at how to increase the coverage of target accounting. The development of methods to account for carbon in organic soils such as peat, and biomass on grasslands such as small lots of trees and regenerating vegetation should be prioritised. These are among the most significant emissions sources and sinks not currently covered (see Figure 3.3 in *Chapter 3: How to measure progress* of the *2021 Supporting Evidence*). There was also strong support in consultation feedback to start accounting for these in targets. Some stakeholders were also interested in accounting for carbon in soil more generally, but the evidence base for this is currently weak as noted in *Chapter 18: Policy direction for forests and other carbon stocks*.

52 We also acknowledge the ongoing interest from stakeholders in using the land-based approach to accounting from the national inventory. As noted earlier, our main concern with the land-based approach is related to stock-change accounting for exotic production forests. We remain open to the possibility of using the land-based approach in accounting for other sources and sinks.

53 We would, however, need to understand more about how this might work, including whether any problems would arise from combining land-based accounting with modified activity-based accounting for forests. To do this, we would need to draw to an extent on land accounting expertise and analysis from within the government Ministries who prepare the national inventory and other emissions reports.

54 For this further work on expanding coverage we would therefore like the Government to look at both the activity-based and the land-based options. We encourage this to be done with consideration of the Commission's objective and principles to guide accounting choices. In particular, it is important to think about the role of emissions budgets and the 2050 targets in driving actions to reduce human impact on the climate, and the principle on sending a clear signal for climate action.

55 Finally, if accounting is expanded beyond the scope used to set the 2050 targets, this should trigger a review of the target to ensure its integrity. For example, if a land accounting scope change makes the target significantly easier to achieve, this would justify increasing the ambition of the 2050 net zero target for long-lived gases. This is a further reason why including new sources and sinks in the rules for measuring progress is most appropriately considered in 2024, when the 2050 targets can reviewed and there is an opportunity to update the second and third emissions budgets.

10.6 Voluntary offsetting and carbon neutrality

56 Voluntary offsetting refers to mitigation beyond government requirements for the purpose of making 'carbon neutral' or 'net zero' claims. This could include the purchase and cancellation of emissions units such as New Zealand Units (NZUs). It aims to compensate for the emissions footprint associated with an organisation, product or service such as air travel.

57 There are several requirements that are widely recognised as necessary to enable a credible carbon neutral claim. One is that voluntary offsetting should contribute to *additional* emissions reductions or removals. This requirement means that voluntary offsetting should deliver something extra on top of what would occur anyway due to business as usual activities, including those due to government policies like the NZ ETS. Another is the avoidance of double claiming, a type of double counting where more than one entity counts an emissions reduction against an emissions reduction target.

58 In Aotearoa the issues of additionality and double claiming are linked. It is not possible to guarantee that an emissions reduction or removal is additional, unless it is not double claimed against the country's emissions reduction targets. In practice, this means that to deliver additional mitigation in any NZ ETS sector whose emissions are in scope for target accounting, both an NZU must be cancelled and an adjustment made to the accounting for targets, emissions budgets and the NDC.

59 This requirement is due to the NZ ETS, which is managed in way that takes account of emissions from the whole economy, including from agriculture and forests that are not covered by the NZ ETS. If over time the country's total net emissions recorded in the Inventory are lower than what is needed to meet emissions reduction targets, more units will likely be added to the NZ ETS cap via the annual cap updates. This adjustment is to keep Aotearoa on track to achieve its targets, to avoid imposing more cost than necessary on the economy and New Zealanders.

60 If NZUs were cancelled for voluntary offsetting without removing the same volume from the target, it would simply make it appear that the NZ ETS is driving more reductions than necessary to meet the targets. The NZ ETS cap would then be adjusted upwards, permitting more emissions elsewhere in the economy, negating the impact of the voluntary mitigation.

61 The Government is considering what guidance to provide about voluntary offsetting from 2021 as Aotearoa moves to Paris Agreement accounting practices. It has not yet made any decisions about whether to allow adjustments against emissions budgets when NZUs are cancelled for the purpose of voluntary offsetting. Nor has it decided whether carbon neutral claims can be made when an NZU is cancelled.

62 The Government should explore options for enabling voluntary mitigation and clarify the types of claims that can be made about it in Aotearoa. This should aim to encourage the desire for voluntary action of the private sector, local governments and other institutions for the benefit of the climate. Clarification will also be needed on how the Government's carbon neutral programme will operate for accounting.

63 We consider that, given the way the NZ ETS currently operates, if there is no adjustment against targets when an NZU is cancelled, it is not legitimate to claim that any additional emissions reduction or removal has occurred. This is in line with our objective and principles for accounting that relate to transparency, consistency and tracking genuine environmental gains.

64 Feedback from submissions indicated that voluntary offsetting is of high interest to a range of people, businesses and institutions. This is both from the perspective of those who want to undertake voluntary offsetting for carbon neutral claims, as well as of those who question the validity of such claims or activities. This is another area where the Government should work to clarify what constitutes sound and robust accounting practices that track genuine progress in reducing emissions.

10.7 Legislative requirements, including out-of-scope sources and sinks

65 The Climate Change Response Act 2002 (the Act) sets out the framework for the system of emissions budgets to set the path to the 2050 targets, including some of the parameters for accounting. These relate to the scope of emissions budgets, which excludes emissions from international aviation and international shipping and from Tokelau, and that emissions budgets be expressed as a net quantity of carbon dioxide equivalent, calculated in accordance with international climate change obligations.

66 A significant number of submitters called for emissions budgets and the 2050 targets to include emissions from international aviation and shipping. This exclusion is set in law, so the Commission does not have the ability to include these emissions in emissions budgets now unless Parliament amends the legislation.

67 Like the submitters, we think that these emissions are significant and part of the overall emissions footprint of Aotearoa that should not be ignored. They are currently calculated and reported as a memo item in the national inventory. They also come under the jurisdiction of the International Civil Aviation Organization and the International Maritime Organization, which have or are developing measures to reduce or offset these emissions.

68 As required by the legislation, in 2024 we will review whether these international transport emissions should be included in the 2050 targets. In the meantime, we have tested to make sure that our recommended emissions budgets allow for Aotearoa to meet a 2050 net zero long-lived gas emissions target including international aviation and shipping emissions, in case a decision is made in future to include these in the 2050 targets.

69 A further out-of-scope issue raised by several submitters was carbon in the ocean ('blue carbon'). The ocean has a role as a source and sink of emissions, but limited data exists about this for the marine environment around Aotearoa. Furthermore, there is no internationally agreed greenhouse gas accounting guidance in respect of the ocean. More work needs to be done on the scale and permanence of these emissions and removals and how they could be accounted for before they could be included in emissions budgets. We recognise this is an important issue and will follow developments including any IPCC assessments or accounting guidance relevant to the ocean.

70 Overall, we maintain the view, expressed in our *2021 Draft Advice for Consultation*, that no changes to the Act are warranted at this stage, given the high bar for recommending legislative change. A more detailed explanation of some of these issues is provided in *Chapter 3: How to measure progress* in the *2021 Supporting Evidence*.

10.8 Method updates to the national inventory

71 Another issue raised during consultation relates to challenges that method updates in the GHG Inventory may create for achieving emissions budgets.

72 Emissions budgets are expressed as a specific, absolute volume of net emissions. This potentially creates challenges for maintaining consistency and integrity in accounting for emissions budgets over time, given that the national inventory is regularly updated as scientific knowledge evolves. We note that this is not a new issue, as the current and previous international targets adopted by Aotearoa have also been set as a fixed amount of emissions.

73 We heard concerns that these method updates could prevent the Government from meeting emissions budgets, through no fault of its own. Method updates could also make achieving emissions budgets easier, with no additional effort. Ideas raised to manage this issue included holding back on significant updates to the national inventory or presenting two sets of emissions estimates, with the one used for judging compliance with emissions budgets excluding method updates.

74 These options have significant downsides. For example, delaying science-based method updates is inconsistent with international obligations to continually improve the national inventory. Reporting two sets of emissions estimates in the inventory could create confusion among stakeholders. There might also be extra resource demands on the already limited resources within Government for preparing the GHG Inventory.

75 Another approach would be for the Commission to address inventory updates in its monitoring reports. We would assess the extent to which changes in emissions estimates are caused by method updates, as opposed to genuine progress or lack of progress in reducing emissions. This could then be factored into the Commission's advice and commentary on the adequacy of the emissions reduction plan, including in our report at the end of each emissions budget period.

76 On balance, we consider that accepting the risk of inconsistencies between an emissions budget and the national inventory emissions estimates is preferable to delaying science-based updates to the inventory or preparing two sets of estimates. We intend to proceed with our monitoring responsibilities on this basis. More information on this issue can be found in *Chapter 3: How to measure progress* of the *2021 Supporting Evidence*.

Recommendation 5

The rules for measuring progress towards emissions budgets and the 2050 targets

We recommend the following package of rules for measuring progress:

a. Use of the production-based approach from *New Zealand's Greenhouse Gas Inventory* as the basis for accounting for emissions budgets and the 2050 targets.
b. Use of the modified activity-based framework for land emissions accounting, with a 1990 base year and 'averaging' for post-1989 forests, substantially aligning emissions budget accounting with the approach used for accounting for the Nationally Determined Contribution (NDC).
c. Within the modified activity-based land emissions accounting framework, to:
    i. Include the land areas and uses corresponding to afforestation, reforestation, and deforestation, as confirmed for the first NDC.
    ii. Exclude forest management, the activity relating to the impact of management practices on pre-1990 forest carbon stocks. This is despite its inclusion in NDC accounting because the forest management reference level has not yet been set for the period through to 2030 and we have been unable to assess how it manages accuracy and uncertainty risks. Improved management of pre-1990 forests nevertheless remains important and should be encouraged through policy.
    iii. Include harvested wood products (HWPs) from post-1989 forests, but not HWPs from pre-1990 forests because they are accounted for as part of forest management which is excluded from emissions budget accounting.
    iv. Include a natural disturbances provision, aligned with the first NDC and the 2013 IPCC Kyoto Protocol Supplement. The Commission will judge whether to invoke the provision in its reports that monitor progress each year and at the end of an emissions budget period.
d. From 2021, if the Government allows voluntary offsetting for carbon neutral claims to take place in Aotearoa through cancelling New Zealand Units (NZUs), adjustments corresponding to the amount of NZUs cancelled must be made to the relevant emissions budget, or to the inventory, to avoid the emissions reductions claimed from being negated by increases to the New Zealand Emissions Trading Scheme (NZ ETS) cap.

We also recommend that the Government undertake the following work to improve emissions estimates and broaden the options available for emissions budgets accounting in future:

e. Continue to produce and improve annual reports on national consumption emissions estimates
f. Develop an appropriate method to reflect changes in carbon stored in above ground biomass and harvested wood products due to increased use of biomass for energy
g. Develop methods for tracking emissions and removals by sources and sinks not yet included in the country's domestic or international target accounting. This should include:
    i. Prioritising development of methods to account for carbon in organic soils (such as peat) and biomass (such as small lots of trees and regenerating vegetation), with a view to allowing them to be included in future target accounting.
    ii. Examining the feasibility of using the land-based approach in accounting for targets and emissions budgets for sources and sinks other than production forests, while managing the uncertainty and emissions fluctuations from the harvest cycles of production forests.
h. Develop sound and transparent practices for accounting for domestic voluntary mitigation and offsetting claims, in relation to the NZ ETS, emissions budgets and NDCs.

Part 2

Emissions reduction plan advice

The emissions reduction plan

The Government's role:

Under the Climate Change Response Act 2002, the Minister of Climate Change must prepare and make publicly available a plan setting out the policies and strategies for meeting the next emissions budget. This is known as the emissions reduction plan.

Each emissions reduction plan must include:

- Sector specific policies to reduce emissions and increase emissions removals
- A multi-sector strategy to meet emissions budgets and improve the ability of sectors to adapt to the effects of climate change
- A strategy to mitigate the impacts these measures will have on employees and employers, regions, Iwi/Māori, and wider communities, including the funding for mitigation action

In preparing the emissions reduction plan the Government must consider the advice received from the Climate Change Commission. However, the Government is responsible for drafting and implementing the plan, which provides the detailed strategy for meeting emissions budgets. In this way, the Government of the day remains accountable to the public for the policy choices it makes.

The Climate Change Commission's role:

The Commission is required to provide the Minister of Climate Change with advice on the direction of policy required in the emissions reduction plan for the next emissions budget period.

In developing this advice, the Commission must consider a wide range of matters, including likely economic effects, distributional impacts and latest scientific advice. The full list of considerations is included in *Chapter 3: The role of the Climate Change Commission*. The Government must consider the Commission's advice when preparing its emissions reduction plan.

As part of its ongoing monitoring role, the Commission must assess the adequacy of the Government's emissions reduction plan. This includes assessing the Government's progress implementing the plan and identifying any new opportunities to reduce emissions.

Chapter 11

Te Kaupapa – Kia whakawhanake tohutohu tukanga
Approach to developing advice on policy direction

1 Meeting emissions budgets and sustaining emissions reductions over the long term will require fundamental changes to the economy and society. Aotearoa will look different in 2050 than it does today.

2 Transitioning to a low-emissions Aotearoa will mean changes to the way energy is produced, the way people travel, the communities people live in, and the way land is used. It will involve changes to individual and corporate behaviour, changes to existing processes and ways of operating, as well as technological innovation.

3 The shift away from high emitting technologies, practices and behaviour will not happen all at once, but over the course of the coming decades.

4 In developing our advice on policy direction, we have drawn on international research showing that the best approach is to implement a comprehensive suite of climate policies.

5 Policies must target a range of different problems and can reduce emissions in a way that supports other goals. The transition to low emissions presents opportunities to contribute to health, freshwater quality, biodiversity, reducing existing inequities, and addressing historic grievances.

6 At the same time, policies that push against the goal of reducing emissions should be amended or removed.

7 Reducing emissions is not the only objective. The nature of the transition also matters. Aotearoa needs to transform in a way that maintains and builds wellbeing, and supports natural, social, and human capital. The transition also needs to endure over time, well beyond 2050.

11.1 Elements of an effective policy package

8 The Commission's overall vision is of a thriving, climate-resilient and low-emissions Aotearoa. Our approach to developing advice on policy direction for the Government's emissions reduction plan is summarised in Figure 11.1 below.

9 Our policy approach is informed by the Climate Change Response Act 2002 (the Act), and supports the principles that have informed our advice on emissions budgets – which are described in *Chapter 5: Recommended emissions budgets.*

10 Building on these foundations, our policy approach focuses on the importance of mutually reinforcing policies that can achieve and sustain emissions reductions in line with targets, and in a way that supports, maintains and builds wellbeing.

11 The elements of this policy approach sit within two broad categories. First is creating an enabling environment for socially acceptable climate policy. This is about the foundations that need to be put in place so that people can get behind and support efforts to achieve emissions budgets and targets. Second is driving the creation, and choice, of low-emissions options in different sectors and across the economy. Three main areas of policy intervention will support this.

12 In this chapter we discuss how these elements have guided our advice, and the rationale behind them. Our specific recommendations for the direction of policy in the Government's first emissions reduction plan are presented in the following chapters.

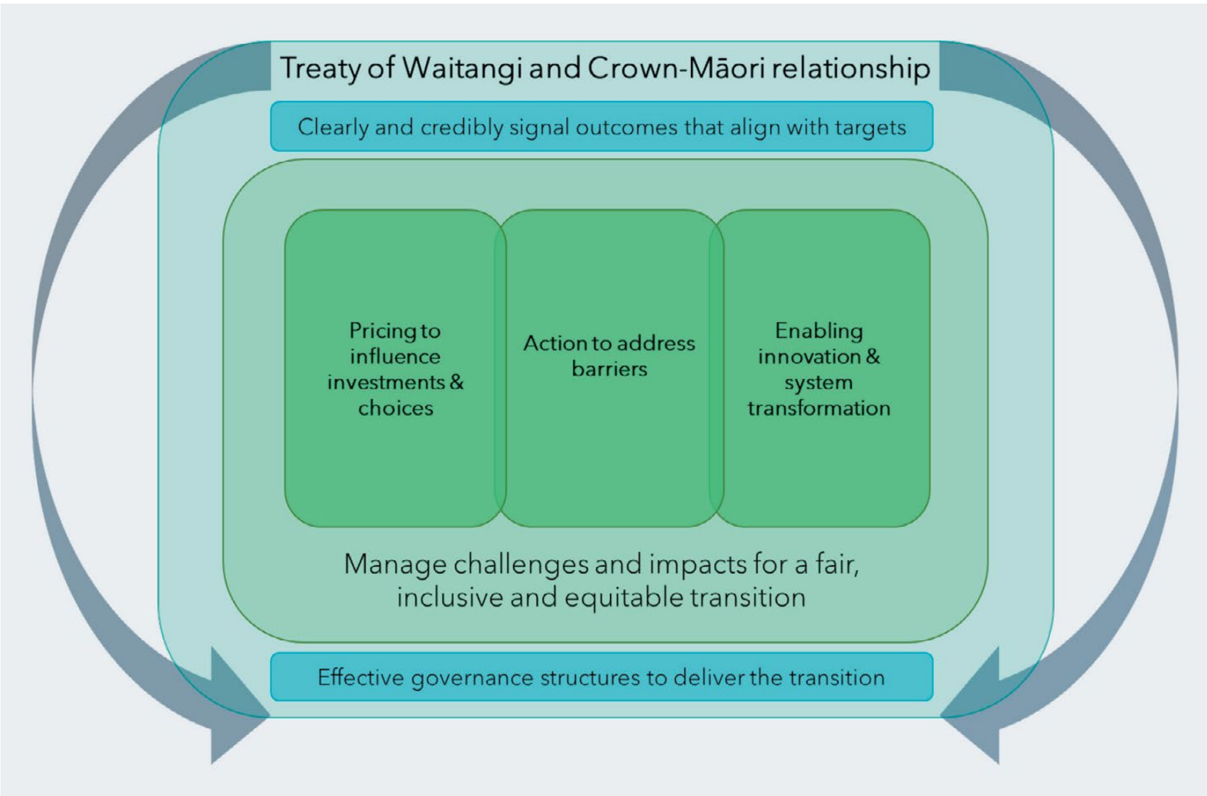


Figure 11.1: Elements of a comprehensive climate policy package

11.2 Creating an enabling environment

13 Achieving our vision will require an enabling environment that supports ambitious and enduring change. This means ensuring social, political, and institutional systems and structures are fit for purpose, because it is these systems and structures that create the conditions for behaviour and technological change.

14 There are four key areas in our framework that are important for creating an enabling environment, which are described in the following sections.

11.2.1 The Crown-Māori relationship

15 In Aotearoa, an enabling environment must be firmly rooted in The Treaty principles of partnership, participation, protection, and equity. These principles underpin the unique relationship between the Government and tangata whenua under Te Tiriti o Waitangi/The Treaty of Waitangi.

16 Te Tiriti o Waitangi/The Treaty of Waitangi is widely accepted to be a constitutional document that sets out principles that recognise the rights and interests of Māori and underpin the Crown-Māori relationship.

17 Submission feedback, and the recent *Hauora Wai 2575 Waitangi Tribunal Report 2019*, emphasise the importance of upholding the principles of Te Tiriti o Waitangi/The Treaty of Waitangi (see Recommendation 5, in *Chapter 12: Policy direction to create an enabling environment for change*).

18 In developing emissions reduction plans, the Government must take an approach that upholds Te Tiriti o Waitangi/The Treaty of Waitangi. This will support an equitable transition that should mitigate against compounding historic grievance or creating ongoing disadvantage for Iwi/Māori and will set Aotearoa up to achieve long-term success for tangata whenua and all New Zealanders. See *Chapter 19: Policy direction for an equitable transition for Iwi/Māori*.

He Ara Waiora

19 As well as focusing on the importance of upholding Te Tiriti o Waitangi/The Treaty of Waitangi, the Commission has also applied the framework 'He Ara Waiora – A Pathway towards Wellbeing' throughout our work. He Ara Waiora is a developing framework, designed by Māori in collaboration with the Treasury.

20 Drawing from mātauranga Māori, the framework has been designed for government, rather than for Māori, as a tool to help policy teams build a high-level understanding of Māori perspectives on wellbeing. It helps to improve awareness of how policy can impact on Iwi/Māori, to achieve more equitable policy outcomes.

21 Submission feedback was mainly supportive of using He Ara Waiora as a policy analysis tool for incorporating Iwi/Māori perspectives, but stressed the importance of achieving equity by upholding the Treaty.

22 However, some submitters cautioned that He Ara Waiora should not be interpreted as a proxy for all Iwi/hapū based tikanga and emphasised that while it has resonance within te ao Māori, it should be tested further at the hapū/marae level. Submitters also indicated that the application of the He Ara Waiora framework should extend beyond an impact analysis on Iwi/Māori, to include impacts more broadly.

23 A te ao Māori view, as captured in the framework, is integrated and recognises that we exist in an ecosystem. Aspects of the system should not be considered in isolation of the interrelated parts. Effective policy design should balance what is good for people, the whenua, water, and climate, and protect whakapapa, enhance whanaungatanga, and ensure intergenerational sustainability and prosperity.

24 This is important for the wellbeing of all New Zealanders and for long-term policy approaches to meeting climate change goals.

25 He Ara Waiora is anchored in wairua (energy/spiritual realm) as a source of wellbeing. The taiao (environmental realm) sits at the centre, iterating a Māori perspective that environmental wellbeing is a precursor to human wellbeing. The framework also identifies four dimensions of wellbeing within the ira tangata (human realm):

- **Mana tuku iho** – identity and belonging
- **Mana tauutuutu** – individual and community rights and responsibilities
- **Mana āheinga** – aspiration and capability
- **Mana whanake** – sustainable prosperity

26 In addition to thinking about integrated policy design, applying tikanga helps to qualify how policy will enhance intergenerational wellbeing. He Ara Waiora sets out the following tikanga to support policy development:

- **Manaakitanga** – having a deep ethic of care towards the people and systems involved.
- **Tikanga** – ensuring the right decision makers are involved, and the right decision-making process is implemented.
- **Whanaungatanga** – being mindful of the relationship between all things, our connections to each other and how we connect to our whenua.
- **Kotahitanga** – taking an inclusive approach and working collaboratively with other agencies/organisations, to have access to the best information, and to do the best work we can, collectively.

27 More information on He Ara Waiora is contained in *Chapter 10: Perspectives from Tangata Whenua: Considering impacts of emissions reductions and removals for Iwi/Māori* of the *2021 Supporting Evidence*.

11.2.2 Clearly and credibly signal outcomes that align with targets

28 The Government must signal policy changes well in advance, while articulating a clear and credible vision for the future of different sectors, industries, and communities. People need to understand the speed and direction of travel for transitioning to a low-emissions Aotearoa.

29 To support this, the Government must take a long-term view, and present a clear strategy for achieving climate goals. This will provide communities, businesses, and investors with the predictability that they need to plan. It will also help to spur innovation and avoid the creation of stranded assets.

11.2.3 Effective governance structures for delivering the transition

30 Transitioning to a low-emissions Aotearoa involves balancing the country's short electoral cycle and bias towards short-term decision-making with the sort of enduring long-term change needed across our economy and society.

31 Developing effective policy approaches, implementing, and monitoring those approaches, and supporting an equitable transition to low emissions will require coordination across a wide range of government agencies, levels of government, and partnership with Iwi/Māori.

32 Meeting our climate change targets will need governance structures and institutional arrangements that support stability and coordination and keep the government focused on long-term goals.

11.2.4 Manage impacts for a fair, inclusive and equitable transition

33 The climate transition can bring significant benefits to New Zealanders' health and wellbeing. A fair, inclusive and equitable transition involves making sure that the benefits of climate action are shared across society, and the negative impacts do not disproportionately fall on those least able to adjust.

34 It means making sure New Zealanders are involved by working collaboratively and inclusively in line with kotahitanga and tikanga. It means not creating or exacerbating existing inequities.

35 A fair, inclusive and equitable transition also means supporting people most impacted and least able to adjust, and investing in people.

36 The importance of maintaining social and political licence for government action to reduce emissions, and ensuring public support for climate goals, was highlighted in many submissions.

37 Actions for achieving emissions budgets and targets should be deliberately paced and planned to give households, communities and companies certainty about the direction of change, and time to find the opportunities for transition. In some instances, targeted support may be needed (see *Chapter 20: Policy direction for a fair, inclusive and equitable transition* for more discussion).

11.3 The three pillars for a comprehensive policy package

38 No single policy will be able to overcome all the barriers to reducing emissions. At the same time, it is important that climate policies do not waste resources or direct efforts at the wrong things.

39 To help navigate the most appropriate policies and approaches, our framework identifies three main areas ('pillars') for interventions:

- Pricing to influence investments and choices
- Action to address barriers
- Enabling innovation and system transformation

40 To date, the New Zealand Emissions Trading Scheme (NZ ETS) has been the key policy tool for reducing emissions.

41 There continue to be calls to rely heavily on the NZ ETS to drive the transition to low emissions, and this was reflected strongly in some submissions received during consultation. There were also many submitters who thought that there should be a stronger focus on other policies or even that the NZ ETS should be repealed.

42 Some business submitters thought the NZ ETS should be the central policy tool but acknowledged that other policies were needed alongside it.

43 International research and experience clearly show that the most effective approach to reducing emissions is to implement a comprehensive suite of climate policies. What is needed is emissions pricing that works in conjunction with companion policies that help to provide a wider range of low-emissions options.

44 This includes policies that enable the infrastructure needed for low-emissions options to work, promote access to finance, and raise awareness and increase access to information that supports good decision making.

45 Policies alongside the NZ ETS can put people and businesses in a better position to respond to a rising emissions price – and lower their exposure and vulnerability to that price.

11.3.1 Emissions pricing and other market incentives to influence choices

46 Emissions pricing incentivises businesses and individuals to make choices that lower emissions. The main pricing tool in Aotearoa is the NZ ETS, but there are others that can also be used to incentivise investments and choices – such as taxation, electricity pricing and grants or subsidies.

47 Emissions pricing is a strong and flexible lever for tackling climate change, as it makes emitters feel the costs associated with the emissions their decisions create. Its power comes from how it allows those driving emissions to find their own way of reducing them. It also has broad coverage, affecting a much wider range of decisions than would be possible with more targeted policies.

48 However, some sectors have characteristics that impact how effective emissions pricing can be. Characteristics of the NZ ETS also moderate its ability to drive emission reductions.

49 Experience shows that emissions pricing works best when decisions about emitting activities are made based on optimising costs. This decision-making behaviour generally holds true for large businesses operating in industries where energy costs make up a large proportion of total costs.

50 An Emissions Trading Scheme (ETS) can push choices towards low-emissions alternatives that are already commercially available, especially if they are being deployed at scale and have a low-to-medium cost gap relative to standard technology.

51 On the other hand, emissions pricing plays a more limited role where decisions are made by individuals, or by small businesses or firms for whom energy and emissions are not business critical. These decision makers are less likely to optimise effectively for cost, largely due to behavioural factors, lack of information or capability.

52 Other factors that hinder response to an emissions price include barriers like high up-front capital costs, lock-in to existing systems or infrastructure, and lack of readily available or affordable low-emissions options.

53 Looking across sectors in Aotearoa, the potential for emissions pricing to drive emissions reductions differs.

54 In areas such as buildings, urban form, and transport, existing infrastructure and long-lived assets lock in emissions and make it difficult for people to alter choices in response to the emissions price. In other areas, such as some industrial processes and agriculture, pricing can be expected to drive efficiencies, but is unlikely to deliver the new technologies and processes needed to reduce emissions at scale.

55 In contrast, experience in Aotearoa has demonstrated that forestry is highly sensitive to an emissions price. International experience also shows that emissions pricing can strongly influence the power sector, in particular helping to drive out fossil fuels.

56 Concern was raised by several submitters that the NZ ETS has a 'neutralising effect' on emissions reductions achieved by other policies. They cited that in an ETS with a fixed emissions cap (limit on total emissions), every tonne not emitted by one party will be available for someone else to emit.

57 The NZ ETS, however, does not have a fixed cap. This is partly the legacy of how the NZ ETS was run in the past, which has led to over 130 million units banked in participant accounts. This represents significant oversupply beyond what is likely needed for annual demand and hedging purposes.

58 The lack of a fixed cap is partly by design – recent reforms have implemented price measures to either withhold or release units, to put a brake on the emissions price from going above or below certain levels. These reforms reflect the political context in which the NZ ETS operates, where policy makers are concerned not just about efficiency but also about where costs fall.

59 This is not unusual. Every functioning ETS in the world today contains market stability mechanisms that alter the number of units available depending on the market price or other factors. This means that ETSs are hybrid instruments, with safety valves to manage price or adjust the cap in response to economic changes – given the inherent uncertainty in setting a cap based on forecast emissions.

60 The recent NZ ETS reforms also implemented a flexible, five-year rolling cap. Emissions reductions that are expected to be achieved through other policies can be factored in when the cap is set.

61 The cap can be adjusted over time to reflect actual emissions reductions achieved through other measures, or reductions to emissions not covered by the NZ ETS. This is important in Aotearoa, as significant emissions are not covered by the NZ ETS, such as agricultural emissions and emissions and removals by some forests.

62 The combination of oversupply, price measures and a flexible cap in the NZ ETS mean that it will not necessarily guarantee a specific emissions outcome. It also means that the NZ ETS can be managed in conjunction with other policies so that emissions reductions or removals from other policies are not a wasted effort (see *Chapter 19: The direction of policy for Aotearoa* of the *2021 Supporting Evidence* for more information).

11.3.2 Regulation, information and other action to address barriers

63 There are a range of structural, political and behavioural barriers that prevent people and businesses from making the most of cost-effective opportunities to reduce emissions. These barriers will vary by sector.

64 The NZ ETS is focused on addressing the climate change externality (the costs that emissions put on others), and is not suited to addressing these other barriers. Removing these barriers can boost responses to the emissions price and reduce the cost of achieving emissions reductions.

65 Table 11.1 below outlines some of the many market distortions or failures that can make the emissions price less effective. Measures to address these sorts of barriers can include standards or regulation, information and support to address knowledge and capacity gaps, or removing regulatory barriers that push against achieving emissions reductions.

Table 11.1: Market problems that need other policies alongside emissions pricing

Market Problems	Description
Imperfect or asymmetric information	Carbon pricing works best if emitters make informed decisions. But critical information about the emissions and lifetime costs of alternative products and technologies can be difficult or too expensive for an individual household or firm to get. Government can introduce regulations to require that this information is made available or can exploit economies of scale to provide it at lower cost. For example, in Aotearoa energy rating labels must be displayed on household appliances such as refrigerators or dryers.
Uncertainty about future emissions prices	A rising emissions price can signal to the market that investing to reduce emissions will be rewarded. However, these price signals are relatively short term, as NZ ETS caps are only set for a few years into the future. Emissions prices in Aotearoa and other countries have also been volatile, sometimes due to uncertainty about the future of pricing policy – for example, due to changes in government. This makes investing in reducing emissions riskier, so households and businesses may under-invest. Putting standards or target dates in place for phasing certain technologies in or out can provide the certainty people need to invest in reducing their emissions in a timely manner.
Split incentives	This refers to where the person who pays for an action is not the one who will benefit from that action. For example, landlords have little incentive to install insulation as it is the tenants who benefit from the warmth and reduced bills. An example of addressing this problem in Aotearoa is the healthy homes standard, which introduced minimum standards for insulation of rental properties.
Bounded rationality and myopia	Businesses and individuals do not always base their decisions on an economically rational optimisation of costs. Due to limited time and resources, decision makers may rely on rules of thumb or routines that they have established over time. They may also discount future costs disproportionately when making purchase decisions. For example, consumers might short-sightedly choose a good with a lower purchase price despite it incurring higher costs over its lifetime. Approaches like product labelling to encourage longer-term thinking, and minimum efficiency standards can help steer these decision makers towards low-emissions options.

Barriers to accessing capital	Accessing the finance needed for the significant up-front capital costs involved in reducing emissions can be difficult for a range of reasons. A specific example in Aotearoa is Māori land, which cannot be used as collateral for loans. This creates challenges for owners of Māori collectively-owned land wishing to fund farm improvements, forest planting or land-use change. Introducing alternative funding options or changing regulation so particular groups are not disadvantaged can help to overcome this barrier.
Infrastructure lock-in	The options for reducing emissions can be constrained by available infrastructure. Infrastructure can refer to physical structures such as buildings and electrical grids, but also to networks or services such as public transport. For example, if public transport is not available or convenient, it is difficult for individuals to choose not to use a car. Avoiding high-emissions lock-in is also a concern for new infrastructure, as infrastructure has a long lead in time and a long life, so once investments are made there is little scope for revisiting earlier decisions. Buildings, in particular, last for several decades, so those built or renovated now, should ideally be compatible with net zero emissions in 2050.
Network externalities	This is when the benefits to an individual from using a product depend on how many others are also using the product in question. Where these occur, individuals might be discouraged from using an available low-emissions alternative if it is not yet deployed on a wide enough scale. Policies that encourage network development or densification can induce greater adoption, for example promoting charging infrastructure can hasten the adoption of electric vehicles (EVs).
Policy coordination or regulatory failure	Government policies can also undermine or obstruct the emissions price. For example, cost-effective options to reduce emissions may be blocked if planning rules do not encourage urban development that is compatible with low-emissions transport options.
Co-benefits or other externalities	Actions to reduce emissions may also have other benefits, such as for health or for biodiversity. These wider benefits can justify certain policies to reduce emissions, even if when judged by their ability to reduce emissions alone, they are not cost-effective. For example, encouraging active transport options like cycling can contribute both to health and a range of environmental benefits, including reduced emissions from private vehicle use.
Innovation and learning spillovers	See next section

66 Figure 11.2 illustrates how a range of policy instruments will be needed to address the wide range of existing market failures and cover the whole economy. It draws on current policy as well as the Commission's advice on direction of policy to show what a more comprehensive policy package could look like in Aotearoa.

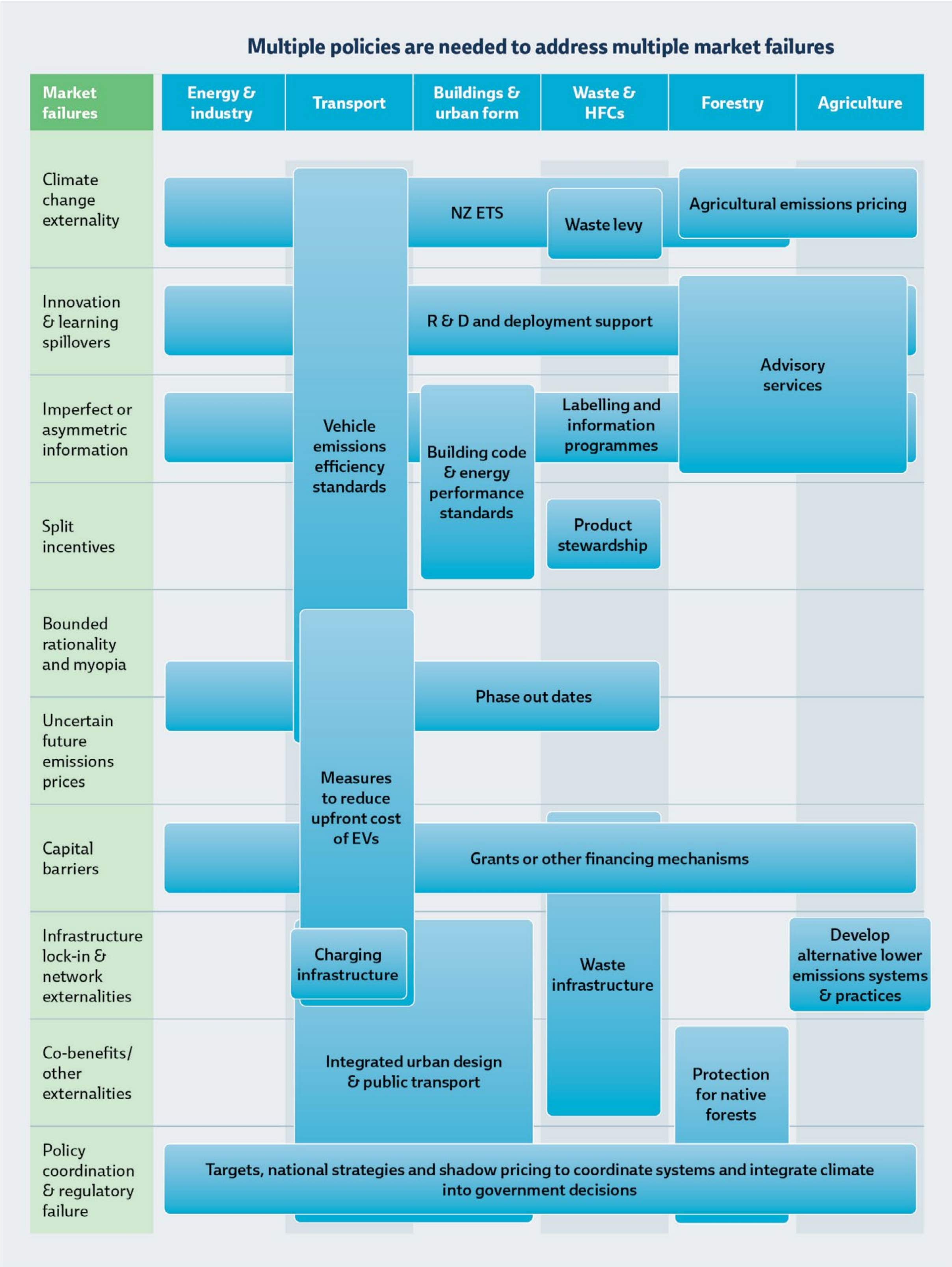


Figure 11.2: A package of policies is needed to address multiple market failures

11.3.3 Enabling innovation and system transformation

67 To achieve the scale and pace of change needed, efforts to create and adopt new technologies and systems that give people and businesses more, better and less costly ways of reducing their emissions need to speed up.

68 There are many areas where low-emissions options do not exist or are not yet commercially available at scale. Investment in innovation and infrastructure can help create and deploy new solutions to unlock and bring down the costs of future emissions reductions.

69 There are broader societal benefits when innovations are used and dispersed – when knowledge 'spills over' to those who did not produce it. A good example of this is where the innovation behind mobile payment technology spilled over into the transport sector and unlocked rapid advances such as ride share systems and micro mobility options like bike hire and e-scooters.

70 An emissions price boosts the incentive for low-emissions innovation, but it is still unlikely to be enough to encourage the level of research, development and deployment of new technologies and practices that is needed. The spill-over benefits from innovation and learning often justify targeted interventions.

71 Aotearoa is a 'technology taker' in some areas, for example in relation to new vehicles and many industrial technologies.

72 Research and development efforts here are likely to focus more on primary industries (including the bioeconomy), given our capabilities and emissions profile. For example, further innovation and development of expertise could bring down costs for regenerating and planting new native forests.

73 Nevertheless, adapting and deploying technologies developed elsewhere for local circumstances still requires a great deal of learning-by-doing to enable them to spread. This means that technology-specific policy support can be justified to speed up deployment beyond early research and development (R&D). R&D on behaviour change may also be needed, to make sure technologies and approaches suit local circumstances.

74 Before committing high levels of resources, it is important to assess and have confidence in a technology's role over the longer term.

75 Even where limited or no technical change is expected, another reason for early investments is because reducing emissions takes time. This is particularly relevant where transformation of long-lived infrastructure or systems is needed, such as in buildings, urban form and urban transportation systems.

76 While reducing emissions in these areas is expensive and difficult, it makes sense to start early to spread the effort and reduce cost over time. In most cases, abrupt transformation would be more expensive than a gradual transition.

77 This may mean accepting a higher cost in the short term. However, it avoids the highly costly scenario of having to transform a city over an infeasibly short timeframe, such as only a decade.

78 Emissions pricing can only play a limited role in bringing new technologies or system change online. This is because a price on emissions, assuming rational behaviour by those subject to it, leads to cheaper emissions reduction opportunities being used up first.

79 As long as these less expensive options exist (for example, efficient internal combustion engine vehicles), the emissions price will not incentivise the uptake of new options that are at an earlier, costlier stage in the 'S-curve,' or which require upfront investment in new infrastructure (for example, EVs.

80 But by the time these cheaper options have been exhausted, or are no longer viable given tighter limits on emissions, it will be too late to develop and deploy the transformative solutions needed.

81 Emissions pricing is key for scaling up solutions that are approaching market maturity, but will not initiate and guide the roll-out of transformational solutions. Other policies, along with capital to fund investment, will be needed to drive deep and enduring systems change.

11.3.4 Policies should complement and reinforce each other

82 Emissions pricing works better when accompanied by other policies that address the full range of market and policy failures and barriers. However, it is still important to carefully design these policies so that they are effective, efficient, and reinforce, rather than undermine each other.

83 When developing a package of complementary policies to reduce emissions, the Government will need to consider the nature of different options available, how mature they are, what the barriers preventing their uptake are, their costs and how those costs might reduce over time.

84 Understanding effectiveness and efficiency requires a long-term perspective. Dynamic effects mean that some policies may appear in the short term to be expensive, but can contribute to a more economically efficient transition over time.

85 The reverse is also true – some policies that appear to be least cost today may increase costs over the long term because they lock in future emissions or create assets that will become stranded in the future.

86 It is important to consider these dynamic effects, and to take a long-term view of cost effectiveness. We have factored this into our approach to developing our policy advice.

87 The Commission's analysis out to 2050 and beyond has helped to make it clearer what this means for Aotearoa. For example, our analysis shows that EVs will need to play a key role in any credible approach to delivering the emissions reductions needed to meet the 2050 net zero target. Investing in charging infrastructure and other ways to speed up their adoption is therefore justified.

88 Emissions pricing should be key to any policy package, so how other policies interact with it should be considered. Figure 11.3 below illustrates how different combinations of an ETS and companion policies can interact to affect the emissions price and reductions. It highlights that heavy reliance on an ETS risks triggering cost containment measures and failure to meet reduction goals, while relying too heavily on other policies can be inefficient. A balanced mix of policies should be the aim.

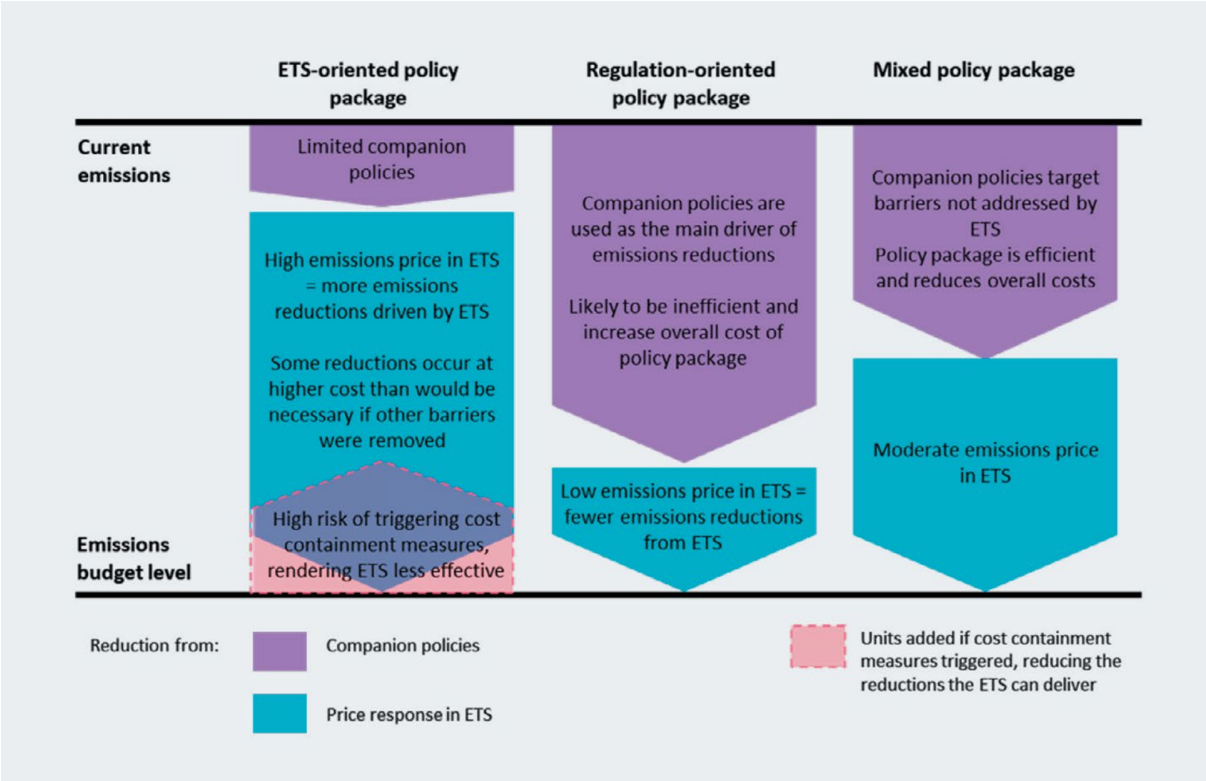


Figure 11.3: How different packages of ETS and companion policies impact emissions prices and reductions

Source: Climate Change Commission, adapted from IEA (2011), *Summing up the parts,* IEA, Paris; and Agora Energiewende and Ecologic Institute (2021); *A "Fit for 55" Package Based on Environmental Integrity and Solidarity: Designing an EU Climate Policy Architecture for ETS and Effort Sharing to Deliver 55% Lower GHG Emissions by 2030.*

11.4 How we have applied our approach to our advice on policy direction

89 The following chapters outline our advice on the direction of policy for meeting the first emissions budget and setting Aotearoa on the path to meet future emissions budgets and our 2050 targets.

- *Chapter 12: Policy direction to create an enabling environment for change* looks at how some systems, institutions and arrangements may need to change to help to create an enabling environment to support the transition.
- *Chapter 13: Policy direction that cuts across sectors* looks at policies and outcomes that cut across sectors.
- *Chapter 14: Policy direction for transport, Chapter 15: Policy direction for energy, industry and buildings, Chapter 16: Policy direction for waste, Chapter 17: Policy direction for agriculture* and *Chapter 18: Policy direction for forests and other carbon stocks* look at policies and outcomes in specific sectors.
- *Chapter 19: Policy direction for an equitable transition for Iwi/Māori* looks at how to support an equitable transition for Iwi/Māori.
- *Chapter 20: Policy direction for a fair, inclusive and equitable transition* looks at policies and outcomes to support an equitable transition.

90 This advice has been informed not only by our policy approach, but also by the analysis carried out for our emissions budget advice.

91 For this, we gathered information about current and likely future costs for various technologies. We tested different paths, gaining insights about the nature and timing of the actions needed to meet the 2050 targets.

92 We also assessed current climate policy in Aotearoa to identify the gaps, barriers and opportunities. We considered where emissions pricing is likely to drive change. For each sector, and across the broader system, we identified where barriers currently deter low-emissions choices, and where strategic investment can help drive deeper change over the long term.

93 In doing this, we reviewed a broad 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 also been invaluable for informing our advice on policy direction.

94 In some areas, such as in relation to the NZ ETS, a strong evidence base supports relatively specific policy advice. In other areas, particularly ones that have not been the focus of climate policy in the past, our advice is more focused on outcomes.

95 Overall, our policy advice is intended to provide strategic direction. It is the Government's role to consider the detailed design and implementation of policies, guided by this direction.

11.5 Assessing the Government's progress

96 The Commission has a statutory monitoring and reporting function, which is set out in the Act. As part of this role, we will monitor the Government's progress in implementing its emissions reduction plan and assess its adequacy. We will report on this annually from 2024 (See *Chapter 3: The role of the Climate Change Commission*).

97 Monitoring the emissions reduction plan will be critical for understanding whether the Government is taking sufficient action, quickly enough, to achieve emissions budgets and targets. The process for doing this will evolve over the period of the first emissions reduction plan.

98 As part of our ongoing monitoring role we will publicly assess and report on the:

- Most recent reported emissions and removals
- Latest projections for current and future emissions and removals
- Government's progress implementing the emissions reduction plan
- Adequacy of the Government's emissions reduction plan, including any new opportunities to reduce emissions

99 Carrying out our monitoring role will require a framework that draws on multiple sources of data. This includes *New Zealand's Greenhouse Gas Inventory,* which is published annually by the Ministry for the Environment and provides much of the core information we will need. It provides the data and information for the latest projections of emissions and removals.

100 However, data in the inventory lags two years – for example, emissions from 2021 will be reported in 2023. This means we will not be able to track emissions using the inventory in the very short term. Because of this lag, we will also need other types of activity indicators. For example, reporting on the number of EVs purchased each year would let us anticipate likely reductions in transport emissions.

101 We will also need additional information linked to government processes. The Government can design and implement policies in a relatively short timeframe, but the associated emissions savings can take time to become evident.

102 For example, incentives to increase uptake of low-emissions vehicles could be put in place relatively quickly. However, the emissions reductions from those policies would build over a number of years, affected by the rates at which new cars are bought, and emitting cars are retired each year.

103 To monitor progress, the Commission will therefore initially need to rely, to a large extent, on measuring the actions and policies implemented by the Government. Potential indicators of progress could include, for example, legislation that has been passed, additional budget committed and spent on programmes, or internal government resources being deployed.

104 To do this, we will need a monitoring framework that includes progress indicators – to set expectations for what should be delivered, by when, under the emissions reduction plan. Progress indicators should be designed around the information we need to assess the adequacy of the plan, and track government progress on implementing it.

105 The Commission acknowledges that the Government's choice of a package of policies may differ from what the Commission has recommended. Therefore, the monitoring framework will need to be completed once the emissions reduction plan is in place, and the objectives are understood.

106 However, in order for us to be able to assess the implementation of the emissions reduction plan, the Government should state, in the plan, the date each action or policy will be initiated, implemented and completed by. This should include milestone reporting periods. The Government should also consider reporting other complementary information, such as on budgeting and resourcing.

107 At the same time, in order for us to be able to assess the adequacy of the emissions reduction plan, the Government should create a headline statistic (or measurement) linked to the policy objective. It could also select and track additional or supporting indicators, where appropriate.

108 In our advice on policy direction in the chapters that follow, we have included some provisional progress indicators. These illustrate the types of indicators that will help us to assess the implementation and adequacy of the Government's emissions reduction plan.

109 We have not included progress indicators for all recommendations. Rather, we have provided example indicators for the actions we regard as being particularly important – either because of the large potential emissions reductions, or because policy action needs to begin immediately. Once the Government has released its emissions reduction plan, the Commission will need to reassess the provisional progress indicators and develop a final full set.

Chapter 12

Aronga Kaupapa – Kia whakawhirinaki mai ki te pae taurikura
Policy direction to create an enabling environment for change

Summary

To reach its climate targets Aotearoa needs to create an environment where long-lasting change is possible.

This means making it easy for people and organisations to make choices and decisions that support the transition. The choices and decisions that people, households, businesses, industries, and local government make will result in lasting change. Everyone has a role in getting Aotearoa to net zero.

The Government's main role is to create conditions where addressing climate change is achievable, affordable, and supported across Aotearoa.

This chapter outlines areas where the Government should take action to support an enabling environment for lasting change:

- **Uphold its commitments and obligations to Te Tiriti o Waitangi/The Treaty of Waitangi**. To achieve an equitable and enduring transition for Iwi/Māori, we recommend developing and implementing a strategy to ensure emissions reduction plans are firmly rooted in the Treaty principles of partnership, participation, protection, and equity.
- **Provide clear, credible, and consistent signals about the direction and pace of change.** Cross-party political support is central to this and is particularly important with the emissions budgets because they set the pace of the transition.

- **Different organisations and groups need to coordinate and work together. In particular:**
    1. Well-supported local government will be critical to meeting emissions reduction targets.
    2. Government ministries, departments and agencies need to work together in an effective and efficient way to support climate action. They must also be sufficiently resourced. A separate appropriation, or 'Vote Climate Change', will support the scale of response required and make sure action is coordinated.
    3. Effective public participation will make sure people's voices are heard and everyone can participate in the transition.
    4. The Government needs to work collaboratively with business and industry, and leverage private sector leadership. The investment decisions and choices that businesses make are critical to the transition.
- **Ensure a fair, inclusive and equitable transition.** Government must recognise the challenges different groups will face during the transition and make sure plans and support are in place to manage them. As the government develops and implements how it will meet the emissions budgets, it must reflect the te ao Māori values of manaakitanga, tikanga, whanaungatanga and kotahitanga and ground the approach to reducing emissions firmly in these values. This will ensure that people, the environment, and Te Tiriti o Waitangi/The Treaty of Waitangi remain at the centre of the transition.

Changes in our final advice

This is a new chapter that includes some content that was elsewhere in our *2021 Draft Advice for Consultation*. We have taken on feedback through consultation and adjusted the recommendations, as well as placing more emphasis on the importance of laying the groundwork for the transition.

We have distinguished between the need for cross-party support for the emissions budgets and for the Government's emissions reduction plans. This recognises that support for the emissions budgets is more critical. It also recognises that views on the best policies and approaches to meeting emissions budgets are likely to be party-specific, making cross-party consensus more difficult to achieve.

We strengthened our recommendation for climate considerations to be included in all government decision making, and emphasised the need for adequate resourcing.

We have emphasised the need for collaboration and partnership with business. This recognises how crucial these groups are in the transition.

Introduction

1 Climate change touches on the lives of everyone who lives in Aotearoa. All New Zealanders, businesses, industries, communities, and regions will need to play their part in addressing it.

2 The policy direction in this chapter draws on our policy framework and focuses on putting the foundations in place for people to get behind and support efforts to achieve emissions budgets and targets.

3 The choices and investment decisions that people, households, businesses, industries, and local governments make is what will drive emissions reductions, and make the transition to a low emissions society happen.

4 Meeting emissions budgets and achieving our climate goals will not be possible without bringing all New Zealanders along on the journey and supporting them to make decisions that align with those goals.

5 The five recommendations in this chapter are about creating a social and political environment that supports this. The Government must create the conditions for ambitious and enduring change.

6 This includes making sure that upholding Te Tiriti o Waitangi/The Treaty of Waitangi is at the core of the transition. It also means providing certainty via clear and consistent signals about how Aotearoa will transition, and how quickly.

7 Effective governance structures will also be important. There must be better coordination across government with respect to climate change, and central government needs to work closely with local government to deliver low-emissions outcomes. Making sure a wide range of perspectives feed into decisions about the transition to low emissions will also be important.

8 The Government also needs to ensure the benefits of climate action are shared across society, and that certain groups do not shoulder an unfair share of the cost burden from the climate transition.

9 As the Government develops and implements how it will meet emissions budgets, it should support and align with the te ao Māori values of manaakitanga, tikanga, whanaungatanga and kotahitanga (see *Chapter 11: Approach to developing advice on policy direction*). By grounding the approach to reducing emissions firmly in these values, the Government will ensure that people, the environment, and Te Tiriti o Waitangi/The Treaty of Waitangi, remain at the centre of the transition.

12.1 Treaty of Waitangi and the Crown-Māori relationship

10 Under the Climate Change Response Act 2002 (the Act), the Commission must consider the Crown-Māori relationship, te ao Māori, and specific effects on Iwi/Māori in our advice.

11 When acting on our advice, the Government is required to include strategies to recognise and mitigate the impacts, on Iwi/Māori, of reducing emissions and increasing removals of carbon from the atmosphere. This includes considering the economic, social, health, environmental, ecological, and cultural effects of climate change for Iwi/Māori.

12 Almost 80% of total submissions to the *2021 Draft Advice for Consultation* supported an approach that upholds Te Tiriti o Waitangi/The Treaty of Waitangi. Submissions from both Māori and some non-Māori emphasised the importance of ensuring that the Te Tiriti partnership and Te Tiriti o Waitangi/The Treaty of Waitangi underpins all aspects of our advice and policy direction.

13 We also heard through consultation that the Government's failure to comply with principles of Te Tiriti over time has disadvantaged Iwi/Māori, who in many circumstances do not experience the rights of protection, partnership, participation, and equity.

14 Further, historic actions and ongoing barriers continue to inhibit Iwi/Māori from exercising rangatiratanga and kaitiakitanga as guaranteed under Te Tiriti o Waitangi/The Treaty of Waitangi.

15 Based on the recent findings from the *Hauora Wai 2575 Waitangi Tribunal Report 2019*, giving effect to Te Tiriti o Waitangi/The Treaty of Waitangi as Aotearoa transitions to a thriving, climate-resilient, low-emissions future would require that:

- The Government works in **partnership** with Iwi, hapū, and whānau Māori through the balancing of the concepts of kāwanatanga and tino rangatiratanga expressed in Articles one and two of Te Tiriti o Waitangi/The Treaty of Waitangi. This requires the Government to consult and partner with Māori genuinely through co-decision making and co-governance structures.
- The Government upholds its responsibility to the principle of active **protection** of Iwi/Māori rights to exercise rangatiratanga and kaitiakitanga. Active protection includes a government obligation to focus specific attention on inequities experienced by Māori and, if need be, provide additional resources to address the causes of those inequities. To achieve this the Government needs to work with Iwi, hapū, and whānau Māori to ensure sufficient understanding of Māori perspectives so new policies uphold Te Tiriti principle of protection, particularly regarding Iwi/Māori rights to exercise rangatiratanga and kaitiakitanga.
- The Government ensures Iwi/Māori **participate** within an enabling environment by working with Iwi, hapū, and whānau Māori in co-design and co-decision-making processes.
- The Government satisfies its obligations under the principle of **equity,** closely linked to the principle of active protection, by reasonably ensuring Iwi/Māori do not suffer inequity through government actions or omissions. Government should work with Iwi/Māori to promote equitable outcomes in alignment with Iwi/Māori aspirations for intergenerational wellbeing.

16 Upholding Te Tiriti o Waitangi/The Treaty of Waitangi must be at the core of our transition, to ensure climate action is enduring, sustainable, and equitable.

17 In Aotearoa, effective action to address climate change must be premised on an equitable Te Tiriti partnership to correct the existing inadequacies. To accomplish this, government must demonstrate a commitment to Te Tiriti o Waitangi/The Treaty of Waitangi that reflects a genuine desire to remove barriers and achieve equitable outcomes.

18 Consultation feedback from the majority of Māori-collectives indicated that government failure to comply with Te Tiriti o Waitangi/The Treaty of Waitangi, lack of adequate consultation and understanding, and inequitable policy design and outcomes, have caused Iwi/Māori to be continuously impeded by moving goal posts.

19 Our recommendation, in response to this feedback, is for the Government to work in partnership with Iwi/Māori to develop a strategy that ensures the principles of Te Tiriti o Waitangi/The Treaty of Waitangi are embedded in emissions reduction plans.

20 We heard from Iwi/Māori that they often face competing priorities and resourcing constraints. This, coupled with the time required to build capability to establish an effective and enduring collaboration, means that this work will take time.

21 While work to implement this strategy will likely develop during the first emissions reduction plan period, this strategy should be considered a priority so it can be embedded in subsequent emissions reduction plans.

Recommendation 6

Treaty of Waitangi and the Crown-Māori relationship

We recommend that the Government commit to:

Working in partnership with Iwi/Māori and local government to develop a strategy to ensure the principles of Te Tiriti o Waitangi/The Treaty of Waitangi are embedded in subsequent emissions reduction plans.

The strategy should:

1. Include an outcomes framework and action plan, as well as an evaluation framework outlining agreed accountability milestones and measures.
2. Specify outcomes that align with the principles of protection, partnership, participation, and equity, recognising the guarantee of rangatiratanga and kaitiakitanga for Iwi/Māori under Te Tiriti o Waitangi/The Treaty of Waitangi.
3. Include actions to give effect to Recommendations 26 and 27 (see *Chapter 19: Policy direction for an equitable transition for Iwi/Māori).*
4. Take a whole of systems approach that addresses climate change in parallel with wai (water) and whenua (land).
5. Be resourced appropriately.

Recommendation 6

Provisional progress indicators

1. Government to work in partnership with Iwi/Māori, by 30 June 2022, to agree on an approach for developing the strategy, and to develop and publish the strategy. This should include an outcomes framework with a phased implementation plan.
2. Government to have initiated, by 31 December 2022, the first phase of implementation and work in partnership with Iwi/Māori to develop an evaluation framework.
3. Government to report annually, from 31 of December 2022, on a suite of indicators, including how the strategy will be resourced and funded.

12.2 Clearly and credibly signal outcomes that align with targets

22 The Government must provide clear and consistent signals about how Aotearoa will transition to low emissions, and how quickly. Signalling the speed and direction of travel well in advance will help to provide as much certainty as possible.

23 This will help New Zealanders, businesses, industries, communities, and regions make informed decisions that align with climate change goals.

24 Under the Act, the Minister of Climate Change has a duty to set emissions budgets well in advance, and to ensure that they are met. A key purpose of the emissions budgets process is to provide greater predictability for all those affected by giving advance information on the emissions reductions and removals required.

25 The Commission has made recommendations on the level of the first three emissions budgets in *Chapter 5: Recommended emissions budgets*. As required under the Act, this advice includes recommendations on the overall level of each of the first three emissions budgets, the balance of emissions reductions and removals, the breakdown of emission budgets by gas, and the use of offshore mitigation to meet the budgets.

26 If the Minister does not adopt the emissions budgets the Commission recommends, they must explain the reason for any departures from this advice. As part of our ongoing role, the Commission will continue to provide advice on future emissions budgets, not less than 10 years before the start of each budget period.

27 This emissions budget process will ensure that the speed and direction of transition to low emissions is clearly signalled well in advance, and that those signals are robust and credible.

12.2.1 Cross-party support for emissions budgets

28 Emissions budgets provide clear direction on the pace of change and set goals for how Aotearoa will step down towards our emissions targets. Seeking cross-party support as emissions budgets are set would help to provide even greater certainty.

29 There will be ten elections between now and 2050. Abrupt changes of course as Governments change would not give businesses and individuals the predictability they need to make decisions. To reduce uncertainty and ensure enduring progress, it is important that emissions budgets are set in a transparent way and that they are non-partisan.

30 The Minister is already required under the Act to consult with other political parties on emissions budgets before they are notified. Cross-party support for emissions budgets would provide reassurance that actions to reduce emissions will endure, and that progress will not easily be undone by future Governments.

31 During consultation, some submitters, including some business and industry submitters, expressed a desire to see cross-party support as a condition for the Government to set an emissions budget.

32 However, many others – including many NGOs and individual submitters, expressed concern that pursuit of consensus could become a barrier to ambitious action on climate change. Many emphasised that a lack of cross-party support should not be a reason to forestall action on climate change.

33 The Zero Carbon Bill passing in 2019 showed that cross-party consensus on ambitious climate action is possible. Every effort should be made for all parties to continue to build on that foundation.

34 Consensus will not always be possible. Each emissions budget must be accompanied by an emissions reduction plan, setting out policies and strategies for meeting the budget. As current and future Governments develop these plans, approaches will vary. Preferred policies will be based on the priorities and preferences of the Government of the day, and Governments will remain accountable for the policy choices they make.

35 Achieving cross-party support on a package of policies is desirable but will be challenging. Consensus on the overall goals of climate policy – the emissions budgets – must be the highest priority.

36 In the absence of consensus, transparency remains critical. Debating the budgets in Parliament would enhance transparency by making sure that cross-party deliberations are captured on the parliamentary record.

Recommendation 7

Cross-party support for emissions budgets

We recommend that the Government commit to:

1. Seeking cross-party support on emissions budgets.
2. Debating emissions budgets in Parliament before they are notified, so that the positions of each political party are on the parliamentary record.

12.3 Effective governance structures for delivering the transition

37 Effective institutional arrangements and governance structures are very important to support the transition to a low-emissions society. Without this, there is a risk that policies and approaches chop and change with electoral cycles, and are based only on short-term interests.

38 Creating political processes and institutions that support wider technological, behavioural and systems change will be critical. An important part of achieving this will be ensuring that there is policy coherence and coordination across government, and across different levels of government.

39 Measures will also be needed that ensure the Government maintains the social licence for climate action, and that community, individual and business perspectives are heard as the Government develops its plans and policies.

40 This is because emissions budgets are not only the concern of Government. Rather, they lay foundations that will guide the actions that New Zealanders, households, businesses, industry, local government, and others take to reduce emissions.

41 Emissions budgets need to guide a partnership between government and wider society. The choices and investments these actors make will be critical to achieving our climate goals. Their ongoing support will be important as the Government develops and implements emissions reduction policies.

42 The sections that follow focus on some of the most important areas of partnership needed to support the transition to a low-emissions society.

12.3.1 Aligning central and local government efforts

43 Local government plays an important role in the transition to a thriving, climate-resilient and low-emissions Aotearoa.

44 Councils make decisions on land use, urban form, road and transport services, housing, the three waters (stormwater, wastewater and water supply), waste management, flood risk management, and coastal management. These decisions affect how New Zealanders live, work, and run businesses.

45 We heard consistently in our engagement about how important coordination between central and local government is. This was reinforced strongly in some submissions we received during consultation.

46 Councils are the level of government closest to individual communities, and the 78 local authorities across Aotearoa will play an important role supporting diverse communities through the transition. Central and local government need to be aligned and work closely together to achieve emissions budgets and targets.

47 Policy alignment will be important for delivering low-emissions outcomes. Alignment will be needed across the Local Government Act, the Building Act and Code, the Resource Management Act (RMA), national direction under the RMA, proposed RMA reforms and the infrastructure plan.

48 This will be important to ensure that central and local government actions support the same climate goals. This was strongly supported in submissions, some of which emphasised the importance of a strong, reciprocal relationship between local and central government for meeting climate change goals.

49 Local government will also need additional funding and resources. Some submitters emphasised how many councils are already facing resource as well as capacity and capability constraints. These constraints are likely to grow as more measures are put in place over the coming years and decades, which will have an impact on local government.

50 Resourcing needs and funding and financing arrangements must be carefully addressed to ensure that councils can effectively support the transition to a low-emissions Aotearoa. In their submissions several councils also called for more guidance from central government in certain areas to support this – for example, how to measure emissions at a local level, and how to make effective procurement and investment decisions that consider climate impacts.

51 There was concern expressed during consultation that efforts to align central and local government efforts could lead to more bureaucracy and increased costs to tax and ratepayers. Clarity around the respective roles of central and local government will be important for ensuring the relationship is streamlined and effective.

Recommendation 8

Aligning central and local government efforts

We recommend that the Government commit to:

1. Aligning policy and investments to enable local government to make effective decisions for climate change mitigation and adaptation. This should include aligning the Local Government Act, the Building Act and Code, the Resource Management Act (RMA). national direction under the RMA, proposed RMA reforms and the infrastructure plan.
2. Implementing funding and financing mechanisms that provide adequate funding to enable local government to take action aligned with emissions reduction plans, and the implementation of climate adaptation plans.

Recommendation 8

Provisional progress indicators

1. Government to have, by 30 June 2022, published an agreement that sets out the mechanism for achieving the necessary alignment between central and local government.
2. Government to have published a work plan by 31 December 2022, outlining how alignment and funding will be addressed, and the milestones for achieving this plan.

12.3.2 Coordinate efforts to address climate change across government

52 The Act requires the Government to publish an emissions reduction plan outlining the policies and strategies it will put in place to meet the first emissions budget. It also allows the Government to include policies and strategies for meeting the second and third emissions budgets, but this is not a requirement.

53 It will take time for government actions to take effect, so signalling longer-term policy well in advance will support public and private investment decisions in line with targets. For this reason, it is vital that the Government focuses not only on policy for delivering on the first emissions budget, but also looks out to future emissions budgets – to 2050 and beyond.

54 Government agencies need to work together on climate change action. Currently, the government machinery of Aotearoa is siloed, which presents a challenge.

55 For example, while the Ministry for the Environment holds the lead in terms of the overall architecture of climate policy, the policy levers for the different sectors sit with a range of other agencies. For these other agencies, climate change is not their core business, and climate considerations are often crowded out by other priorities.

56 There needs to be coordinated action across government departments and agencies. This includes the Ministry for the Environment, Treasury, Ministry for Primary Industries, Ministry of Business, Innovation and Employment, Ministry of Transport, Ministry of Health, Ministry of Housing and Urban Development, Waka Kotahi, Energy Efficiency and Conservation Authority, Ministry of Foreign Affairs and Trade, Te Puni Kōkiri, Department of Conservation, Ministry of Social Development, Inland Revenue, StatsNZ, Department of Internal Affairs, Ministry of Education and the Tertiary Education Commission.

57 An important theme emerging from consultation is the need for transparency and clear lines of accountability for delivering on climate outcomes. The roles and expectations of agencies in addressing climate change will need to be clearly set out. Accountability mechanisms for delivery will also need to be defined.

A separate appropriation for climate change can support better outcomes

58 There is currently no separate appropriation in the Crown accounts and annual budget for climate change. Rather, climate change sits under the broader Vote Environment appropriation for the Ministry for the Environment.

59 Numerous levers for addressing climate change sit outside of the Ministry for the Environment and expenditure on climate change action sits with many other government agencies.

60 A separate appropriation for climate change is needed to support the scale of response required from government. Without this, it will be difficult to make sure action across departments and agencies is synchronised and achieving the most effective and efficient outcome.

61 Having all expenditure under one appropriation will increase the transparency of how this funding is being used and protect it from being redirected to other areas.

62 There is precedent in Aotearoa for integrated work programmes across government agencies, which could be used as a reference in establishing a dedicated cross-agency climate change work programme. An example is the Joint Venture for Family Violence and Sexual Violence. Integrating climate change initiatives across government would be strengthened by consolidating funding for these initiatives within a dedicated Vote Climate Change.

63 There was support for this from submitters during consultation. However, some submitters emphasised the importance not only of creating a new appropriation for climate change, but also of ensuring that this work is adequately resourced.

64 The point was also made that the onus must be on all decision makers to ensure that emissions budgets and targets are considered in all discussions and decisions on regulatory change.

Climate change considerations need to be mainstreamed

65 Another challenge is the lack of 'mainstreaming' of climate change considerations across government policies and procedures.

66 Measures such as tax levers and structures, procurement procedures, and cost benefit and regulatory impact analysis are all instruments that can be used to support climate outcomes. Currently this is not done systematically, which can undermine climate change goals.

67 Consistent signalling across investments, policy statements, direction to officials, and internal policies and directives is important to ensure that all regulatory and policy frameworks are aligned with low-emissions objectives.

68 Different agencies also give different weighting to various concerns in their decision making. To ensure that climate change goals are not undermined, it is important that climate change is considered in the development of all new policies, regulations, and fiscal proposals.

69 There was wide support for this goal expressed during consultation, including from some individual, NGO and business submitters. Some submitters expressed a desire to see government go further, and also be required to consider costs of inaction, or to factor in the range of co-benefits into policy and investment decisions.

70 A few areas were also highlighted as warranting special focus alongside climate change outcomes, due to important linkages and interactions. Biodiversity, water, education, and health emerged as key themes in this respect.

71 In addition, some activities that take place across sectors, such as tourism, food production and distribution, construction, and international education all have a large impact on emissions, but opportunities for reducing emissions are often not well understood due to their cross-cutting nature.

72 The responsible government agencies do not have climate change as part of their core business, and do not focus on low-emissions objectives. Emissions reduction potentials and interdependencies among these types of multi-sector activities need to be investigated.

Recommendation 9

Coordinate efforts to address climate change across government

We recommend that the Government commit to:

1. Nominating specific Ministers and agencies with accountability for implementing policies and strategies in the emissions reduction plans in line with emissions budgets.
2. Assessing and meeting funding requirements for implementing each emissions reduction plan in line with emissions budgets.
3. Establishing Vote Climate Change as a specific multi-agency appropriation which consolidates existing and future government funding for core climate change mitigation and adaptation activities.
4. Providing consistent signalling across investments, policy statements, direction to officials, internal policies and directives to ensure that all regulatory and policy frameworks and decisions are aligned with low emissions and climate resilience objectives.

12.3.3 Ensuring inclusive and effective consultation, engagement and public participation

73 Taking action on climate change inevitably involves making choices, judgements, and trade-offs. These include, for example, what future landscapes should look like, and how much to pay to reduce emissions here or overseas.

74 In making these decisions, it is helpful to understand a wide range of perspectives. This includes perspectives from industry, businesses, workers, NGOs, community groups, individuals, and others.

75 All will play important roles in the transition to a low-emissions Aotearoa and have important perspectives that the Government should seek to understand and consider.

76 Emissions reduction targets and budgets are not just for government – they guide a partnership between government and society. Building consensus and understanding at all levels of society will be important.

77 Many representative groups have knowledge and capacity to engage with and influence government. They are able to access leaders and shape conversations. Their perspectives in the transition, and the actions they take to reduce emissions, will be crucial.

78 However, a collective and coordinated response will require the views and perspectives of people from all parts of society, not just the highly engaged.

79 It is important that a wide range of voices have the opportunities and resources to input into judgements and decisions on how Aotearoa addresses climate change. Government needs to engage with audiences in ways that are suitable, culturally appropriate and support people to meaningfully contribute.

80 At the same time, this needs to be balanced with the potential for over-consultation. This is already becoming an issue with the response to climate change as it increases in prominence. It is also a particular issue for Iwi/Māori. The risk is that back-to-back consultations will lead to engagement and consultation fatigue. This concern was reiterated during consultation, including by some Iwi/Māori and local government submitters.

81 Some NGO and individual submitters also expressed concern that a mechanism for public engagement could slow down progress on climate change. Ensuring a wide range of voices are heard and understood as climate policy is developed is important, but it will also be important to make sure that diverging perspectives or lack of consensus do not cause delay.

82 Some submissions emphasised the importance of making sure that any mechanism for consultation, engagement and public participation is truly representative of Aotearoa. This means ensuring that representation reflects the full diversity of our society across ethnicity, age, gender and ability.

83 Aotearoa also needs to ensure consultation is a genuine collaboration between government and the public, rather than a tick box exercise.

84 There are a number of tools that could be used to address these issues. In the past, the Government operated an online consultation hub for all policies relating to climate change to give stakeholders a clear view of upcoming and closed consultations. This provided a source of information for stakeholders, allowing them to plan, allocate time and develop a high-level view of a collaborative government.

85 In our engagement, some stakeholders suggested establishing an ongoing public forum or citizens' assembly for climate change. A citizens' assembly would allow the Government or Parliament to work with a group of citizens to source views on the direction Aotearoa should take to reduce emissions and address climate change.

86 Such a mechanism would ensure a genuine public process, rather than a stakeholder process that could become dominated by particular business or industry interests – which already have other avenues for engaging with government.

87 During consultation, the point also came through that public input into decision making should happen alongside education. This includes education on the science of climate change, its potential impacts, the impacts of policies for reducing emissions, as well as education on actions individuals, households and communities can take to reduce emissions. The importance of public education is discussed further in *Chapter 13: Policy direction that cuts across sectors*.

88 Public participation in discussion of how Aotearoa addresses climate change provides a different perspective from the evidence-based analysis that we put forward.

89 Taking action on climate change inevitably involves making judgements and trade-offs. New Zealanders should be intimately involved in making such judgements. The focus of a public forum should be on conversation and mutual learning, and the process should be deliberative.

Recommendation 10

Ensure inclusive and effective consultation, engagement and public participation

We recommend that the Government commit to:

1. Evolving more effective mechanisms to incorporate the views of the public when determining how to prioritise climate actions and policies to meet emissions budgets, to create more inclusive policy development.

12.3.4 Working in partnership with business

90 Emissions budgets also need to guide the development of a partnership between government and business. The investment decisions and choices that businesses make will be critical for driving the transition to a low-emissions economy.

91 As noted by business and industry submitters, achieving the budgets will require a huge effort across Aotearoa and will need cooperation in every part of the economy.

92 Emissions budgets and targets will not be met unless businesses right across Aotearoa commit significant capital, undertake research and development, and change processes and ways of doing things. Businesses will need to take risks and support their workers through significant change.

93 Many businesses are already showing leadership and driving important change, even before emissions budgets and the emissions reduction plan have been put in place. For example, some businesses have committed to measuring and reporting emissions created through their activities (including across supply chains), and to reducing those emissions. Some businesses are already investing significant capital in innovation and efficiency.

94 A number of industrial emitters have also signalled their commitment to reducing emissions. For example, some manufacturers have set emissions reduction goals, committed to no new coal-fired boilers, and invested in technologies to reduce energy use while improving productivity.

95 The Government must work closely with business and industry as it develops the policies and approaches for reducing emissions. In doing so, government can leverage private sector leadership to accelerate the transition to a thriving, climate-resilient and low-emissions Aotearoa.

96 In our advice on policy direction we have highlighted the importance of this collaboration within many of our recommendations. For example, we highlight the need for collaboration with business in the preparation of sector strategies and plans.

12.4 Manage impacts for an equitable transition

97 A fair, inclusive and equitable transition involves making sure that the benefits of climate action are shared across society, and that the negative impacts do not disproportionately fall on those least able to adjust.

98 It means making sure New Zealanders are involved in the transition by working collaboratively and inclusively, in line with kotahitanga and tikanga. It will be important not to create or exacerbate existing inequities, and to support people most impacted and least able to adjust.

99 The Commission has made some recommendations *in Chapter 19: Policy direction for an equitable transition for Iwi/Māori* and *Chapter 20: Policy direction for a fair, inclusive and equitable transition.* These recommendations focus on showing the Government can support an equitable, inclusive and well-planned climate transition. This includes the development of an Equitable Transitions Strategy.

Chapter 13

Aronga Kaupapa – Kia whakauru ki ngā rāngai tumatanui Policy direction that cuts across sectors

Summary

In this chapter we give advice on policy direction that cuts across different sectors, which is important for enabling change at a systems level.

1. **Amend and continually improve the NZ ETS** to make sure it incentivises reductions in gross emissions.
2. **Make sure that every major decision the Government makes is consistent with climate goals**. Climate change goals should be factored into all government policy and investment decisions. This includes decisions by local governments, as well as by Crown agencies, Crown entities and Crown-owned companies.
3. **Drive low-emissions innovation.** The Government can help make sure Aotearoa will have more options for reducing its emissions in the future by putting in place measures to support and encourage research, development and innovation for low-emissions solutions.
4. **Mobilise public and private finance.** Making sure public investments support low emissions outcomes will be important. The Government also needs to help redirect private capital away from emissions intensive activities and towards low emissions investments.
5. **Make it easier for people to make lower emissions choices**. The Government needs make it easier for people to make choices that are better for the climate. It should establish a lead agency and a dedicated fund to support behaviour change.
6. **Develop a clear plan for how to move Aotearoa towards a more circular economy**. This will encourage people to use less and reuse more. This can lower emissions across supply chains. Good data and measurement will be needed to support this.
7. **Deliver a strategy for a bioeconomy**. The bioeconomy can reduce emissions across supply chains by using waste from agriculture, forestry, and households in place of fossil fuels. It will be important to look at the bioeconomy system in an integrated way.
8. **Change the way cities and towns are planned and designed.** The Government needs to do what it can to improve existing communities to support emissions reductions, and make sure that new developments are planned in a way that is compatible with a low emissions future.

Changes in our final advice

We have brought our bioeconomy, circular economy and urban form recommendations into this chapter in response to public feedback that they are all much broader than any one sector.

We did not previously have an over-arching recommendation on research and development, so we have added advice on this after coming through in submissions as an important theme.

We have also given more prominence to finance in our advice. The draft advice focused on climate-related disclosures and aligning investments for climate outcomes. This has been broadened to emphasise the importance of mobilising public and private capital towards investments that are net-zero compatible.

We have strengthened our advice on behaviour change and been more specific in our recommendation that Government should establish a dedicated fund and nominate a lead agency.

We have broadened the recommendations in our draft advice on ensuring emissions are factored into every policy and investment decision that government makes, to also include Crown agencies, Crown entities and Crown-owned companies.

We have amended the wording in the NZ ETS recommendation to improve clarity.

Introduction

1 As discussed in *Chapter 11: Approach to developing advice on policy direction*, the Government needs to implement a comprehensive suite of policies to achieve and sustain emissions reductions in line with targets. This includes policies across the three areas of intervention identified in our policy framework:

- Action to address barriers
- Pricing to influence investments and choices
- Investment to spur innovation and system transformation

2 Significant action will be needed within specific sectors – for example, to drive changes to how energy is generated, the way people travel, or how land is used. However, some important changes also need to cut across sectors to enable change at a systems level.

3 Drawing on our policy framework, this chapter contains six recommendations that will help to drive change across all sectors, and at the system level.

4 Amending the New Zealand Emissions Trading Scheme (NZ ETS) will have impacts that cut across sectors by boosting the price signal and incentivising businesses and individuals to make choices that lower emissions. Measures at the system level are needed alongside the NZ ETS to help overcome market problems and to spur innovation.

5 Action is also needed in some areas that cuts across sectors, for example, to support a more circular economy, develop a bioeconomy, and reduce emissions from towns and cities. This will require coordination across government, while working in partnership with local government, industry, business, and other stakeholders.

6 During consultation, submitters to the *2021 Draft Advice for Consultation* highlighted the country's response to the COVID-19 pandemic as an important example of what is possible. Some noted that it showed how strong leadership can lead to rapid and dramatic changes and achieve great outcomes.

7 There were strong calls for the Government to respond to climate change with similar urgency and to learn lessons from the COVID-19 response, including the importance of 'going hard and going early'.

Box 13.1: The New Zealand Emissions Trading Scheme (NZ ETS)

The NZ ETS was established in 2008. Its emissions price applies to around half of all emissions in Aotearoa, covering the following sectors:

- Liquid fossil fuels (mainly petrol, diesel and aviation fuel used in domestic transport)
- Stationary energy (mainly fossil fuels used for heat and electricity generation)
- Industrial processes (such as making steel, aluminium or clinker)
- Waste (operating landfills)
- Synthetic gases (fluorinated gases used as refrigerants or in electrical switchgear)
- Forestry

Forests are treated differently in the NZ ETS depending on if they were planted before 1990 or after 1989.

Participation in the NZ ETS for post-1989 forests is voluntary, so there is a significant area of this forest that is not in the scheme. If registered in the NZ ETS, these forests can earn units for the carbon they store as they grow, but units must be paid back for the loss of carbon on deforestation.

Pre-1990 forests cannot earn units but are subject to a mandatory liability to pay units to the Government if they are deforested (see Box 10.1 in *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets* for more information).

Nitrous oxide and methane emissions from agriculture are not covered by the NZ ETS emissions price. The Government is currently aiming to implement an alternative farm-level emissions pricing scheme for these emissions by 2025.

Some businesses receive free units from the Government because they undertake activities that are both emissions intensive and trade exposed. This is called industrial free allocation. Free allocation recognises that NZ ETS costs might affect the international competitiveness of these activities, causing production to shift offshore in a way that increases global emissions.

An effect of this free allocation is a weaker incentive to reduce emissions from these activities. In 2019, total industrial free allocation was 8.3 million units. In comparison, gross emissions from covered sectors other than forestry was 38.8 million tonnes CO_2e.

13.1 Strengthen market incentives to drive low emissions choices

8 Emissions pricing is a powerful tool, and an essential component of an effective policy package for reducing emissions, as discussed in *Chapter 11: Approach to developing advice on policy direction*. In Aotearoa, the main emissions pricing instrument is the NZ ETS.

9 A strong theme that we heard during consultation was a lack of trust in the effectiveness of the NZ ETS, in part based on its limited impact on emissions over the first decade of implementation. A significant number of submissions called for it to be replaced by other policies, particularly a carbon tax or to a lesser extent, by a different type of trading scheme.

10 Since 2016, there have been a series of reforms to the NZ ETS to improve its effectiveness and give it the framework it needs to have more impact – including a cap on emissions.

11 Stability and political commitment to climate policies are two of the most important factors needed to give businesses the confidence to invest in reducing emissions. Dismantling the NZ ETS and attempting to replace it with a different policy would create a great deal of uncertainty and would likely delay much needed action to reduce emissions. In effect, emissions trading schemes and carbon taxes are also very similar policies, and share many features and challenges.

12 For these reasons, we do not see a compelling case for replacing the NZ ETS with a different type of emissions pricing policy.

13 The NZ ETS will need adjusting on an ongoing basis to keep it fit for purpose. The NZ ETS now has much of the architecture it needs to be effective, but further improvements are needed, detailed below.

13.1.1 Amend the NZ ETS to drive gross emissions reductions

14 The Commission's advice on meeting emissions budgets and the 2050 target focuses on reducing gross emissions wherever possible, as outlined in *Chapter 5: Recommended emissions budgets*. This is a departure from current policy, and from the way the NZ ETS is currently operated.

15 The NZ ETS in its current form does not differentiate between carbon removals by forests and gross emissions reductions. If left unchanged, this will drive the relatively low short-run cost abatement option of planting pines, rather than more costly gross emissions reductions that put Aotearoa on a path to net zero that is sustainable over the long term beyond 2050.

16 Carbon removals by fast-growing tree species, such as pine, can offset an amount of gross emissions, but this benefit is one-off. It does not reduce ongoing gross emissions, and, to maintain the one-off benefit, the planted land must remain in forest permanently.

17 This puts a burden on current and future generations because it reduces the flexibility of land use and only delays the need to reduce gross emissions. These drawbacks have informed the Commission's advice on the proportions of emissions reductions and removals for meeting emissions budgets.

18 To deliver outcomes aligned with this advice, the NZ ETS will have to be amended to decouple the incentive for gross emissions reductions from forestry. There are several options that could achieve this, all of which involve amending the NZ ETS's rules on forestry or on use of forestry units.

19 How best to achieve this decoupling will need to be carefully considered and consulted on, to understand the implications and avoid unintended consequences. The Government will need to undertake the detailed analysis on the best way to make this change, rather than the Commission. Further discussion of this and other issues connected with the NZ ETS and forestry is in *Chapter 18: Policy direction for forests and other carbon stocks*.

13.1.2 Adjust NZ ETS unit volumes and price control settings to align with budgets

20 The Commission's recommended emissions budgets differ from the provisional emissions budget that was used to inform NZ ETS unit supply and price control settings for 2021-2025.

21 In 2021, unit supply and price control settings must be updated to cover the 2022-2026 period. These settings include the volume of units to be auctioned in the NZ ETS as well as the auction reserve and cost containment reserve trigger prices, which start at $20 and $50 respectively in 2021.

22 The Commission's modelling indicates that meeting the 2050 target will involve marginal abatement costs to reduce emissions from energy use higher than these NZ ETS auction price control settings, at around $140 in 2030.

23 In addition to this indicative value our evidence suggests that in process heat, a sector where an emissions price can be expected to play an important role in driving decarbonisation, significant opportunities exist at costs from around $50 upwards.

24 The value of $140 in 2030 should not be interpreted as a forecast of the NZ ETS market prices. The actual prices observed in the NZ ETS will depend on the mix of policies implemented to meet emissions budgets.

25 The more the Government chooses to complement the NZ ETS with other policies, the more likely it is that the New Zealand Unit (NZU) price in the NZ ETS can be lower while still achieving the same overall emissions reductions.

26 Regardless of the policy combination the Government chooses, the auction reserve and cost containment reserve price triggers in the NZ ETS both need to be higher. The price corridor they signal should be sufficiently wide to allow price discovery by the market to occur and factor in inflation to prevent the price levels from eroding in real terms.

27 The NZ ETS cost containment reserve trigger price should be set well above expected market prices. An initial step up in value, to mitigate risks that it will be triggered and add to the NZU stockpile, should be followed by annual increases to give a trajectory that allows for prices of at least $140 in 2030.

28 The auction reserve price trigger should also step up to a higher value closer to recent market prices, to ensure price continuity and to safeguard existing investments (we note the afforestation levels in our modelling are based on an assumed emissions price of $35). Annual increases after this can be more moderate than those to the cost containment reserve trigger price, to manage risks of creating unintended speculative opportunities.

29 The unit volumes making up the NZ ETS cap, including the amount of units to be auctioned, will also need to be updated to reflect the first and second emissions budgets. Both unit volume and price control settings should continue to factor in the need to reduce the NZU stockpile.

13.1.3 Improve NZ ETS market governance

30 Effective governance of the NZ ETS is important for the integrity and efficiency of market trading and to reduce the risks of misconduct.

31 The Government has recognised that the regulatory framework governing conduct in the NZ ETS market is patchy and incomplete.

32 It has established a work programme to address the lack of effective governance and associated risks, which include insider trading, market manipulation, false or misleading advice to participants, potential lack of transparency and oversight of trades in the secondary market, money laundering, credit and counter-party risks and conflicts of interest.

13.1.4 Address other NZ ETS-related issues

33 There are a range of other NZ ETS-related issues that also need progressing. They are already being worked on within government and it is important that this work continues. They include:

- **Considering options for recycling some or all of the cash generated from NZ ETS unit auctions**

34 For example, these proceeds could be invested in emissions reductions, assisting communities or local authorities with adapting to the impacts of climate change, climate education, equitable transitions or helping Aotearoa to meet its Nationally Determined Contribution.

35 Any plan for use of these proceeds should consider how to provide appropriate support to Iwi/Māori and have governance arrangements that ensure equitable outcomes for Iwi/Māori. We note that support for recycling the proceeds of emissions pricing was a strong theme in consultation feedback.

- **Continuing to implement the legislated process for phasing out industrial allocation**

36 A number of submitters expressed strong support for eliminating industrial allocation entirely. Others were concerned that the phase-out will increase emissions leakage risk, with potential adverse impacts on their business or employment.

37 We note, however, that the legislation includes the ability to decrease the mandated phase-out rates on the basis of the Commission's assessment of emissions leakage risk.

38 We note that if agricultural emissions are priced, either in the NZ ETS or in an alternative pricing mechanism, the methods, level and phase-out of agricultural free allocation will need to be appropriately designed. See *Chapter 17: Policy direction for agriculture* for more information.

- **Reviewing other aspects of industrial allocation policy**

39 In particular, the government must consider overallocation risks, eligibility rules, updates to the Electricity Allocation Factor and allocative baselines.

- **Exploring alternative policy instruments that could address the risk of emissions leakage**

40 Potential instruments include product standards, consumption taxes and border carbon adjustments, given that ongoing output-based industrial allocation is not compatible with deep decarbonisation.

41 We note that these options all come with challenges. For example, there are questions around how border carbon adjustments could be made compatible with international trade law. This means that they are likely to be potential options for the longer term, rather than implemented as replacements for industrial allocation in the near future.

42 Consultation feedback on this issue was mixed. Some submitters were supportive, but others were concerned about the potential use of trade measures to achieve climate change goals, particularly scope for these measures to be used against Aotearoa.

- **Providing more information to reduce uncertainty about adjustments to NZ ETS settings**

43 This will help to build confidence in the market and support informed decision making by market participants.

44 The flexible design of the NZ ETS cap allows significant scope for cap adjustments over time. Looking forward, the way the cap is set can factor in forecast emissions or removals, either within or outside of NZ ETS coverage. Under certain circumstances, the cap can also be amended after it is set, taking into account actual emissions performance and revisions to forecasts.

45 This flexibility is useful, given that significant emissions and removals, such as those from post-1989 forests not registered in the scheme, remain outside of the NZ ETS. The downside is the uncertainty, and therefore risk, that these adjustments create for market participants.

46 Providing more information about how this flexibility will be exercised would reduce uncertainty for participants. In particular, it would be useful for the Government to clarify how it intends to manage NZ ETS unit volumes in light of the split-gas 2050 target and the planned inclusion of biogenic agricultural emissions in a separate pricing mechanism.

47 One option the Government could consider would be to outline its approach to making adjustments to the NZ ETS cap over time in a published document or policy. This would help to reduce uncertainty about future unit supply and feed into price expectations.

- **Clarifying the role and avenues for voluntary mitigation in Aotearoa.**

48 Some individuals and businesses wish to undertake voluntary action to contribute towards or go beyond meeting the country's emissions reduction targets. Failure to leverage this desire for voluntary action in addition to government policy would be a missed opportunity to deliver further climate benefits.

49 Businesses and other organisations are already making voluntary commitments, including for carbon neutrality, which may be based on incorrect expectations about using NZUs for voluntary offsetting. This is therefore a matter that should be clarified as a priority, so that voluntary market participants understand the options available to them for making robust voluntary mitigation commitments or claims.

50 Any government guidance should also take into account the accounting issues connected with voluntary offsetting and carbon neutral claims, which are discussed in *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets*. Some submitters requested that the Commission provide detailed guidance about how to enable voluntary mitigation. However, detailed policy design and decisions sit with the Government, rather than the Commission.

Recommendation 11

Strengthen market incentives to drive low-emissions choices

We recommend that, in the first emissions reduction plan, the Government commit to:

Amending and continually improving the NZ ETS so that it delivers the incentives needed to achieve emissions budgets.

This should include:

1. Amending the NZ ETS to strengthen the incentive for gross emissions reductions and to manage the amount of exotic forest planting the NZ ETS drives, in line with the Commission's advice on the proportion of emissions reductions and removals necessary for meeting emissions budgets (see also Recommendation 25).
2. Updating NZ ETS unit supply and price control settings to:
   a. Align unit volumes with emissions budgets, taking into account the need to reduce the NZU stockpile.
   b. Increase the cost containment reserve trigger price to $70 at the first possible opportunity and then every year by at least 10% plus inflation.
   c. Maintain continuity with recent prices, by increasing the auction reserve trigger price to $30 as soon as practical, followed by annual increases of 5% plus inflation per year.
3. Establishing an effective market governance regime for the NZ ETS as soon as possible to mitigate risks to market function, delivered through an interagency team.
4. Continually improving the NZ ETS, including by:
   a. Developing and implementing a plan for recycling proceeds from NZ ETS unit auctions into emissions reductions, adaptation, climate education, equitable transitions and meeting international climate change obligations. This plan should include mechanisms to ensure that it contributes to equitable outcomes for Iwi/Māori.
   b. Implementing the legislated process for review and phase-out of industrial free allocation, reviewing other aspects of industrial free allocation policy to ensure they are fit for purpose and exploring other policy instruments that over the longer term could be used to address the risk of emissions leakage.
   c. Providing more information to reduce uncertainty about adjustments to NZ ETS settings, to support informed decision-making by market participants.
   d. Urgently clarifying the role and avenues for voluntary mitigation in Aotearoa, so that businesses and other organisations can understand the options available to them for making robust voluntary commitments or claims.

Recommendation 11

Provisional progress indicators

1. Government to have, by 31 December 2022, developed proposals for strengthening the NZ ETS incentive for gross emissions reductions and managing the amount of exotic forest planting driven by the scheme, with amendments to be effective by 31 December 2024.
2. Government to ensure that, in the next annual update to NZ ETS settings, unit volumes are aligned with emissions budgets and price control settings are increased.
3. Government to develop proposals by 30 June 2022 for establishing an effective market governance regime for the NZ ETS, and to have legislated to address the most significant risks by no later than 30 June 2023.
4. Government to develop and publish a plan for recycling proceeds from NZ ETS unit auctions by 30 June 2022, followed by annual reporting on the implementation of the plan and how the proceeds have been used.

13.2 Make investments net-zero compatible

51 To meet emissions budgets and achieve the 2050 target, it is important that policy decisions and investments made now do not lock Aotearoa into a high emissions development path, or increase exposure to the impacts of climate change.

52 Safeguards and signals will be needed to prevent this, including a specific focus on ensuring long-lived assets such as infrastructure are net-zero compatible.

53 Incorporating long-term abatement cost values consistent with climate change goals into the Government's cost-benefit or cost-effectiveness analysis would have a powerful effect in helping to make sure policy and investment decisions are net-zero compatible. This is sometimes termed a 'shadow price' on emissions and is common practice internationally.

54 As discussed in *Chapter 11: Approach to developing advice on policy direction*, emissions pricing incentivises businesses and individuals to make choices that lower emissions. Shadow emissions pricing anticipates future emissions prices and complements emissions pricing through the NZ ETS because it helps decision makers account for emissions impacts and costs over the project's entire lifetime.

55 Shadow emissions prices are especially important for government policy and investment decisions that involve large resources, or that become long-lived or irreversible once made. This includes significant national infrastructure investments, such as those being made to support the post COVID-19 recovery.

56 Work has progressed on developing an approach to incorporating shadow emissions prices into government decision making. However, it is not yet widely embedded within government processes or consistently applied.

57 The use of shadow emissions prices by local government and the private sector would also help to make sure other infrastructure and investments are future proof.

58 However, some local government submitters noted that they face capacity and capability challenges when it comes to factoring costs into long-term investment decisions, and called for more guidance from central government for how to do this well. Some private entities will face similar challenges and may also need guidance.

59 The Commission's modelling has enabled a better understanding of the marginal abatement costs likely to be required in Aotearoa to meet the emissions budgets and 2050 target. Our analysis suggests that marginal abatement costs of around $140 per tonne of CO_2e abated in 2030, and $250 in 2050 in real prices, are likely to be needed to reduce emissions associated with energy use, as outlined in *Chapter 5: Recommended emissions budgets*.

60 This information should inform the values used for policy and investment appraisal in Aotearoa. However, this information is not complete, as it primarily relates to the energy and transport sectors. It would therefore be prudent to treat these abatement cost estimates as conservative and use a range of values or sensitivities in analysis.

61 For example, the UK Government uses a set of central, high and low carbon values in its policy appraisals, as outlined in its Green Book framework for policy and project appraisal.

62 Over time, the abatement cost values used will need to be updated as the evidence base improves and extends to non-energy related abatement costs.

Recommendation 12

Make investments net-zero compatible

We recommend that, in the first emissions reduction plan, the Government commit to:

Ensuring policy decisions and investments made now support Aotearoa moving towards a thriving, climate-resilient and low-emissions society.

This should include:

1. Starting to factor shadow emissions prices into policy and investment analysis in central government immediately.
2. Encouraging and facilitating local government and the private sector to use shadow emissions prices by, for example, providing guidance to upskill and grow local government capacity to use them in their policy and investment analysis.
3. Measuring and reporting on how the post-COVID-19 economic stimulus is delivering climate benefits and the transformational investment needed to reach the climate and economic goals.
4. Requiring Crown agencies, entities and Crown-owned companies to include climate change as part of their decision making. This should be a particular focus for long-lived investments such as housing and transport infrastructure, to help achieve emissions reduction and climate-resilience objectives, and should include embedded emissions.

13.3 Enable system level change through innovation, finance and behaviour change

63 Aotearoa needs to speed up efforts to create and adopt new technologies and systems to give people and businesses more, better and less costly ways of reducing their emissions. To achieve this, government, business and industry will need to make significant investments in innovation and infrastructure.

64 To support this the Government needs to take action to mobilise public and private capital to support low-emissions outcomes, and make it easier for researchers, industry and businesses to develop, adapt and deploy innovative technologies.

65 The Government will also need to address behavioural barriers that prevent people and businesses from making the most of cost-effective opportunities to reduce emissions, by putting in place policies and programmes to enable New Zealanders to make choices that support low emissions outcomes.

13.3.1 Accelerate transition through innovation and research, development and demonstration

66 Transitioning Aotearoa to low emissions will require innovation right across the economy. Aotearoa is likely to be a technology taker in some areas, but innovation will still be needed to absorb, adapt, and deploy new technologies and processes developed elsewhere.

67 Low-emissions research, development and demonstration (RD&D) is about creating new technologies and process that reduce emissions – for example, inventing new ways of generating energy, new fuels, developing more efficient processes, or technologies to reduce emissions from agriculture.

68 Innovation is broader than RD&D, it is the process of converting knowledge and ideas into new and better ways of doing things. Innovation includes adapting, absorbing and extending the reach of technologies and knowledge generated through RD&D.

69 Innovation can play a central role in speeding up emissions reductions and reducing costs. Yet, innovation is costly and risky, and can be hard for many businesses to justify in the face of competing pressures. Success depends on access to knowledge, skills and finance.

70 As discussed in *Chapter 11: Approach to developing advice on policy direction*, emissions pricing through the NZ ETS provides some encouragement for the development of new technologies and practices. However, it does not provide the full incentive that would exist if all the co-benefits of low emissions innovation were considered.

71 The spillover benefits of innovation and RD&D justify more direct support, which would help to maximise and accelerate the benefits.

72 The Government should ensure it has well-designed policies and support in place to enable researchers, industry and businesses to develop, adapt and deploy innovative technologies in Aotearoa. This could include both direct and indirect support.

73 Direct support could include measures such as RD&D tax incentives, research grants and intellectual property regulation. More indirect support could include measures to increase the supply of skilled workers and researchers, and to improve access to financing and venture capital.

74 There is already a considerable body of local and international research looking at how government can most effectively support innovation, including from the Productivity Commission.

75 Ensuring support for RD&D and innovation that aligns with broader societal goals is important, and the transition to a low-emissions society is a key priority that should be reflected in the Government's approach.

76 It is important to note that RD&D and innovation bring gains over long timeframes, so incentives need to be in place early to drive the innovation needed to support a cost-effective path to meeting the 2050 target.

13.3.2 Mobilise finance for low emissions investments

77 Investment will be needed right across the economy to support the transition to low emissions. It is essential for funding innovation and RD&D, as well as infrastructure, equipment and more efficient processes to reduce emissions, including to enable responses to emissions pricing.

78 The important role of finance was highlighted during consultation, with some submitters noting that access to finance and investment capital will underpin emissions reductions in every sector. Some submissions from business, industry and the financial sector called for a greater focus on how the transition to low emissions will be financed.

79 Ensuring that public investments support low-emissions outcomes will be a critical part of this. Government project and programme funding must be aligned with climate goals (as discussed in the previous section). Some submitters highlighted the scale of public resource made available as part of the country's COVID-19 response, including significant investments in infrastructure.

80 Public entities and investment vehicles (for example, ACC and the NZ Superfund) also hold significant financial assets. Incorporating low-emissions investment criteria into their investment strategies could have a significant impact. The actions that public entities undertake can affect change in the actions and investments of others, spurring wider change.

81 Mobilising private investment will also be critical. Capital needs to be redirected away from emissions-intensive activities, and finance for low-emissions investments needs to be scaled up.

82 Barriers that currently hinder flows of private capital towards low-emissions investments must be identified and addressed, and ways to incentivise the growth of sustainable capital markets need to be explored.

83 A considerable amount of advice has been developed in Aotearoa and overseas that looks at approaches to changing the way investment and lending decisions are made, to support sustainable finance flows. This includes, for example, the Sustainable Finance Forum's *Roadmap for Action* and work undertaken through the global Network of Central Banks initiative *Network on Greening the Financing System.*

Climate change exposes the financial system to risk and instability

84 Without clear and transparent information about exposure to climate risk, firms, lenders, investors, insurers and other stakeholders may be left with unforeseen liabilities or risks.

85 Internationally, firms are increasingly being required to provide information on the extent of their climate risk exposure and to identify how those risks are being managed – known as climate-related disclosure.

86 Such disclosures generally include information about a firm's exposure to transition risks such as ownership of emissions intensive assets, physical risks from climate impacts, as well as information about how the risks will be managed.

87 Climate-related disclosure gives investors, insurers, consumers and others access to the information they need to make informed choices and avoid exposure to climate risks. It also helps individual entities improve their own understanding of how exposed they are to climate risks.

88 The mandatory climate-related financial disclosures regime recently enacted by the Government is an important step in improving transparency and information about climate risk in Aotearoa. It draws on the recommendations of the Task Force on Climate-related Financial Disclosures, which are considered international best practice for climate-related financial reporting.

89 The ongoing review of this regime will be important to ensure that it remains fit for purpose in the future, and as knowledge about the nature of climate risks evolves. It will also be important to ensure that firms and other entities have the guidance they need to make sure disclosures are consistent, and of good quality.

13.3.3 Support behaviour change

90 Low-emissions technologies, practices and processes can only be effective at reducing emissions if they are adopted and taken up by individuals and businesses. Creating an enabling environment for New Zealanders to make choices that support low-emissions outcomes is therefore critically important.

91 Transitioning to a low-emissions economy will require New Zealanders to change some aspects of their lives. Many people will need to change the type of car they choose to drive, the way they choose to travel, and the way they heat their homes. Many businesses both large and small will need to switch to new processes and ways of doing things. Many farmers will need to change how they manage their land.

92 These changes do not need to be expensive or reduce New Zealanders' quality of life. Many changes will offer immediate and significant co-benefits to health and wellbeing. However, the pace or scale of change needed will not be achieved without first addressing the barriers that prevent the uptake of low-emissions options and approaches.

93 Insights from behavioural economics suggest that adopting new behaviours and technologies can be slow and costly at first but can become cheaper and faster with practice and over time. Once established, initial changes can quickly become embedded into general societal behaviour and form a new status quo.

94 For example, an individual considering a shift to cycling to work will need to consider the initial costs of a bike (including helmet, locks, lights), learning a safe and quick route to work, and finding somewhere safe and convenient to store the bike. However, after this initial investment, it may quickly become a more efficient and preferable way to commute.

95 As the number of cyclists on a particular route increases, social norms around the preferred way to travel may also change. As this example shows, the range of barriers to behaviour change are varied and interconnected. The barriers to changing individual and business behaviour will be different, but understanding and addressing both will be important.

96 The importance of behaviour change emerged as a key theme during consultation, with many submitters focused on the need for measures that support behaviour change – especially in areas where low-emissions alternatives already exist.

97 There were also calls for more research to increase understanding of the most effective ways to influence consumer choice and shift behavioural choices in different sectors. Understanding how to encourage long-term and sustainable behaviour change will require an evaluation of current and past programmes in Aotearoa and internationally to determine what tools to use when, and why.

Education, engagement and information can help shift behaviour

98 Education and information can support behaviour change. Individuals and small businesses, in particular, may not have the time and resources to seek out reliable information. Large-scale change will not occur without widespread communication and access to information. Public engagement is also addressed in Recommendation 10.

99 Specific tactics may involve changing public narratives and perceptions to create a shared positive narrative about climate action. This could help to bolster public support and make behaviour changes more feasible.

100 Public support, even if it starts from a small group, can serve as a tipping point for wider social change creating a positive feedback effect.

101 To shift social norms and promote low-carbon choices it will be important to engage different actors and groups of society, such as businesses, local community groups, and Iwi/Māori. Using community approaches and local knowledge can help to promote and socialise the wide-scale behaviour changes needed.

102 Many submitters used the example of COVID-19 as an example of a successful national effort to engage the public and address a problem, and wanted to see similar efforts to address climate change.

103 Access to information through better data and technology can help people make more informed decisions and support low-emissions practices. Providing clear information through labelling schemes and consumption-based emissions accounting approaches could also help consumers understand the emissions embodied in goods and services, and in the choices they make.

104 However, some submitters were concerned about the tendency to focus on individual behaviour change, rather than the behaviour of business, industry, and central or local government. To accelerate the transition to low emissions, it is important that change happens at both the individual and system level.

105 There have been some efforts by government in Aotearoa to change public behaviour towards low emissions options, notably by the Energy Efficiency and Conservation Authority for energy efficiency outcomes. However, there has not been a systematic effort that involves multiple agencies to coordinate, share best practice and focus efforts on shifting behaviour for climate outcomes.

106 Many of the actions in our advice rely on behaviour change at the individual and organisational level. Government should consider targeted interventions or campaigns for behaviour change in its climate change policies, such as encouraging mode shift in transport, energy efficiency measures, and reducing waste generation.

107 Any behaviour change programmes should be monitored and evaluated against specified outcomes and be supported by evidence and research.

108 Understanding public attitudes could also help to identify opportunities for change, so interventions are targeted to the most receptive audience and could be more effective. It is also important to support early movers and share good practice, so that individuals and organisations can see that behavioural shifts are possible and desirable.

Recommendation 13

Enable system-level change through innovation, finance and behaviour change

We recommend that, in the first emissions reduction plan, the Government commit to:

Enabling system-level change in Aotearoa through innovation, finance and behaviour change

This should include:

1. Accelerating the transition through innovation by:
    a. Giving high priority to low-emissions research, development and innovation within public science and innovation funding approaches. This should include support for research, development and innovation that draws on mātauranga Māori.
    b. Introducing targeted measures to support low-emissions research, development and innovation. This could include tax incentives, research grants and intellectual property regulations, and must include mechanisms to enable Māori-collectives and researchers to equitably benefit.
    c. Creating an enabling regulatory environment for new and emerging low-emissions industries and sectors, including removing barriers for Iwi/Māori to participate in these opportunities.
2. Mobilising finance for low emissions and climate-resilient investments:
    a. Investigating and developing actions government can take to help mobilise private sector finance, including ways to improve access to low-emissions finance for Māori-collectives.
    b. Exploring the extension of the mandatory climate-related disclosure regime to cover a broader range of activities, for example, public entities at the national and local level.
    c. Evaluating the benefits of extending mandatory climate-related disclosure to cover emissions enabled by loans, from financial institutions, over a certain threshold.
3. Supporting behaviour change:
    a. Including behaviour change in the design of climate change policies and programmes, in order to enable New Zealanders to make choices that support low-emissions outcomes.
    b. Identifying a lead agency and establishing a dedicated, well-resourced fund for education and information to promote and socialise the wide-scale behaviour changes needed. This should involve communities, Iwi/Māori and local knowledge.

13.4 Increase the circularity of the economy

109 Transitioning from a relatively linear economy to a more circular economy has the potential to reduce emissions across the economy and generate numerous social, environmental and economic co-benefits. Increasing circularity reflects a consumption based perspective to reducing emissions – see *Chapter 10: rules for measuring progress towards emissions budgets and 2050 targets*.

110 In a linear economy resources are used in a straightforward process from extraction, to production, to consumption, and then to disposal. A circular economy is one where products are designed to last as long as possible, with products and materials recovered and reused at the end of each service life.

111 A circular economy is based on three principles:

- Designing out waste and pollution
- Keeping products and materials in use
- Regenerating natural systems

112 The concept of a circular economy encompasses both biological and technical cycles. The biological cycle is about directly displacing fossil fuels with renewable biological resources. This is primarily addressed in Section 13.5.

113 The technical cycle is about recovering and restoring products, components and materials – including those from non-biological resources. This is primarily the focus of this section.

114 A clear plan and vision for a more circular economy, supported by good data collection and methods to measure circularity, could help assess the scale of potential emissions reductions. However a more circular economy would be more resource efficient, change consumption behaviours to be more sustainable and would likely lead to significant emissions reductions.

115 Waste is a common end point for many products in the linear economy but would play only a minor role in a fully circular economy.

116 Moving to a more circular economy aligns with a te ao Māori view that recognises the relationships across the whole system. Incorporating mātauranga Māori from the outset would provide access to tikanga and kaitiaki practices that already emulate a circular economy. It would also help Aotearoa embed Te Tiriti principles into the evolving fabric of the economy.

117 An Aotearoa specific approach is needed, although we can draw on international examples.

118 For example, the Netherlands have set a goal for achieving a completely circular economy by 2050, and are supporting this through public sector circular procurement, budget funding for circular projects, and publishing a progress report every two years.

119 Other examples include the European Commission, which has a circular economy action plan as a key component of the 'European Green Deal'. This is tracked through a circular economy monitoring report. China also adopted the Circular Economy Promotion Law in 2009 and enacted this with preferential policies for scavenger and decomposer companies and green labelling of recycled products.

Box 13.2: What a more circular economy could look like – a building sector example

The construction sector already contains circular economy elements. For instance:

- In Auckland, gypsum is extracted from construction waste and used as agricultural and horticultural products.
- Golden Bay Cement has begun to use 'tyre derived fuel' – chipped or shredded used tyres. This has the dual benefit of reducing emissions by displacing coal use and consuming a waste product otherwise disposed of in landfills or dumped.
- Most steel is repurposed at the end of life. In Aotearoa, this is largely exported for recycling overseas.

However, there are greater opportunities to increase the circularity of the construction sector. Reducing building waste by moving to more efficient processes will prevent wood and construction waste going to landfill, therefore preventing the emissions from landfill.
Reusing construction materials will also reduce the associated emissions from extracting new materials from forests, processing it into building material and transporting it from manufacturers to the construction site.

13.4.1 The Government needs a long-term circular economy strategy

120 A clear, integrated long-term strategy would help identify cross-sector enabling regulations and investments that would be required to move towards a more circular economy. Clear governance structures would need to be established as part of this.

121 A long-term strategy would provide a roadmap to help businesses, communities and households understand what a future circular economy would look like, and support them to take action.

122 The strategy would need to include measureable indicators, which are yet to be developed for the Aotearoa context.

123 Gathering better data across the waste sector would be a useful starting point for developing a better understanding of the circularity of the economy, and where the biggest emissions reductions can be achieved.

124 Thought also needs to be given to how resources would flow between a more circular Aotearoa economy and other economies internationally. Aotearoa has a limited economy of scale, and interacting with other economies taking circular approaches can increase efficiencies.

125 Moving towards a more circular economy should be aligned with other sectoral strategies such as the Bioeconomy Strategy, National Energy Strategy, Industry Transformation Plans, New Zealand Waste Strategy and equitable transitions planning.

Recommendation 14

Increase the circularity of the economy

We recommend that, in the first emissions reduction plan, the Government commit to:

Developing and delivering a long-term strategy to move Aotearoa to a more circular economy.

This should include:

1. Acting in partnership: To be enduring, the strategy must be created in partnership with Iwi/Māori, give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, and align with the He Ara Waiora framework. Consideration should also be given to:
    a. How to embed a complementary mātauranga Māori approach in the strategy (see also Recommendation 26 on equitable and proactive partnership with Iwi/Māori).
    b. Enabling Māori-collectives to participate in associated business opportunities.
2. Prioritising and investing in data collection to support measurable indicators to enable monitoring of progress towards circularity and the impact on emissions.
3. Providing a clear governance structure, including tasking a minister and lead agency to assess and implement actions for a more circular economy.
4. Setting up a mechanism that enables active collaboration with Iwi/Māori, local government and industry.

13.5 Develop a thriving, climate-resilient bioeconomy that delivers emissions reductions

126 The 'bioeconomy' refers broadly to the parts of the economy that use renewable biological resources (biomass) to produce food, products and energy. When it incorporates circular economy principles, a bioeconomy can use biomass residues or waste from forestry, fisheries, agriculture and households as raw materials to produce other products.

127 A thriving bioeconomy in Aotearoa could deliver emissions reductions by decarbonising energy sources, replacing fossil fuel-derived materials in supply chains, increasing the carbon stored in long-lived products, and reducing waste. It would also provide significant regional employment opportunities.

128 For example, used cooking oil, crop residues and woody biomass can be used to produce bioenergy. When lower-emissions bioeconomy products displace materials or energy derived from fossil fuels, emissions are reduced.

129 There are several challenges to creating a thriving, climate-resilient bioeconomy that delivers emissions reductions. Many sectors are involved, which can have different priorities and are managed by different agencies who are accountable to several Ministers.

130 Developing a bioeconomy involves transforming and integrating supply chains. While the current resource available to support a bioeconomy that displaces fossil fuels is large, it is still limited, and there are data gaps that prevent efficient matching of regional supply and demand. We heard during consultation that the limited coordination at a central government level is currently a major barrier.

131 While the current resource available to support a bioeconomy that displaces fossil fuels is large, it is still limited, and there are data gaps that prevent efficient matching of regional supply and demand.

132 There are also alternative uses of some available residues, such as forest harvest residues providing nutrients for subsequent rotations, which need to be considered. Other land uses, particularly food production, also compete for land that could be used to create biomass.

133 Our analysis to determine the budget levels has not involved assuming any land-use change to dedicated biomass crops. However, bioenergy could complement some current land uses.

134 We heard mixed views on the scale of the resource during consultation. Some industry submitters believe bioenergy sources are underutilised and underdeveloped, while others worry there will not be enough bioenergy to meet our needs.

13.5.1 The Government needs a bioeconomy strategy

135 To realise the emissions reductions potential of the bioeconomy, the Government should develop and deliver a strategy.

136 To address tensions and diverging priorities across sectors, the strategy will need to lay out a clear governance structure, including clearly identifying a lead agency and Minister.

137 The strategy should be developed in partnership with Iwi/Māori, including with tangata whenua and kaitiaki that have significant interests in assets that will contribute to a bioeconomy. The strategy would benefit from tikanga-based values that emphasise intergenerational wellbeing. It will also need to draw on international best practice.

138 In the short term, publishing data on existing biomass supply and demand would enable industry to develop new regional supply chains. The Government should also assess the emissions reduction potential of existing biomass, and introduce regulatory settings to target this resource towards the hardest-to-abate sectors.

139 In the longer term, the strategy should evaluate the future value of the bioeconomy, with a view to stimulating areas with the most potential to reduce emissions and generate economic opportunity. The strategy should include a package of policies to create effective settings for attracting investment into the sector.

140 This could include, for example, grants, tax credits, or regulation, as well as measures to support the development of regional hubs to support resilience and measures for monitoring the supply, use and demand of biomass residues. Supportive procurement and building policies would also have flow-on effects to support production and use of greater biomass residues.

141 The bioeconomy strategy should be developed alongside the National Energy Strategy and closely linked to Industry Transformation Plans, the revised New Zealand Waste Strategy, Circular Economy Strategy, and equitable transitions planning.

142 It will also be important to ensure the strategy considers and monitors how the development of a bioeconomy impacts carbon stored in forests and wood products.

Recommendation 15

Develop a thriving, climate-resilient bioeconomy that delivers emissions reductions

We recommend that, in the first emissions reduction plan, the Government commit to:

Developing and delivering a strategy for a thriving, climate-resilient bioeconomy that reduces emissions through displacing fossil fuel-derived production materials and energy sources.

This should include:

1. Acting in partnership: To be enduring, the strategy must be created in partnership with Iwi/Māori, give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, and align with the He Ara Waiora framework. Consideration should also be given to:
   a. How to embed a complementary mātauranga Māori approach in the strategy (see also Recommendation 26 on an equitable and proactive partnership with Iwi/Māori).
   b. Enabling Māori-collectives to participate in associated business opportunities
2. Providing a clear governance structure, including tasking a Minister and lead agency to assess and address competing interests and trade-offs within and across the sectors involved in the bioeconomy.
3. Setting up a mechanism that enables active collaboration with Iwi/Māori, local government and industry.
4. Integrating considerations across the agriculture, building, energy, forestry, land, transport, and waste sectors (see relevant sector recommendations) including:
   a. Collating and publishing data on existing biomass resource supply and demand to identify potential regional supply chains.
   b. Introducing regulatory or investment settings that prioritise high value and emissions reduction uses for biomass resources.
   c. Evaluating the future value of the bioeconomy including as a source of fuels, construction materials, other products, employment and economic opportunity.
   d. Creating an environment that enables research and innovation to drive a valuable future bioeconomy (consistent with Recommendation 13 on innovation, finance, and behaviour change).

13.6 Enable emissions reductions through changes to urban form, function and development

143 The way cities and towns are designed affects emissions from land use, transport, buildings, energy and waste. It also affects exposure of communities and businesses to climate risk. Changes to urban form can play a role in the response to climate change, and have the potential to unlock deeper emissions reductions over the long term.

144 Urban form refers to the physical characteristics that make up urban areas, including the shape, size, density, activities and configuration of settlements.

145 Emissions are generated throughout the lifecycle of infrastructure and buildings in urban environments. This includes emissions embodied in the materials and processes used to produce them, emissions generated through their operation and use, and emissions created as they are maintained and disposed of.

146 Emissions will vary depending on the type and location of buildings and infrastructure – for example, how dense and accessible urban communities are, and what type of transport infrastructure residents have access to.

147 The importance of urban form was emphasised in many submissions during consultation. This included submissions from the building and construction sector, local government, NGOs, academia and individuals who called for more action to reduce emissions from the built environment, and changes to urban form to reduce transport emissions.

13.6.1 Well-integrated policy and planning will be important

148 Development has a long lead time, and buildings and infrastructure have long lifetimes. Urban form and function need to consider planning for future renewable energy infrastructure, intensification, afforestation and changes in transport networks, among other things.

149 Some submitters wanted a more integrated approach to land and transport planning, and highlighted the importance of clear national direction to support and empower local governments.

150 It will be important to make sure energy, three waters, and digital infrastructure can accommodate increased demand. Urban form also needs to support the shift to different types of low-emissions transport, and ensure accessibility and connectivity within and across communities.

151 It will also be important for urban planning and design to weave mātauranga Māori into the decision-making framework to increase understanding of the impacts of urban form on Iwi/Māori communities, including their taonga tuku iho, whenua, te taiao and tikanga.

152 Achieving these outcomes will require well-integrated policy and planning. Urban development requires collaboration across many actors and alignment across multiple pieces of legislation, some of which are in the process of being amended – such as the Resource Management Act (RMA).

153 Local government efforts are underway to implement policy direction under the National Policy Statement on Urban Development and to renew long-term plans. The Government should support these ongoing efforts.

154 The Government should ensure that the reform of the resource management system enables low emissions transport, land use, infrastructure and building systems. This includes supporting the development of regional spatial strategies under the proposed Spatial Planning Act and mandatory national direction for climate change mitigation and adaptation under the proposed Natural and Built Environments Act.

155 Weak national direction and lack of prioritisation of different objectives can make it difficult for local governments to plan accordingly. This can also make it difficult to ensure accountability and joined up thinking around climate change outcomes, particularly when assessed against other social and economic outcomes.

156 Lack of legislative alignment across different levels of government can also make it difficult for developers to build in a cost-effective and timely way. The complexity of the consent process has been examined in the review of the RMA.

Retrofitting existing communities, and constructing new developments pose different challenges

157 As the population and economy grow, urban areas grow to meet housing and infrastructure needs. How urban expansion takes place, where and what gets built, and how it is built will lock in emissions for a long time and create further path dependencies for development.

158 Cities can 'grow out' (construction at the edge of the city), 'grow up' (more intensive development within established areas), or both. In Aotearoa cities tend to grow out, which results in populations living farther from the city centre. The challenges and opportunities of each are different.

159 For existing urban areas, current spaces and infrastructure can be retrofitted to make it preferable to use active and public transport and make other low-emissions choices.

160 This could involve, for example, reallocating street space away from cars, creating low- or no-emissions zones, or piloting '15-minute cities'. The 15-minute city is a residential urban concept in which all city residents can meet most of their needs within a short walk or bicycle ride from their homes. Increasing density also encourages use of existing land and infrastructure.

161 However, there are considerable challenges associated with retrofitting urban areas, buildings and infrastructure that have not been designed with low-emissions outcomes in mind.

162 In contrast, new developments offer significant opportunities. These communities can be designed in a way that avoids locking in emissions for decades to come if services, amenities, facilities and infrastructure are provided for at the planning stage. These need to accessible and interconnected, including via safe cycle and walkways and connections to public transport.

Changes to urban form and function can bring other benefits

163 Good urban design is important for reducing emissions over the long term at a systems level. It also brings many other health, environmental and wellbeing benefits. This includes reduced air and noise pollution, increased levels of physical activity, reduced congestion, better connected communities and improved safety.

164 Urban design also affects accessibility and mobility. The design and layout of buildings, transport networks and public spaces must accommodate diverse needs to provide more equitable and inclusive access to city spaces and amenities, buildings, infrastructure and transport systems.

165 Accessible urban spaces can also support people to 'age in place', which in turn supports mental and physical health, along with other benefits for wellbeing.

13.6.2 A robust and consistent approach to quantifying emissions from urban form is needed

166 There have been many studies on the impact urban form, density, mobility, land use and planning approaches have on emissions. However, there is limited evidence available on the relationship between these factors, particularly for Aotearoa circumstances.

167 The variation in urban form can make it difficult to quantify the effects of different strategies to support climate outcomes. The range of different emissions sources affected by the ways towns and cities are designed can also make it difficult to coordinate planning and investments, and to ensure decision making is focused on clear outcomes.

168 Further investigation is needed to develop a robust and consistent methodology for quantifying how different aspects of urban design affect emissions. This will also help to develop a comprehensive Aotearoa-specific evidence base. Together, these should inform how approaches to reducing emissions from cities and towns, transport networks and buildings are designed.

169 Collaborative processes to integrate mātauranga Māori into modelling, quantitative assessments and planning phases will also be important to help ensure urban design solutions acknowledge Iwi/ Māori whakapapa, identity and tūrangawaewae, and the need to preserve and protect their wāhi tapū and sites of cultural significance.

170 Improving our understanding of the impact of urban form on emissions is a matter of urgency, because reducing emissions through the design of towns and cities depends on decisions that are made today.

171 Once investments are made there is little scope for revisiting earlier decisions. This means that in the face of continued uncertainty and lack of national direction, building, infrastructure and transport emissions continue to be locked in. The scale can be significant, particularly for large commercial buildings or suburban developments.

Recommendation 16

Enable emissions reductions through changes to urban form, function and development

We recommend that, in the first emissions reduction plan, the Government commit to:

Enabling emissions reductions through changes to urban form, function and development.

This should include:

1. Developing a policy approach in partnership with Iwi/Māori to ensure well-integrated planning and policies related to urban form, function and development. This approach must also be developed in active collaboration with local councils and communities.
2. Promoting urban design solutions that acknowledge Iwi/Māori whakapapa, identity and tūrangawaewae and the need to preserve and protect their wāhi tapū and sites of cultural significance.
3. Developing a consistent approach to quantifying the emissions impacts of urban development decisions. Use this to continually improve the way emissions consequences are integrated into decision making on land use, transport and infrastructure investments.
4. Improving the evidence base on the relationship between urban form, function, density, transport systems, land use and other factors. This will support the design of approaches to reduce emissions across different urban areas.

For existing urban areas:

5. Retrofitting existing public spaces and infrastructure to prioritise the use of active and public transport and other low emissions choices. This recommendation should be considered alongside Recommendation 17 for transport and Recommendation 13 for behaviour change.
6. Ensuring regulatory settings allow for increased density and use of existing infrastructure, land and built form to reduce emissions.

For new urban areas:

7. Enabling low emissions choices by ensuring services, amenities, facilities and infrastructure are accessible and interconnected. This includes providing safe cycle and walkways and connections to public transport.

Assessment of our recommendations against our policy approach

Recommendations 11-16	Action to address barriers	Pricing to influence investment & choices	Enable innovation & system transformation
Multisector strategy			
Update and improve the NZ ETS		✓	
Make investments net zero compatible		✓	✓
Enable system change through innovation, finance and behaviour change	✓		✓
Increase the circularity of the economy	✓	✓	✓
Develop a strategy for a thriving, climate-resilient, low emissions bioeconomy	✓		✓
Enable emissions reductions from urban form	✓		✓

Chapter 14

Aronga Kaupapa – Te Āheinga o Ngā Rori
Policy direction for transport

Summary

Transport makes up almost 33% of total long-lived gas emissions in Aotearoa. Action to reduce these is critical if Aotearoa is going to reach its climate targets.

There is an opportunity to decarbonise transport by 2050. This can be achieved by investing in the right infrastructure and systems, encouraging changes to behaviour, and adopting technologies that are available now and improving fast.

We have recommended three areas for the Government to focus on to reduce greenhouse gas emissions from transport. They are:

1. **Reducing the reliance on cars (or light vehicles)** and supporting people to walk, cycle and use public transport. Government needs to support this change with clear targets, plans to meet those targets, and substantial increases to funding.

   Local government plays an important role in changing how people travel, and it needs more support from central government to do the job well. This includes enabling them through legislation, removing regulatory barriers, and providing increased and targeted funding.

2. **Rapidly adopting electric vehicles (EVs).** Ambitious policies are needed to address supply and cost constraints, and bring more EVs into the country. Aotearoa should import more efficient vehicles until EVs are widely available and affordable.

3. **Beginning work now to decarbonise heavy transport and freight.** Government should develop a national low-emissions freight strategy, that includes moving more freight by rail and sea. It should also encourage the production and use of low-emissions fuels, such as biofuels, electricity, and green hydrogen.

Changes in our final advice

Our final advice is more ambitious, compared to our *2021 Draft Advice for Consultation*, around shifting the way New Zealanders travel and supporting better infrastructure for walking and cycling. It places less emphasis on private vehicle use, although accelerating EV uptake is still key to achieving our emissions budgets.

We have moved the section on urban form to the multi-sector chapter, and have conducted further analysis into this area to highlight its system-level importance.

More detail on the benefits of reducing emissions from transport, including health and environmental benefits, have been added.

We heard through consultation that the role of alternative fuels, such as hydrogen for heavy transport, was underplayed in our *2021 Draft Advice for Consultation*. In response, we have been more fuel-neutral in our discussion of low-carbon fuel options.

We have also taken a broader and more ambitious approach to heavy transport and freight, which considers efficiency and shifting to lower-emissions alternatives such as shipping and rail, rather than solely focusing on increasing low-carbon fuels.

Introduction

1 Transport made up 33% of long-lived greenhouse gas emissions in Aotearoa in 2019 and provides many options for reducing emissions within the first three emissions budget periods.

2 Investing in infrastructure, behaviour change, and technology that is available now is important. Action in these areas will be critical for achieving the 2050 net zero target for long-lived gases.

3 Our advice on policy direction was informed by the 'Avoid, Shift, Improve' hierarchy. To achieve a systematic change in our transport system, action is required on all components of this hierarchy. This point was emphasised strongly by some submitters during consultation.

- **Avoid:** reducing the need to travel and/or the time or distance travelled by car, while improving or maintaining accessibility.
- **Shift:** changing how New Zealanders move. For example, shifting from cars to lower-emissions types of travel such as public transport, cycling and walking.
- **Improve:** improving the emissions efficiency and the use of low-carbon fuels in the fleet.

4 This chapter contains three recommendations that fit across all three pillars of our policy approach.

5 The New Zealand Emissions Trading Scheme (NZ ETS) is the primary mechanism for pricing emissions, but it is insufficient on its own to change behaviour in the transport sector. Complementary policies are required to drive changes to the way New Zealanders travel.

6 In the short term, emissions savings are possible through supporting behaviour change, including reducing travel or car use. Over the next 15 years, the largest opportunity comes from electrifying the light vehicle fleet. Policies will be needed to overcome barriers and support this.

7 In the long term, better urban planning could create cities and towns that are designed for liveability and ease of mobility. Decarbonising heavy transport and freight is also a longer-term challenge, but there is action government can take now to unlock future emissions reductions.

8 Transport policy should be designed in a way that reflects the context of a diverse range of communities and individuals. Some communities have and will continue to have a high dependence on vehicles for their mobility. For example, public transport is often not practical in rural communities. Other groups have limited transport options – for example people with disabilities or limited mobility.

9 Some submitters were concerned that policies that increase the cost of vehicles, or increase driving costs, may fall disproportionately on low-income households.

10 In upholding Te Tiriti o Waitangi/The Treaty of Waitangi throughout the transformation of the transport system, the Government should ensure that transport options reflect the realities for whānau Māori, particularly in remote or rural communities. Iwi/Māori submissions identified a range of barriers to transitioning away from high-emitting transport options, mainly due to affordability constraints and lack of appropriate low-carbon vehicle options.

14.1 Provide affordable, reliable, convenient, low emissions alternatives to high emissions vehicles

11 Aotearoa has high rates of vehicle ownership and high rates of travel per person compared to other developed countries. Travel by light vehicles, such as cars, utes, vans and SUVs must be reduced as a priority, with light vehicles accounting for over 70% of transport emissions in 2019.

12 Increasing the use of low-emissions public transport, shared transport, and encouraging walking and cycling will be important for reducing reliance on light vehicles. However, decades of under-investment in infrastructure and services have often made these travel choices slower, less reliable, and ultimately less attractive than travelling by private vehicle.

13 Making sure people have access to affordable, reliable, convenient and well-integrated public transport, and extensive, high-quality and safe cycling and walking infrastructure will be critical for achieving the scale of change required.

14 Communities need to be connected to a range of different transport options to make it easy for people to get where they need to go. There are several ways to reduce reliance on driving and support the scale of shift required, which will have impacts over different timeframes. These include:

- **Optimising existing systems**, such as reallocating road space and creating low-traffic neighbourhoods or streets. This can happen immediately.
- **Investing in new infrastructure and services** and providing better connections between different transport modes. This is important but will take time to become fully effective.
- **End-to-end integrated transport planning**, which includes making sure operations are coordinated so that services function well together, with 'first-and-last kilometre solutions'. It also involves providing convenient payment and booking options, secure car parking near public transport hubs and access to mobility.
- **Designing compact communities with infrastructure that enables easy access to alternative transport.** Changing the way cities and towns are planned can support rapid/frequent transit, shorter trips between home, work and leisure, and safe, healthy and attractive urban environments that encourage more walking and cycling. This is discussed further in *Chapter 13: Policy direction that cuts across sectors*, *Section 13.6* on urban form.

15 At the moment, transport planning and funding is largely centred around private vehicle use. Of the approximately $4 billion spent on land transport in 2017, only around $600 million was spent on public transport, and less than $100 million on walking and cycling.

16 This may improve based on the strategic direction set out for transport in the new Government Policy Statement on Land Transport 2021, but there should be a large increase in the proportion of funding spent on public and active mobility, including for integrating a national public transport network.

17 Local authorities play a crucial role in enabling the shift away from private car travel. They need adequate funding and must be empowered through regulation to make the necessary changes.

18 This includes, for example, changing the cost recovery model for public transport, which currently requires 50% of costs to be recovered through fares (the 'farebox system'), to allow public transport fares to be reduced. Another example is enabling local authorities to put additional price signals in place, such as congestion charging, as appropriate for their region.

19 Yet, we heard during consultation that local authorities face many barriers in making these types of changes, including regulatory barriers.

20 Setting transport targets can help to make sure funding for low-emissions alternatives are prioritised, and can help make central and local government accountable. This includes targets to increase public and active types of travel, and to decrease the kilometres travelled by private vehicles.

14.1.1 There are significant co-benefits from increasing alternative types of transport

21 Some submitters stressed the significant co-benefits of shifting to public and active transport. These submitters stressed that many of the true costs of travelling by light vehicles are hidden, especially health and environmental effects***.***

22 Greater use of active types of travel promotes physical activity, which improves health and reduces deaths from diseases of inactivity – including cardiovascular disease, diabetes, dementia, cancer and depression. Low physical activity was estimated to contribute to about 1,400 deaths in Aotearoa in 2015. This compares to about 300 people per year who die in road crashes, which justifies a large amount of road investment.

23 Improved public transport can also help to reduce health inequities. Public transport is a very safe way to travel, reduces crashes due to fewer vehicles, while also reducing noise and harmful emissions – all of which have health benefits. These benefits are increased if clean public transport is used, such as electric buses.

24 We heard during consultation on our *2021 Draft Advice for Consultation* that an affordable and accessible public transport system must ensure that non-drivers (e.g. young people, the elderly, those with a physical disability, those who cannot afford a car) are able to get around easily.

25 We also heard that the cost of public transport is a barrier to many people, especially those with large families. Services that do not connect to outer city suburbs or do not account for shift work are another barrier.

Recommendation 17

Improve mobility options and reduce emissions

We recommend that, in the first emissions reduction plan, the Government commit to:

Improving mobility options and reducing emissions by providing affordable, reliable, convenient and low-emissions alternatives to high-emissions vehicle use.

This should include the Government working with local authorities in:

1. Setting targets and implementing plans to substantially increase walking, cycling, public transport and shared transport use to displace vehicle use. This should be delivered through:
    a. Substantially increasing the share of central government funding dedicated to active and public transport infrastructure. Funding should be aligned with achieving a thriving, climate-resilient and low-emissions Aotearoa.
    b. Better connecting communities, cities and regions by improving the frequency, accessibility and integration of intermodal low-emissions transport services.
    c. Reducing public transport fares to encourage greater use of public transport.
    d. Developing targets, plans and approaches:
        i. In partnership with Iwi/Māori, giving effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, and aligning with the He Ara Waiora framework.
        ii. In collaboration with local authorities, consideration should be given to the different circumstances for rural communities, towns and cities.
        iii. In collaboration with stakeholders in the community and business to ensure that outcomes are low emissions, affordable, and support mobility options for diverse communities.
2. Encouraging higher rates of working from home and flexible work arrangements to reduce travel demand and associated emissions. (see also Recommendation 24 (2c) in *Chapter 17: Policy direction for agriculture*).
3. Ensuring regulatory settings provide local authorities with the tools needed to deliver a low-emissions and climate-resilient transport system at pace. This should include evaluating the role of pricing incentives beyond the NZ ETS. For example, congestion charges or where public transport fare reduction would have the greatest impact on behaviour change.

Recommendation 17

Provisional progress indicators

1. Government to have, by 31 December 2022, set targets and implemented a plan, including substantially increasing the share of central government funding, to increase walking, cycling, public transport and shared transport to displace vehicle use.
2. Government to have, by 31 December 2022, identified and implemented the regulatory settings needed to enable local authorities to deliver a low-emissions transport system at pace.
3. Government to report on indicators annually from 31 December 2022. This could include mode share by distance travelled for walking, cycling and private car use, public transport, and would need to be measured regionally and aggregated nationally.

14.2 Accelerate emissions reductions from the light vehicle fleet

26 Light vehicles are the biggest source of transport emissions in Aotearoa, with most running on petrol or diesel. They were responsible for almost 11 $MtCO_2e$ emissions in 2019.

27 Electrifying light vehicles and rapidly improving the energy efficiency of the light vehicle fleet will play a crucial role in meeting emissions budgets and the 2050 target. Battery electric vehicles, plug-in hybrids (together referred to as EVs), and more efficient vehicles are currently the best technologies available to reduce emissions from the light vehicle fleet.

28 In the future other very low-emissions vehicles such as hydrogen fuel cell vehicles, or low-emissions fuels such as drop-in biofuels, may become available.

29 Although 84% of New Zealanders live in urban areas, Aotearoa is sparsely populated. There is limited connectivity between towns and cities, and there are limited transport options for people living outside urban centres. Some communities have, and will continue to have, a high dependence on vehicles for their mobility.

30 Aotearoa is heavily dependent on private vehicles. As a result, New Zealanders spend a significant amount of money on private vehicles each year ($8.7 billion in 2019). Culturally, New Zealanders have strong preferences for utes and SUVs, which made up 8 of the top 10 selling vehicles in Aotearoa in 2020.

14.2.1 Electric vehicle ownership in Aotearoa is increasing but remains low

31 Aotearoa has one of the most renewable electricity systems in the world. This gives the country one of the best opportunities in the world to reduce emissions from transport by adopting EVs.

32 The majority of submissions from individuals who mentioned EVs supported an ambitious package of policies to accelerate electrification of the light vehicle fleet. During consultation we also heard concerns about the environmental impact of EVs, including from their manufacture and from battery disposal, as well as emissions from electricity use.

33 An EV used in Aotearoa emits about 60% fewer emissions over its full life cycle than an equivalent petrol vehicle. This is the case even when accounting for emissions from raw material extraction, manufacture, and shipping. This figure will improve as Aotearoa phases out fossil fuels in electricity generation and as global efforts decrease emissions from EV supply chains.

34 Policy actions and consumer demand will be important to encourage manufacturers to adopt sound ethical and environmental practices across their supply chains, including managing the reuse, recycling and disposal of batteries.

35 There are several supply and demand barriers to people choosing EVs. Barriers to EV uptake include higher up-front costs, lack of choice and supply volumes. Range anxiety, charging network access and expected battery life also affect demand. These concerns were raised by some submitters during consultation.

36 The country's limited leverage for accessing future EV supplies contributes to the lack of choice and supply. The availability of EVs is also a potential constraint. The Aotearoa vehicle market is small, remote, right-hand drive, and is heavily dependent on used vehicle imports from Japan.

37 We heard from some industry submitters that EV manufacturers currently have limited production capacity globally, and that they are likely to prioritise markets with stronger low emissions vehicle policies than Aotearoa currently has.

38 Putting policies in place to support the adoption of new EVs can help to limit the impact of this constraint. There are strong signals that EV production will scale up significantly in the coming years. Many vehicle manufacturers announced EV targets in late 2020 and early 2021, in response to overseas regulations.

39 Used vehicle imports make up about 45% of total annual vehicle imports, with a large proportion of these coming from Japan. Aotearoa is therefore heavily dependent on the choices Japanese manufacturers and consumers make at least five years prior to those vehicles entering the Aotearoa market. Consumers in Japan have historically favoured conventional hybrid vehicles as a low-emissions option, although Japan's small domestic EV market is growing.

40 Aotearoa also faces competition from other right-hand drive countries for second hand EVs. As a result, there are likely to be supply constraints on the volume of second-hand EVs that can be sourced from Japan over the coming decade. In contrast, there are unlikely to be constraints on the availability of second-hand conventional hybrid vehicles.

14.2.2 An ambitious package of policies is needed to address the challenges

41 If Aotearoa is to achieve a low-emissions vehicle fleet by 2050, all light vehicles entering the country must be low emissions by 2035.

42 Most vehicles entering the country today will be on the road for almost 20 years. Conventional internal combustion engine (ICE) vehicles need to be rapidly phased out and replaced by EVs, if the transport sector is to meet our proposed emissions budgets.

43 In the short term, policy action should focus on the emissions efficiency of the vehicles being added to the fleet each year. In 2019, Aotearoa imported about 300,000 light vehicles.

44 Once the emissions efficiency of vehicles entering the fleet has been addressed, the Government will need to consider actions that address the emissions from the existing ICE vehicle fleet. This will be important because of the slow turnover of vehicles in Aotearoa.

45 International experience shows that sending strong, clear signals is important for improving the efficiency of the light vehicle fleet.

46 A ban on the import or manufacture of ICE vehicles at some point in the early 2030s would help set a clear timeframe for the phase out of ICE vehicles. This would send a strong signal to manufacturers about the future requirements of our fleet. It could also remove the risk of Aotearoa becoming a dumping ground for ICE vehicles.

47 Access to EVs is important in the context of an equitable transition. The high upfront costs of EVs create a significant barrier for low-income households who struggle to access capital for major one-off purchases like an EV. We heard this concern clearly reflected through consultation, and particularly from Iwi/Māori.

48 Fiscal incentives to lower the upfront costs of EVs should also be introduced as a matter of urgency, to help overcome this cost barrier. Such incentives could include, for example, direct subsidies or a feebate scheme. A feebate scheme has the additional benefit that it disincentivises high-emitting vehicles, while encouraging lower-emissions ones.

49 High costs could be a particular barrier if Aotearoa faces increased competition from other nations for the limited supply of used EVs. Leasing, financing, and car share schemes targeted at low-income communities should be considered to help address this. Policies to support EV adoption by government and businesses could also be designed in a way that encourages fast rotation of their fleets, which in turn could support a domestic second-hand market.

50 The tax system should also be examined for ways to discourage the adoption of ICE vehicles and encourage low-emissions options. For example, some submitters raised concerns about how the Fringe Benefit Tax is calculated on light vehicles, specifically the ability to claim for emissions-intensive utes and trucks.

51 Charging infrastructure is relatively well developed in Aotearoa, given the number of EVs currently on the road. However, it will need to keep pace with EV uptake to ensure wide coverage and multiple access points in urban centres. More community charging stations, including at marae, will be needed to ensure access for people who cannot charge at home.

52 A large increase in EVs would also add significant load to local electricity networks if they are all charged during peak periods. As EV numbers increase, measures will be needed to help manage this risk. This could include regulating the use of smart chargers and/or more cost reflective pricing of electricity (see also Recommendation 20 in *Chapter 15: Policy direction for energy, industry and buildings*).

53 Improved charging infrastructure will also be important for electrifying heavy vehicles, which could also put a large demand on local electricity networks.

54 Aotearoa needs clear and urgent guidance on emissions efficiency standards to prevent the country from becoming a dumping ground for inefficient vehicles. A lack of emissions or fuel efficiency regulations, or of restrictions on light vehicles entering the country, has contributed to the inefficiency of the fleet.

55 While EVs will make the biggest difference to the efficiency of the country's fleet and to emissions reductions from transport, more efficient petrol and diesel cars can also contribute.

56 Until EVs reach price parity with ICE vehicles, conventional hybrids are likely to play an important role in increasing fleet efficiency. They will also provide affordable travel options for low- and middle-income households that are reliant on private car use for their mobility.

Recommendation 18

Accelerate emissions reductions from the light vehicle fleet

We recommend that, in the first emissions reduction plan, the Government commit to:

Accelerating emissions reductions from the light vehicle fleet.

This should include the Government:

1. Setting a time-limit on light vehicles with internal combustion engines entering, being manufactured, or assembled in Aotearoa. The time limit should be no later than 2035 and, if possible, as early as 2030.
2. Setting an emissions efficiency standard for light vehicle imports and steadily strengthening this to improve overall efficiency of the light vehicle fleet.
3. Accelerating the uptake of electric vehicles (EVs) by introducing a range of measures, including:
    a. A policy to reduce the relative upfront cost of EVs until they reach price parity with internal combustion engine (ICE) vehicles.
    b. Supporting EV leasing, purchasing and sharing schemes to improve equitable access. Regard needs to be given to ensuring that Iwi/Māori, and those in low income and vulnerable groups have the opportunity to access electric mobility.
    c. Enabling ways to bulk procure electric vehicle fleets, working with the private sector and public sector procurement to do so.
    d. Encouraging battery refurbishment, repurposing, and recycling systems, working with the private sector to do so. (See also Recommendation 13 in *Chapter 13: Policy direction that cuts across sectors* and Recommendation 22 in *Chapter 16: Policy direction for waste*.)
    e. Enhancing the roll out of EV charging infrastructure to ensure greater coverage, including at marae, multiple points of access, mandatory smart charging, and fast charging. (See also Recommendation 19, and Recommendation 20 in *Chapter 15: Policy direction for energy, industry and buildings*).
4. Determining how the tax system could be used to discourage the purchase of ICE vehicles and support the adoption of low-emissions vehicles.

Note: Recommendation 19, part 2 would also deliver emissions reductions from the light vehicle fleet.

Recommendation 18

Provisional progress indicators

1. Government to have, by 30 June 2022, implemented policy options to accelerate EV uptake.
2. Government to report at least annually, from 31 December 2022, on the emissions intensity of the whole light vehicle fleet, and the average emissions intensity of imported light vehicles. Imported light vehicles to average, by 31 December 2028, a maximum of 105 grams CO_2 per kilometre.
3. Government to report on additional indicators at least annually, from 31 December 2022, including the number of EVs being registered in Aotearoa, the percentage of EVs in the fleet, average forecourt cost of an EV by make/model.

14.3 Enable the decarbonisation of heavy transport and freight

57 Aotearoa has one of the oldest heavy transport fleets in the OECD. Most heavy transport is used to move freight, but it is also used for passenger services such as planes, buses, and ferries. Decarbonising heavy transport is challenging, yet it is critical that progress is made in this area.

58 **In the short term**, optimising the current heavy transport fleet can achieve immediate emissions reductions. This means ensuring the heavy fleet runs as efficiently as possible, minimising freight movements and using the lowest emissions form of freight transport available.

To realise these opportunities, some challenges will need to be overcome. Many sectors are driven by 'just-in-time' or 'delivery on demand' business models, so freight needs to be delivered quickly and reliably (such as perishable goods). These models limit the ability to shift away from road, because they prioritise timeliness and reliability over other objectives.

The additional handling and cost of shifting freight from trucks to rail can be a significant disincentive, especially for short distances. Rail and coastal shipping will need to offer freight operators more reliable services to make a significant impact on road freight volumes.

Additional planning and investments are required to overcome these barriers, and to integrate road, rail and coastal shipping into a cohesive transport system. This will be critical as the amount of freight moving around Aotearoa is expected to grow significantly over the next 30 years.

59 **In the medium- to long-term**, switching to low-carbon fuels such as electricity, biofuels and green hydrogen will be central to reducing emissions from heavy vehicles. It is important that work to enable this switch in fuels begins in the first emissions budget period.

60 Public buses and commuter ferries have already begun to electrify and in some cases are already cost effective on a total cost of ownership basis. It will be important to make sure the infrastructure is available to support their wider roll out, and that the local electricity grid can support the increased load from heavy vehicles (see also Recommendation 20 in *Chapter 15: Policy direction for energy, industry and buildings*).

61 Even if Aotearoa rapidly converts to EVs, biofuels or hydrogen will likely still be needed for ships, trains, aircraft, long-distance trucks, and some off-road vehicles. These heavy vehicles are more difficult to electrify, so the transition is likely to take longer.

62 We heard during consultation that new technologies for heavy transport should be a priority. Low-carbon liquid fuels, synthetic fuels, and hydrogen fuel cell technologies are evolving rapidly. While not yet available at scale, demonstration projects of some of these technologies exist in Aotearoa, such as hydrogen-powered trucks and buses.

63 Some forms of heavy transport, such as aviation and shipping, are particularly challenging to decarbonise. For example, there is currently no viable sustainable aviation fuel (SAF) or low-carbon bunker fuel supply in Aotearoa, though it is possible to import it. Where SAF is produced offshore, it has been supported by public funding and other policies.

64 Small electric aircraft are expected to be operational by 2030 for short distance flights. This could include regional flights.

65 An Aotearoa-specific study is needed to identify the best decarbonisation options for the aviation and shipping sectors. Such a study should estimate the high-level costs, feedstock options and supply, the required policy and investment settings, and the co-benefits of setting up a SAF or low-carbon fuel industry in Aotearoa.

14.3.1 There are some barriers to decarbonising heavy transport and freight

66 Some barriers to decarbonising heavy transport and freight cut across fuels, technologies (the vehicles), and infrastructure. For example:

- Biofuels and green hydrogen are more expensive than fossil fuels. In addition, while electricity may be cheaper, heavy-battery EVs are currently limited by the weight of their batteries, the time it takes to recharge them, and their limited range.
- New vehicle technologies are expensive, and businesses are unlikely to adopt them unless they have been successfully proven in the Aotearoa context.
- Some low-carbon fuels require new infrastructure, or significant upgrades to existing infrastructure, before they can be adopted at scale.

67 Because of these barriers, the use of low-carbon fuels and technologies in heavy transport is unlikely to be adopted at scale in the first three budget periods without supporting policies.

68 Policies should include co-funding pilot and demonstrations projects for technologies that are unproven in Aotearoa. It will be important that learnings from these projects are shared with industry and government.

69 Policy may also be required to support the adoption at scale of successful pilot projects. This could include broadening the Road User Charges exemption for electric heavy transport to other low-emissions options such as green hydrogen or a high-blend biofuel.

70 Scaling up low-carbon fuels will provide a longer-term solution to heavy transport and can also improve the emissions efficiency of the light vehicle fleet in the short term. It will help build demand, and therefore supply. Once the light fleet transitions to EVs, this supply can increasingly support heavy transport.

71 Complementary policies will also be needed to support the establishment of low-emissions fuel plants in Aotearoa. This could boost domestic energy security by reducing our reliance on energy imports in the long term. These policies will need to be considered in the context of the National Energy Strategy and the Bioeconomy Strategy (see Recommendation 15 in *Chapter 13: Policy direction that cuts across sectors*).

72 We heard from some submitters that a significant volume of biofuels could be produced in Aotearoa, including from feedstocks such as tallow. The Government should develop a bioeconomy strategy that considers different feedstocks, when they should be used, and for what purpose.

73 In the short term, low-carbon fuels may need to be sourced internationally. The sustainability and lifecycle analysis of low-carbon fuels will have to be managed to ensure this results in overall emissions reductions. The Commission's modelling has not included imported low-carbon fuels, given uncertainties on available supply and pricing, so has focused on domestically available biomass.

74 The Government should develop a national low-emissions freight strategy to integrate and address these challenges in a deliberate manner. This should be done through working with the freight sector to identify where and how emissions reductions can be made**.**

75 During consultation we heard about work led by many companies in the freight sector to identify emissions reduction opportunities, including via efficiency gains and greater use of technology such as advanced biofuels and hydrogen. Collaborating on a national freight strategy will ensure the right investment and policy settings to achieve emissions reductions.

76 More overhead electrification of rail, battery-hybrid or low-carbon fuel locomotives, and shifting freight from road to coastal shipping also has potential to reduce emissions.

77 Significant parts of the freight rail network have faced a state of managed decline due to lack of long-term investment and inadequate planning and funding frameworks. The New Zealand Rail Plan sets out a remedial investment programme, and a new planning and funding framework, to maintain freight rail, but does not focus on increasing rail share.

Recommendation 19

Create options to decarbonise heavy transport and freight by 2050

We recommend that, in the first emissions reduction plan, the Government commit to:

Creating options to decarbonise heavy transport and freight by 2050.

This should include:

1. Developing a national low-emissions freight strategy that establishes the investment settings and infrastructure required to deliver a low-emissions freight system.
   The strategy should:
   a. Be developed in partnership with Iwi/Māori, give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, and align with the He Ara Waiora framework.
   b. Be developed in collaboration with freight stakeholders, to leverage private-sector action and finance.
   c. Enable opportunities to improve emissions efficiency and freight optimisation.
   d. Set clear targets to increase the share of rail and coastal shipping.
   e. Encourage fuel switching opportunities where appropriate. This should be aligned with Recommendation 19.2 below.
2. Developing low-carbon fuel markets through measures that include:
   a. A low-carbon fuel standard or mandate to increase demand for low-carbon fuels.
   b. Supporting demonstration and pilot projects for low-carbon heavy vehicles.
   c. Offering targeted support for the uptake of low-carbon heavy vehicles. This could include broadening the exemption battery EVs have from paying road user charges to include other low-carbon technologies.
3. Undertaking a detailed study into the use of low-carbon fuels for aviation and shipping in Aotearoa. This should identity options for Aotearoa, their barriers to uptake and actions to address them.

These recommendations should be considered alongside the recommendations for a national energy strategy and a bioeconomy strategy.

Recommendation 19

Provisional progress indicators

1. Government to have, by 30 June 2022, consulted on a national low-emissions freight strategy and on measures to support the development of low-carbon fuel markets.
2. Government to have, by 31 December 2022, introduced a national low-emissions freight strategy and made Cabinet decisions on preferred policy options to support the development of low-carbon fuel markets.
3. Government to report annually, by 30 June 2022, on the emissions intensity of the heavy vehicles fleet, and on additional indicators such as the mode share of freight distance by road, rail and coastal shipping.

Assessment of our recommendations against our policy approach

Recommendation 17	**Action to address barriers**	**Pricing to influence investment & choices**	**Enable innovation & system transformation**
Improve mobility options and reduce emissions			
Develop targets and plans to increase walking, cycling, public transport and shared transport	✓	✓	✓
Encourage higher rates of working from home and flexible work arrangements	✓		
Ensure regulatory settings provide councils with the tools they need	✓	✓	

Recommendation 18	**Action to address barriers**	**Pricing to influence investment & choices**	**Enable innovation & system transformation**
Accelerate emissions reductions from the light vehicle fleet			
Set a time limit on light vehicles with internal combustion engines	✓		
Set an emissions efficiency standard for light vehicle imports	✓		
Accelerate the uptake of EVs	✓	✓	✓
Determine how the tax system could incentivise EVs and discourage ICE vehicles	✓	✓	

Recommendation 19	**Action to address barriers**	**Pricing to influence investment & choices**	**Enable innovation & system transformation**
Create options to decarbonise heavy transport and freight by 2050			
Develop a national low emissions freight strategy	✓		✓
Develop low-carbon fuel markets	✓	✓	✓
Study into the use of low-carbon fuels for aviation and shipping			✓

Chapter 15

Aronga Kaupapa – Ahungao, Ahumahi, Ahuwhare
Policy direction for energy, industry and buildings

Summary

Emissions from energy, industry and buildings contribute around 44% of long-lived gases in Aotearoa. To reduce these emissions, Aotearoa must decarbonise how it produces and uses energy. It needs to transform to an energy system that is low emissions, affordable and secure.

Our recommendations to achieve this have been split under the below headings:

1. Energy

Energy production, supply and use, including electricity, is a large complex system relied on by people, business and industry across Aotearoa. Because of this, actions taken to lower emissions from how energy is used and produced must be considered and coordinated across public and private sectors. We recommend that:

- **Government develop a comprehensive energy strategy** to ensure actions to decarbonise are considered across the whole energy system. This includes setting a system-wide renewable energy target and increased investment in energy efficiency. A strategy would help Aotearoa leverage its extensive renewable electricity to decarbonise areas like transport and industry and reduce fossil fuel use in buildings.
- **Government develop this strategy in partnership with Iwi/Māori** to ensure there is equitable and proactive partnership with Iwi/Māori and enable opportunities for a Māori-led approach to a thriving, low-emissions, climate-resilient Māori economy.
- **Government develop this strategy in collaboration** with communities, industries, local government and others to make sure the strategy reflects their experience and knowledge.

The transition must deliver low-emissions electricity that is affordable, accessible and reliable, and which enables the decarbonisation of process heat and transport. **We have made a series of recommendations aimed at ensuring that we have an electricity sector that is ready to meet future needs.**

2. Industry

There are two main ways in which industry creates greenhouse gases. One is from using energy to create heat to process products, for example turning milk into milk powder (process heat). The second is using energy to drive chemical reactions for products, for example steel.

The opportunity to reduce emissions across both is through ending the use of fossil fuels. We have recommended a plan for actions to decarbonise the industrial sector. This should include:

- **Stopping the installation of new coal boilers** and setting a timetable to phase out fossil fuel use in existing boilers.
- **Supporting innovation for decarbonising hard-to-abate industries,** accounting for sector-specific circumstances and their interdependencies and the need for bespoke solutions requiring research and development.
- **Acting in partnership** with Iwi/Māori and in collaboration with industrial and manufacturing stakeholders.

3. Buildings

Aotearoa needs low emissions, energy-efficient, warm, healthy homes and workplaces. Buildings should be constructed using designs and products that lower emissions and improve New Zealanders' health and wellbeing.

There must be standards and legislation to support this. Our advice recommends:

- Considered and continued upgrades of minimum Building Code requirements to overcome key barriers that lead to buildings that are not low emissions or as energy efficient and healthy as possible.
- Encouraging construction based on low-emissions designs and practices, because embodied emissions represent a significant proportion of building sector emissions.
- Scaling up energy efficiency assistance to low-income households, so that low-income households can benefit from lower emissions, lower energy costs and healthier buildings.
- Mandating participation in energy performance programmes for existing commercial and public buildings.

Changes in our final advice

The Commission has changed the name of this chapter and associated work programme from 'Heat, Industry and Power' to 'Energy, Industry and Buildings'. This gives a clearer picture of how energy is produced and used in Aotearoa and where the opportunities to reduce emissions are.

We have emphasised the need for a cohesive energy strategy. We heard concern that decisions on energy are being made in silos and without a complete system view. Energy is used and produced in Aotearoa every day and plays a crucial role in how people live, work and learn.

We have also suggested more work is needed to manage the diminishing role of fossil gas across the energy system, and to develop low emissions gases like biogas and green hydrogen. To better distinguish gases with high emissions from their low emissions alternatives, we have renamed natural gas to be fossil gas.

We did further analysis and refined our assumptions around some of the larger industrial facilities. We call for a plan to decarbonise the industrial sector and have made clearer the need to identify and decarbonise industry that is strategically important to the Aotearoa economy.

We further emphasised the importance of low-emissions buildings, both in terms of energy efficiency and embodied emissions.

Introduction

1 The energy, industry and buildings sectors encompass a wide range of sub-sectors and emissions sources. Together these accounted for about 44% of long-lived greenhouse gas emissions in 2019.

2 Reducing emissions from sources in these sectors will be critical to meeting emissions budgets and achieving the 2050 net zero target for long-lived greenhouse gases. However, reductions are likely to take place at varying rates, across different sources.

3 Our policy direction focuses on a package of actions to transform the way energy is produced and used in Aotearoa, with a view to largely decarbonising it by 2050 – in line with emissions targets. We also recommend actions to reduce emissions associated with industrial heat use and chemical processes, as well as to reduce emissions from the way buildings are constructed and operated.

4 The three recommendations in this chapter fit across all three pillars of our policy approach: actions to address barriers; pricing to influence investment and choices; and enabling innovation and system transformation.

5 Within the energy, industry, and buildings sectors, the New Zealand Emissions Trading Scheme (NZ ETS) influences the choices and investments commercial actors make. It will continue to drive action and reduce emissions, particularly as the emissions price increases. However, emissions pricing has limited impact on the choices made by individuals and households, who, for a range of reasons, cannot always make decisions in a way that optimises costs (see *Chapter 11: Approach to developing advice on policy direction* for more information).

6 In the process heat and energy efficiency arenas there are barriers that need to be addressed. For example, lack of information and issues around access to capital or financing can mean low-cost options are not taken up. For hard-to-abate industrial sectors, the NZ ETS provides only a partial incentive for innovation.

7 Our advice on policy direction stresses that the most urgent area for action is for the Government to set direction of travel through a national energy strategy. Transforming energy production and use requires investment and certainty to allow businesses and individuals to plan and respond.

8 Planning so that technologies, assets, and infrastructure can be replaced with low-emissions alternatives on as natural a cycle as possible will help avoid unnecessary costs and stranded assets.

9 Ensuring that the Government upholds Te Tiriti o Waitangi/The Treaty of Waitangi as it considers the transformation of the energy system is fundamental. Energy is a natural resources intensive sector. When developing plans and policies, the Government should ensure there is equitable and proactive partnership with Iwi/Māori, and that opportunities for the advancement of a Māori-led approach to a thriving, low-emissions, climate-resilient Māori economy are enabled.

15.1 Energy

10 Energy is a necessity in the modern world, as a critical input into every good and service. In 2019, energy use in Aotearoa resulted in 34 $MtCO_2e$, with 30% of total energy consumption renewable and the remaining 70% from oil, fossil gas and coal.

11 This energy is used across the economy in transport, electricity, for heating and by industry.

12 To meet the 2050 target of net zero long-lived gases Aotearoa needs to transition away from fossil fuels. Instead, the country will need to rely more heavily on renewable electricity and low-emissions fuels like bioenergy and hydrogen, while also improving energy efficiency.

13 Energy efficiency improvements are often the lowest-cost option for reducing energy demand and emissions. Reducing energy demand can decrease the total amount of energy the system needs to supply and related infrastructure that needs to be built.

15.1.1 A national energy strategy would support a coordinated approach

14 At present, the Government does not have a coordinated approach to support the development and deployment of different low-emissions technologies, fuels and industries.

15 Developing a national energy strategy would help to ensure different aspects of the energy system in Aotearoa are considered in a coherent way, including:

- Emissions reductions and removals
- System reliability and affordability
- Future energy developments
- Infrastructure
- Equitable industry transitions
- Regional and national economic development planning
- Supply chains
- Workforce and skill needs

16 The objective of a strategy would be to ensure a smooth and appropriately sequenced phase down of fossil fuels, and a scale up of renewable electricity generation and new low-emissions fuels in the context of changing supply and demand requirements.

17 The national energy strategy should also consider a plan for the diminishing role of natural gas, which is a fossil fuel (fossil gas), and associated consequences for network infrastructure and workforce in the transition.

18 Choices the Government makes as the energy system decarbonises should keep options open as far as possible, and a strategy can help to ensure this.

19 For example, consideration should be given to whether gas pipeline infrastructure should be retained, to repurpose it for low emissions gases like biogas or hydrogen. Similarly, consideration should be given to whether a low emissions steel industry is critical for the security of supply for the country's construction industry.

20 The current energy system in Aotearoa is extensive, with a dedicated infrastructure and workforce behind it that is spread throughout the regions. The transition away from fossil fuels will therefore need to be carefully managed.

21 It will be important that the national energy strategy is developed in partnership with Iwi/Māori, gives effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, and aligns with the He Ara Waiora framework. The strategy must also account for Treaty settlement commitments, and obligations between energy-system stakeholders and Iwi/Māori.

22 The national energy strategy should also be developed in collaboration with communities, industries, workers, local government and others.

23 During consultation, some submitters were supportive of the need for such a strategy. However, there were other submitters who were concerned that the development of a strategy would delay action on reducing emissions from the energy system.

Setting a renewable energy target sends a clear signal

24 The Government can signal the emissions reductions that are required across the full energy system by setting a renewable energy target. The target could be set as part of an energy strategy.

25 A renewable energy target would signal the move away from petrol to electricity or other low-carbon fuels in transport, as well as the transition away from fossil fuels in heat and electricity. A system-wide target allows for flexibility, where the switch to lower-emissions fuels is balanced and made across a number of sectors.

26 This type of target is also technology-neutral, as it does not determine what type of low-emissions fuels should be implemented: bioenergy, hydrogen or electricity from a variety of sources. Energy efficiency can also play a role.

27 There are different forms that a renewable energy target could take, outlined in Box 15.1 below. The Climate Change Commission (the Commission) recommends a target of 50% of all energy consumed to come from renewable sources by 2035. This target is across the energy system, which includes electricity, process and building heat, and transport.

28 This target is broadly equivalent to a target of 60% renewable energy as a share of total primary energy supply, as outlined in our *2021 Draft Advice for Consultation*. The Commission recommends a consumption-based renewable energy target because a supply-focused target can be distorted by geothermal energy used for electricity generation. This is because geothermal generation has a very low conversion efficiency from heat to electricity.

Box 15.1: Renewable energy targets

A system-wide renewable energy target can be measured in different forms:

- As a share of total primary energy supply (TPES)
- As a share of total final energy consumption (TFEC)
- As an absolute emissions target from energy production

TPES is the total amount of energy available for use in Aotearoa. Much of this is converted to other forms of energy before it is used.

The Ministry of Business, Innovation and Employment (MBIE) currently reports on renewable energy (wind, solar, geothermal, hydro, biomass, other) as a share of TPES in their annual *Energy in New Zealand* report.

This measure includes all the waste heat lost during fuel combustion in a generator, boiler or internal combustion engine. It also includes non-energy use of fossil fuels, such as the fossil gas which becomes embedded in methanol.

One disadvantage of using TPES as a measure is that geothermal energy used for electricity generation distorts the renewable totals as it has a very low conversion efficiency to electricity.

TFEC is the total amount of energy consumed or used across different sectors of the economy. It does not account for the energy or waste heat lost through electricity production or oil refining. This metric is currently not reported in the annual *Energy in New Zealand* publication.

29 Within this context, the Government's current 100% renewable electricity target should be treated as aspirational. The Government should consider replacing the 100% target with a goal of aiming to achieve 95-98% renewable electricity by 2030.

30 Work undertaken by the Interim Climate Change Committee (ICCC) demonstrated that moving from 98% renewable electricity to 100% renewable electricity would cost about $1,280 for every tonne of carbon dioxide abated, and would result in higher electricity prices. Higher electricity prices could make switching to electricity as a low-emissions fuel relatively less attractive.

31 Instead of doing this, the ICCC recommended prioritising the accelerated electrification of transport and process heat. Moving to 98% renewable electricity would require the use of coal to be phased out, a substantial reduction in the use of fossil gas, and the build of renewable electricity (such as wind and solar) to be accelerated.

32 During consultation, some energy sector submitters were concerned about the effectiveness of a renewable energy target, while others debated the most effective form for a target. A number of submitters supported a renewable energy target as being more favourable than the Government's current renewable electricity target.

The most cost-effective way to reduce energy emissions is to reduce the amount of energy consumed.

33 Scaling up investment in energy efficiency will reduce the amount of energy that needs to be produced, the amount of infrastructure that needs to be built, and will improve energy affordability.

34 In particular, energy efficiency measures that reduce demand for electricity at peak times can have a large system impact, because this can avoid the need to build expensive additional generation plants that are then used infrequently. In this way, avoiding large peaks can reduce costs for consumers.

35 Energy efficiency generally improves at a rate of 1% per year, but this needs to increase.

36 Investing in energy efficiency measures, particularly in the residential sector and for at-risk communities, is also an effective way to improve health and wellbeing outcomes.

15.1.2 Aotearoa needs to maximise the use of electricity as a low- emissions fuel

37 Aotearoa has one of the lowest emission electricity systems in the world. More renewable generation, like wind and solar, will need to be built to further reduce the emissions of the electricity system, and fossil-fuelled generation will need to be phased out.

38 This low-emissions electricity can be used to reduce emissions elsewhere through electrifying transport, process and space heating.

39 For consumers and industry to invest and convert to electricity, they need to have confidence that electricity will be available, affordable and reliable, as well as low emissions. This was reinforced in submissions across all stakeholder groups, who highlighted the importance of balancing these considerations against the need to decarbonise the energy system and rapidly increase renewable electricity generation.

40 Some submitters from the electricity sector, NGOs, academia and individuals also expressed concern that other areas of the Commission's advice could have impacts on electricity prices. The need for well-targeted assistance for some groups to address energy equity in the transition was also highlighted.

41 In times when the ability to produce renewable electricity generation is limited, wholesale electricity prices can rise dramatically. This makes electricity a less attractive fuel for some consumers.

42 Aotearoa is unique in that its hydro lakes contribute around 60% of total electricity supply. However, these lakes only hold enough water for a few weeks of winter energy demand if inflows (rain and snow melt) are very low.

43 When inflows are low for long periods of time, hydro generation reduces, and the system relies on other forms of generation – such as fossil gas and coal. These periods of time are often referred to as 'dry years', and often result in very expensive wholesale electricity prices.

44 The Government's NZ Battery project will advise on potential solutions to the challenge of dry year energy security. While a solution to this challenge could enable Aotearoa to reach 100% renewable electricity, it could cost taxpayers billions of dollars.

45 As noted above, electricity is part of a broader energy transition. Alternative options for reducing emissions should be considered, because other actions may have a larger impact on emissions for the same cost as a solution to the dry year problem. For example, action to electrify the vehicle fleet or accelerate fuel switching in industry.

46 This came through as a theme in consultation, with some energy sector submitters cautioning that pursuing a pumped hydro storage project under the NZ Battery project, like Lake Onslow, could come at the expense of lower-cost emissions reductions elsewhere in the economy.

47 Some submitters highlighted the ICCC's conclusion that while it is technically feasible to achieve 100% renewable electricity, a solution may be very costly in terms of achieving the last few percentage points.

48 Solving the dry year problem avoids relatively few emissions. By 2050 our modelling shows remaining emissions from fossil gas for electricity generation are around 0.6 $MtCO_2e$ per year.

49 Some submitters also raised concerns around continued coal mining, particularly on conservation land. There were also concerns that government policies on offshore oil and gas exploration, coupled with the phase out of coal for heat and electricity generation in the absence of a 'dry year solution', would result in the import of coal and gas, leading to poor economic outcomes.

New generation will be needed to meet increased electricity demand

50 We anticipate a steep increase in demand for electricity as the number of electric vehicles (EVs) on the country's roads grows, and industrial demand electrifies. The industry will need to rapidly build more renewable generation to meet this.

51 Big changes in demand or supply, like the Tiwai Point aluminium smelter closing (see Box 15.2) and the NZ Battery project, can create uncertainty in the market and result in generators delaying investment in new renewable generation, transmission and distribution infrastructure.

52 New generation will need to be built rapidly to meet this increase in electricity demand. However, many forms of renewable generation, especially hydropower, wind and geothermal, have the potential to come into conflict with the resource management system. This is because these types of generation can impact other environmental goals and domains, such as freshwater and biodiversity.

53 To ensure the fast-paced and sustained build of low-emissions electricity, Resource Management Act (RMA) processes, other national and local government instruments, and settings for transmission and distribution investment decisions need to uphold Te Tiriti o Waitangi/The Treaty of Waitangi and be aligned with the required pace for build.

54 This is an opportunity to enable the implementation of tools, such as the Mana Whakahono ā Rohe provisions under the RMA, whereby tangata whenua and local authorities can discuss and agree on how they will work together under the RMA, in a way that best suits their local circumstances.

Box 15.2: Manapōuri hydro station and the Tiwai Point aluminium smelter

The Tiwai Point aluminium smelter consumes 10-14% of the electricity generated in Aotearoa each year. A significant amount of this electricity is generated at the Manapōuri hydropower station.

If Tiwai Point closes at the end of 2024 this electricity will become available for alternative uses. Some of these new sources of demand could produce widespread benefits for the transition to a thriving, climate-resilient and low-emissions economy in Aotearoa, for example, replacing the fossil fuels used in transport and process heat with renewable electricity.

Other sources of new demand, such as data centres or creating hydrogen for export, may not directly reduce emissions in Aotearoa. Broader benefits from such investments could include tax revenue or spillover benefits, like bringing in skills, knowledge and helping to develop hydrogen production for domestic uses, such as steel making.

Modelling shows the change in dynamics of supply and demand could lower wholesale electricity prices by as much as $20 per MWh, for as much as a decade. This does not necessarily translate to an equivalent drop in electricity bills.

Ensuring equitable access to affordable, secure, low-emissions electricity for residential, commercial, and industrial consumers will be essential to the success of the country's low emissions transition. It would be beneficial for the Government to assess and communicate to the public the potential impact of a significant change in the balance of supply and demand on the accelerated electrification of transport and process heat. This should involve an evaluation of the costs, benefits, risks and opportunities of how and when this electricity is used.

The use of coal for generating electricity must end

55 In absolute terms, most electricity emissions in Aotearoa currently come from fossil gas. However, coal results in about double the emissions per TWh of electricity produced.

56 In the future, electricity emissions may be dominated by geothermal emissions. By 2050, geothermal emissions in our demonstration path are modelled to be marginally more (0.1 $MtCO_2e$) than the emissions from fossil gas.

57 Aotearoa has committed to ending the use of coal, as part of the 'Powering Past Coal' alliance. This states that to meet the Paris Agreement, there should be no more coal for unabated electricity generation (coal without carbon capture and storage (CCS)), and that OECD countries should achieve this by no later than 2030.

58 As outlined above, a combination of fossil gas and coal currently provides the energy storage required to meet dry year needs. However, Aotearoa must move away from these fuels, with coal being the priority.

59 There have been public announcements from the electricity sector about ending the use of coal for electricity generation. Our analysis shows that as the cost of carbon rises, it is more economic to build more renewables to displace existing thermal generation plants.

60 Rising New Zealand Unit (NZU) prices, driven by a well-functioning NZ ETS, would likely end coal generation in the mid-2020s.

61 There is the possibility that electricity generators could choose to keep coal generation plants running for other reasons, even with a rising NZU price – for example, security of supply. As a backstop, the Government must take action to ensure that coal is phased out as soon as possible.

15.1.3 The regulatory regime must be able to deliver the services needed to electrify the vehicle fleet, buildings and industry

62 The regulatory regime must continue to adapt and respond to innovations, to ensure it can deliver abundant, affordable, and reliable low-emissions electricity.

63 It must be able to deliver the services that will be needed to support the electrification of different parts of the economy. This includes providing the additional electricity supply that will be needed.

64 Traditional ways of operating may not deliver the most efficient solutions at the pace required for the transition. The capacity and capability of electricity distribution businesses (EDBs) or lines companies will be important.

65 Some submissions reinforced this, including submissions from EDBs, local councils and others. These submitters highlighted the need to ensure the overall regulatory regime is sufficiently adaptive to enable EDBs to undertake the innovation and investment required to meet climate change outcomes.

66 The Electricity Price Review and others have called for these businesses to undertake more innovation. Continued implementation by the Government of the recommendations from the Electricity Price Review will be crucial, as will evaluating whether the current regulatory environment and ownership structures of lines companies are fit for future needs.

Regulatory settings will need to meet the needs of diverse communities

67 Technology has the potential to change the way New Zealanders generate, store and consume electricity. It will affect how the market could work, and will create greater potential for independent and distributed generation, micro-grids and demand response (collectively referred to as distributed energy resources, see Box 15.3).

Box 15.3: Distributed energy resources

Distributed energy resources (DER) are controllable energy resources, located in the distribution network or within consumer premises. They include battery storage, EVs, demand response/demand side participation, and distributed generation like solar photovoltaics and small-scale hydropower generation.

DER can operate quickly and flexibly, which could help manage the electricity system by offsetting the need for grid supply, network capacity or new generation. Different DER have different capabilities.

DER are already in use in Aotearoa but the volume could increase significantly in the future as technology prices decline.

68 Innovations are emerging, including peer-to-peer trading, automation and digitalisation. These disruptions create opportunities for Māori-collectives, remote and rural communities, urban groups and others. The regulatory system needs to allow for, and encourage, this.

69 Innovations that enable consumers to participate in the market can help to reduce the amount of fossil-fuelled generation required to meet peak electricity demand, defer the need for new generation capacity and replace the need for diesel as back-up generation.

70 Measures that government could take to reduce the barriers to participation in the electricity market and deployment of distributed energy resources may include standardised power purchase agreements, open access to electricity networks, development of flexibility markets or access to capital or low-cost financing.

71 A number of submitters from the electricity sector, NGOs, individuals, Iwi/Māori and others voiced broad support for technology innovation, decentralised and local energy generation and alternative ownership structures as means for local climate resilience, energy security and economic development. For example, some marae are used by Iwi/Māori as civil defence management centres and community hubs.

72 Energy sovereignty, using both innovative and existing technology, is a critical component of ensuring an equitable transition. Ongoing support through government programmes, such as the Māori and Public Housing Renewable Energy Fund, to trial small-scale renewable energy technologies and help inform future larger-scale projects, will be important.

73 Government efforts to maximise the use of electricity as a low-emissions fuel must give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi by working with hapū and Iwi to identify equity partnerships and to develop a collective approach to the build of low-emissions electricity generation.

15.1.4 Producing low emissions fuels is important for meeting the 2050 emissions reduction target

74 The Government has a role to play in increasing the amount of clean energy Aotearoa can produce, and opening up future options, in line with the third pillar of our policy approach (see *Chapter 11: Approach to developing advice on policy direction*). This will help ensure the emissions reductions required in later emissions budgets can be met.

75 Aotearoa will need a range of energy sources to support decarbonisation and to retain choices along the path to 2050. Some activities, such as industrial processes that use high temperature heat, will be hard to electrify, and so will need low-emissions alternatives to electricity.

76 Diverse energy sources will also be needed to maintain energy security. During consultation we heard general support from a range of stakeholder groups for maintaining fuel diversity in Aotearoa.

77 Some submitters emphasised the importance of energy diversity in ensuring energy system resilience, particularly in the face of a changing climate. Relying solely on the electricity grid to deliver energy could increase national and community vulnerability, and impact the ability of Aotearoa to adapt to climate change and respond to extreme weather events.

78 Bioenergy (such as biogas, liquid biofuels, wood pellets), and hydrogen, hold promise, and can either be produced domestically or imported. Our analysis indicates that these fuels have significant potential for reducing emissions in transport, space and process heat, and industrial processes.

79 However, Aotearoa needs to better understand how best to make use of their potential. Data sharing and building an evidence base prior to making decisions is key, and government will have a role in facilitating this.

80 This includes building an evidence base of the costs and deployment opportunities in Aotearoa. It will be important that government understands the value of providing fuel, employment and economic development to regions, as well as alternative emissions reduction opportunities. More work is needed to support the establishment of supply chains and infrastructure, to help make them more cost competitive.

81 Low-emissions hydrogen is versatile in how it can be used and where it can be produced. It has potential for supporting energy security, generating high temperature process heat and meeting the needs of certain industries – for example, ammonia-urea production. It will be important to work with industry to identify when and if emissions reductions can be achieved by transitioning to hydrogen.

82 The costs, benefits, trade-offs and risks of a hydrogen economy will need to be carefully assessed. This includes assessing the costs of production and storage, the costs to maintain, upgrade and repurpose existing infrastructure, and the practicality and affordability for all consumers.

83 There are existing and planned green hydrogen pilot and demonstration projects in Aotearoa. It will be important for government to understand the results from these and other projects, to assess the place of hydrogen in the economy and wider energy system.

84 Scaling up the provision of low-emissions energy sources will need to be considered alongside the national energy strategy and bioeconomy strategy to support a coordinated, multi-sectoral approach that considers the role and interlinkages between fuels, sectors, supply and demand.

85 More consideration on scaling up the production of bioenergy, as part of a larger strategy for a thriving bioeconomy, can be found in *Chapter 13: Policy direction that cuts across sectors*, Recommendation 15.

15.1.5 Use of fossil gas will need to reduce as Aotearoa moves towards net zero emissions

86 Fossil gas plays an important role in the current energy system. It provides a secure energy supply for electricity generation and for users of industrial heat, as well as a feedstock into chemicals such as methanol.

87 Many households use gas for heating, cooking and hot water. Having access to a diversity of energy options makes Aotearoa more energy secure. However, the use of fossil gas will need to decrease as Aotearoa moves towards net zero emissions. During consultation we heard broad consensus across all stakeholder groups for the need to move away from using fossil gas by 2050, in most situations.

88 However, some concerns were expressed. There was considerable concern around the consequences of any changes in the availability of gas on energy affordability and reliability. This was a particular concern for Iwi/Māori. It was also a concern for remote and rural communities, communities who live off grid, small businesses, and those who rely on it in emergencies.

89 We also heard from business and industry submitters about the need to ensure that the pace of the transition allows time for plumbers, gas fitters and others who are affected to retrain and upskill.

90 Rising emissions prices through the NZ ETS will help to drive a reduction in the use of fossil gas for generating electricity and process heat, and to make renewable options more competitive.

91 The use of fossil gas in homes and buildings also needs to be phased down. However, smaller users generally do not have access to accurate information about what the future supply and costs of fossil gas, and low-emissions gases, are likely to be. Electricity is a more efficient and lower-emissions source of energy for heating homes and businesses than fossil gas.

92 To get on a low-emissions path Aotearoa needs to:

- Avoid locking in new fossil gas assets; and
- Phase down how much fossil gas is used in existing residential, commercial and public buildings.

93 It is possible that low emissions gases, such as hydrogen or biogas, could be blended into fossil gas to lower its emissions intensity, and this was noted in some submissions.

94 Some submitters said continued expansion of gas network infrastructure should be allowed, given that low-emissions gases may be able to be distributed through the same or upgraded infrastructure in the future. However, the extent to which this is possible, or cost effective, remains uncertain. Doing this would also have costs for consumers.

95 Low emissions gases are currently more expensive than fossil gas. Putting new, low emissions gases through pipelines is also likely to require some reinforcement or replacement. The costs of the gas network are spread across users through their bills, as the network is a regulated asset base. This means that the same costs need to be recovered, no matter how many users there are.

96 The Commission's position, based on existing evidence, is that the possible future availability of low emissions gases is insufficient reason to warrant continued expansion of gas network infrastructure. Until there is substantial evidence that blending or fully converting the gas network to low emissions will not increase costs to consumers, expansion of the fossil gas network to serve residential, commercial and public buildings should not be permitted.

97 The NZ ETS will play a role in deterring expansion of fossil gas infrastructure. But other measures are also needed to safeguard consumers – until such time as it can be demonstrated that the transition to low emissions gases would benefit consumers and substantially reduce emissions in a way that aligns with emissions budgets and targets.

98 One option to reduce emissions from fossil gas use, and safeguard consumers, would be to place a moratorium on new fossil gas connections. Another option would be to set a date after which no new fossil gas connections would be permitted in residential, public and commercial buildings.

99 These options avoid locking in new fossil gas assets where there are existing low-emissions alternatives, until it can be proven that low-emissions gases are technically feasible and economically affordable.

100 Alternatively, a cap on operational emissions from fossil fuel use in buildings that tightens over time could be applied to ensure substantial reduction in emissions. This could discourage new gas connections in new buildings but would not necessarily prevent the expansion of the gas network.

101 These options would provide time for industry to assess the effectiveness of low-emissions gases as a way to significantly reduce emissions, while maintaining affordability. Under any option, the Government will also need to consider how to transition existing fossil gas users towards lower-emissions alternatives.

102 As the use of fossil gas decreases, additional measures will be needed to support security of supply, residential consumer choices around gas, energy affordability and accessibility, network considerations, workforce planning and high temperature heat needs.

103 Maintaining a reliable and affordable electricity supply will be important to support the electrification of transport and industrial and building heat. It will also be important for producing the materials needed for a fast-paced and sustained build out of renewable electricity generation.

104 The use of fossil gas must be phased down where low-emissions alternatives are available. Because fossil gas is less emissions intensive than coal, it lends itself to critical applications that support services needed in the transition, such as security of supply and high temperature process heat.

105 Longer term, innovation and investment will be needed to develop ways to displace these remaining uses of fossil gas. Government will have a role to play in supporting innovation (see also Recommendation 13, *Chapter 13: Policy direction that cuts across sectors*).

Recommendation 20

Decarbonise the energy system and ensure the electricity sector is ready to meet future needs

We recommend that, in the first emissions reduction plan, the Government commit to:

Delivering a strategy to decarbonise the energy system and ensure the electricity sector is ready to meet future needs.

This should include:

1. Developing and implementing a national energy strategy to decarbonise the system. The scope would need to cover:
   a. Setting a target so that 50% of all energy consumed comes from renewable sources by 31 December 2035. Consideration should also be given to replacing the target for 100% renewable electricity with achieving 95% - 98% renewable electricity by 2030.
   b. How to ensure access to affordable, secure, low-emissions electricity for residential, commercial, and industrial consumers. Regard needs to be given to the impacts on Iwi/Māori, those in regional/rural areas, and vulnerable groups.
   c. Ensuring the use of coal for electricity generation is phased out as soon as possible.
   d. Creating a plan for managing the diminishing role of fossil gas across the energy system, covering the associated consequences for network infrastructure and workforce during the transition. This recommendation should be considered alongside Recommendation 28 for a fair, inclusive and equitable transition.

   e. The strategy should be developed in:
      i. Partnership with Iwi/Māori, give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, account for settlement commitments and obligations between energy-system stakeholders and Iwi/Māori, and align with the He Ara Waiora framework.
      ii. Collaboration with energy-system stakeholders.
2. Scaling up of investment in energy efficiency to reduce the amount of energy produced and improve energy affordability.
3. Supporting the evolution to a low-emissions electricity system fit for technology evolution. This should include work to increase the participation of distributed energy resources including demand response, and determining whether lines companies can integrate new technologies, platforms and business models by:
   a. Assessing whether they have the necessary capacity and capabilities to support climate resilience and the transition.
   b. Evaluating whether the current regulatory environment and ownership structures of lines companies are fit for future needs.
4. Designing regulatory settings that meet the needs of diverse communities, ensuring that they enable independent and distributed generation, especially for remote, rural and Māori communities.
5. Enabling a fast-paced and sustained build of low-emissions electricity generation and infrastructure by ensuring resource management processes, other national and local government instruments, and settings for transmission and distribution investment decisions are aligned to the required pace for build.
6. Assessing the consequences of significant changes to the balance of supply and demand of electricity (such as significant blocks of capacity), on the pace, equitable availability, and cost of electrification in Aotearoa.
7. Supporting development and deployment of low-emissions fuel options such as bioenergy and hydrogen. Māori-collectives should be enabled to participate in the associated business opportunities. This recommendation should be considered alongside Recommendation 26 for an equitable transition for Iwi/Māori, Recommendation 15 for the bioeconomy, and Recommendation 19 for transport.
8. Determining how to eliminate fossil gas use in residential, commercial and public buildings. Actions should include:
   a. Setting a date to end the expansion of pipeline connections in order to safeguard consumers from the costs of locking in new fossil gas infrastructure.
   b. Evaluating the role of low-emission gases as an alternative use of pipeline infrastructure.
   c. Determining how to transition existing fossil gas users towards low-emissions alternatives.

Recommendation 20

Provisional progress indicators

1. Government to undertake with urgency, and have published by 31 March 2022, an assessment of the consequences of significant changes in the balance of supply and demand of electricity (such as significant blocks of capacity) on the pace, equitable availability and cost of electrification in Aotearoa.
2. Government to have, by 30 June 2023, delivered a draft strategy to decarbonise the energy system for consultation. To have published the final strategy by 30 June 2024.
3. Government to have, by 30 June 2022, set a renewable energy target of at least 50% total final energy consumption, or equivalent – to be achieved by 31 December 2035.
4. Government to report, from 31 December 2022, on a suite of indicators annually including the emissions intensity of the electricity grid, annual investment in electricity infrastructure, average retail electricity prices for households, volume of low-carbon fuels produced.

15.2 Industry

106 Reducing emissions from low- and medium-temperature process heat will be critical for meeting the 2050 emissions reduction target. Low- and medium-temperature process heat is generated mainly from boilers, and is used primarily in food processing and wood, pulp and paper production. Emissions associated with these activities were around 4 $MtCO_2e$ in 2019.

107 Improving energy efficiency, optimising processes and equipment, and switching to cleaner energy sources, like electricity and biomass, are key opportunities to reduce emissions.

108 During consultation, we heard from some industry, energy system stakeholders, businesses and others who highlighted that many manufacturers who use low- and medium-temperature process heat are taking action.

109 Some manufacturers have set emissions reduction goals, committed to no new coal-fired boilers, and invested in technologies to reduce energy use while improving productivity. Submissions from these groups generally supported phasing out coal use in boilers for low- to medium-temperature process heat, but there was some hesitation around phasing out of fossil gas use in boilers.

110 Other industrial sector submitters raised concerns over the balance of effort across different sectors in the economy, for example, users of low- to medium-temperature process heat relative to high temperature heat users.

15.2.1 Aotearoa needs to accelerate emissions reductions from process heat

111 About 30% of the country's coal demand in 2019 was used in food processing. This is roughly 20 PJ. Meeting emissions budgets and targets requires a reduction in the use of coal in boilers of around 1.4 PJ per year. This is a substantial amount, roughly equivalent to the energy used by one or two very large dairy processing factories.

112 Continued improvements in energy efficiency across industry (including in hard-to-abate sectors) will be important for reducing emissions and will improve the economics of switching to low emissions fuels.

113 At the same time, conversion away from coal must begin immediately. Conversion away from fossil gas will happen incrementally as the NZ ETS price increases. Boilers are enduring assets with life cycles of up to 40 years, so urgent action must be taken to avoid locking in new fossil-fuelled boilers.

114 The rate at which industry emissions can be reduced will be limited by several factors. For example, fuel switching decisions involve long-lived assets and have high up-front capital costs. There may also be practical engineering constraints around the integration of new technologies and fuels into established plants. This includes the time required to conduct feasibility and engineering studies, procure equipment and workers, and shut down plants for conversion.

115 Additional factors include the need to establish or expand low-emissions fuel supply chains, or the need to upgrade grid infrastructure and build new renewable electricity generation, which can add significant time and cost to a project.

116 Government measures like well-targeted, contestable funding, such as the Government Investing in Decarbonisation of Industry Fund, as well as support for energy audits and feasibility studies, can help to identify fuel-switching and efficiency opportunities, and support their uptake.

117 The Government recently announced a ban on new coal boilers used in manufacturing and production and have proposed a phase out of existing coal boilers by 2037. Consideration is also being given to phasing out other fossil fuels in existing sites through reconsenting processes and best practice requirements in a National Environmental Standard.

118 Government leadership and cross-sector collaboration will be important to support the development of robust low-emissions fuel supply chains – for example, as part of the bioeconomy strategy and the national energy strategy.

119 It will also be important that measures are put in place to ensure workers have the skills to identify site-specific emissions reduction opportunities and deliver plant conversions at a pace and scale that supports our emissions budgets.

15.2.2 Innovation will be important for reducing emissions from hard-to-abate sectors

120 Aotearoa has several single company industries with industrial processes that are unique to this country, such as steel or cement. These industrial processes create emissions through burning fossil fuels, and through chemical reactions. These can be challenging to abate.

121 Supporting innovation for these hard-to-abate industrial sectors will therefore be critical for unlocking future emissions reduction opportunities.

122 The country's heavy industrial manufacturing plants were built several decades ago to accommodate specific industrial processes, and there is potential to transform some of these. Entirely new industrial processes and technologies could potentially be adopted. Alternatively, plants could be modernised between now and 2050, or retrofitted to make use of alternative fuels and reactants.

123 Other choices are also available; for example, Aotearoa could import products from low-emissions manufacturing plants overseas. During consultation, we received submissions from the construction, infrastructure and industrial sectors who expressed concern that reliance on imported products exposes Aotearoa to supply chain disruptions, long lead times, increased price volatility and risk of poor-quality materials.

124 Based on current cost estimates, retrofitting industrial plants with new technologies or developing new low-emissions processes for the hard-to-abate sectors will be expensive. Doing so may influence the cost of production, which could impact industry competitiveness.

125 This was highlighted in some industrial sector and other submissions, which also emphasised the importance of reducing the risk of emissions leakage, international collaboration on research and development, and maintaining domestic economic activity.

A long-term strategy for hard-to-abate industries is needed

126 Hard-to-abate industries are likely to still create significant emissions in 2050, but they provide products that are fundamental to the economy, like cement, steel and iron. Aotearoa has a choice as to whether it is critical to keep these industries and manufacturing plants based in this country.

127 Several submitters expressed concern that reliance on imported products exposes Aotearoa to supply chain disruptions, long lead times, increased price volatility and risk of poor-quality materials if these industries were to close here.

128 Research, development and demonstration (RD&D) and innovation is needed to identify cost-effective approaches to reducing emissions associated with industrial processes in Aotearoa. Technologies developed overseas may need to be adapted to work in unique local processes.

129 If Aotearoa keeps existing emitting plants, it may be possible to use forests to offset the emissions associated with some of these processes. Investigating the potential of other options to remove emissions from hard-to-abate industries, such as CCS or bioenergy combined with CCS, could be worthwhile.

130 However, considerable RD&D and investment would be required because these technologies are still largely in a concept phase in Aotearoa. Government measures would likely be needed to support the necessary innovation and system transformation (see *Chapter 11: Approach to developing advice on policy direction,* and Recommendation 13 in *Chapter 13: Policy direction that cuts across sectors*).

131 The Government should develop a long-term strategy for hard-to-abate industries, closely linked to the country's broader economic plans – including the national energy strategy, national infrastructure plans, industry transformation plans and equitable transitions planning.

132 Government should engage with hard-to-abate industries, related sectors and communities to fully understand the opportunities, trade-offs, risks, interdependencies, and the potential future role of hard-to-abate industries in Aotearoa.

133 During consultation, some industrial sector submissions called for the inclusion of sector-specific approaches or plans in the long-term strategy. The strategy must also give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi.

134 If the Government decides these hard-to-abate industries are critical national infrastructure, it must work collaboratively and inclusively to ensure that people working in these industries are upskilled appropriately.

Recommendation 21

Reduce emissions from industry

We recommend that, in the first emissions reduction plan, the Government commit to:

Outlining a plan for actions required to decarbonise the industrial sector.

This should include:

1. Acting in partnership. To be enduring the policy approach must be created in partnership with Iwi/Māori, give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, and align with the He Ara Waiora framework.
2. Developing the policy approach in collaboration with industrial and manufacturing stakeholders.
3. Accelerating industry switching to low-emissions fuels for process heat and uptake of energy efficiency measures. A high NZ ETS price signal is central to delivering this, along with policies that reduce barriers related to access to capital, behaviour change and infrastructure access (see also Recommendation 11 in *Chapter 13: Policy direction that cuts across sectors,* on the NZ ETS).
4. Ensuring no new coal boilers are installed and setting a timetable for the phase out of fossil fuels used in boilers (see also Recommendation 20, on energy).
5. Supporting innovation for decarbonising hard-to-abate industrial sectors. This will require accounting for sector-specific circumstances and their interdependencies and investigating the need for bespoke solutions requiring research, development and demonstration specific to Aotearoa. This recommendation should be considered alongside Recommendation 15, in *Chapter 13: Policy direction that cuts across sectors* (bioeconomy strategy), and Recommendation 20 (national energy strategy).

15.3 Buildings

135 Although Aotearoa has a predominantly renewable electricity system, energy efficiency improvements can still have significant emissions benefits. This is particularly the case if it can reduce energy demand at peak times, when fossil gas or coal fired power stations are used alongside hydro to meet demand.

136 It is essential to continue improving the energy efficiency of existing buildings, particularly in large commercial buildings and public buildings that use a lot of energy.

137 It will also be important that new buildings are designed to be more energy efficient and constructed with less emissions-intensive materials. Such buildings will be able to maintain warmth in winter, stay cool in summer, and have better indoor air quality. They will also require less energy to run.

138 The importance of energy efficiency came through as a key theme during consultation. Some submitters urged more ambitious improvements to energy efficiency across new and existing buildings.

139 Submitters from the building and construction sector, designers, architects and academia suggested a range of measures. This includes improvements to the minimum requirements under the Building Code, updates to product and building standards, requirements for distributed generation on new buildings, mandatory energy performance certificates and improved design and construction practices.

140 Some NGOs and research organisations suggested the need for a systems approach to better account for the co-benefits of improved energy efficiency, improved air quality and higher quality buildings.

141 Some of the technology required to make homes or businesses more efficient can be costly, and this is often a barrier to adoption – particularly for those on low incomes. For example, measures like installing insulation and more efficient heating can significantly improve energy efficiency and health, but come with upfront purchase and installation costs. For more information see *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable*.

142 Designing and constructing high-performance, resilient buildings that exceed minimum Building Code requirements is perceived as costly. There are also sometimes mismatches between those bearing the cost of building beyond the minimum Building Code requirements, and those accruing the benefits over time.

143 There is also the risk that the cost of building beyond the Code will impact housing affordability if developers and property owners seek to pass costs on to tenants or purchasers. The introduction of mandatory energy performance measures, such as energy and emissions benchmarking and reporting, may be required to address information asymmetries and other barriers.

144 Government support for energy efficiency measures should be scaled up so low-income households can benefit from lower-emissions, lower-energy costs and healthier buildings. We heard support from submitters across all stakeholder groups for expanding well-targeted support programmes as a way to address some of the barriers to improving energy efficiency, and enable energy equity in the transition.

145 Support should be viewed within the context of an equitable transition – many low-income households are less able to transition due to inequities in education, welfare, labour force and other factors. For example, some land and building ownership models can make it difficult to access programme funding, such as buildings on Māori land owned by multiple trusts.

15.3.1 Fossil gas needs to be phased down to meet emissions reduction goals

146 Electricity is a more efficient and lower-emissions source of energy for homes and businesses than fossil gas. To get on a low-emissions path Aotearoa needs to avoid locking in new fossil fuel assets that will endure beyond the 2050 emissions reduction target where affordable low-emissions options are available.

147 Reducing emissions from energy use in buildings will require the phase down of fossil gas in existing residential, commercial and public buildings. It also means avoiding the addition of new fossil gas demand from new buildings.

148 While some submitters understood that achieving net zero emissions from long-lived gases by 2050 meant a transition away from fossil fuels for operational energy use in buildings, they disagreed on the means to achieving the goal.

149 Some submitters, including individuals, small businesses and industry, expressed concern about unintended consequences – including on energy prices, impacts on the energy industry, and impacts on workers and communities. Clarity around the timing and scope of government measures will be crucial for providing greater predictability so that businesses, households and industry can plan.

150 In addition to the NZ ETS price signal, measures will also be required to deter growing use of fossil gas and the expansion of associated infrastructure. At the same time, a supportive regulatory environment would help to enable the delivery of low emissions gases, should that become feasible and affordable in the future.

151 To ensure an inclusive transition it is important that people can equally access affordable electricity to adequately meet their energy needs for heating, hot water and cooking. The Government and industry should consider how they can support participation in the move to a low-emissions future.

15.3.2 Low-emissions design and construction can reduce energy use and embodied emissions

152 The built environment is a key driver of demand for emissions intensive materials. A number of submitters from the building and construction sector including designers, architects and research organisations called for greater ambition for reducing emissions from buildings through low-emissions design and construction practices.

153 In particular, they suggested that a focus on embodied emissions and a consumption-based approach to accounting for emissions would help to drive behaviour change across multiple supply chains – from material manufacture to waste management. Increased use of timber in construction was often cited as an option to reduce a building's embodied emissions.

154 A consumption-based accounting approach accounts for all emissions that are 'embodied' in a good or service. This includes emissions resulting from the entire supply chain required to produce that good or service – for example, carbon emissions from raw material extraction, manufacture and use in construction, processing and disposal.

155 Embodied emissions represents a significant proportion of building sector emissions. Some goods, like steel and cement, are high in embodied carbon because of the processes used to make them. These process emissions are hard to abate because there are limited technically and commercially feasible alternatives.

156 MBIE is undertaking two significant work programmes focused on the building and construction sector:

- **The Building Law Reform work programme** will support the sector to shift to new, more effective ways of working, help support productivity improvements, lift the efficiency and quality of building work, and improve trust and confidence in the building regulatory system.
- **Building for Climate Change** (BfCC) is focused on creating a high performing building and construction sector prepared to deliver on the outcomes of reducing greenhouse gas emissions and improve the sector's resilience to climate change. Action areas include reducing whole-of-life embodied emissions, improving operational efficiency and improving buildings' resilience to future climate change events.

157 While the BfCC work programme is currently focused on new buildings, it will be important to extend the programme to existing buildings. Continued development and implementation of these complementary work programmes, as well as regular updates to the Building Code, will be critical to reducing emissions from the building and construction sector and meeting the country's climate change goals.

Recommendation 22

Upgrading existing buildings and constructing new buildings that are low emissions

We recommend that, in the first emissions reduction plan, the Government commit to:

Developing a plan to transform buildings to be low emissions and climate resilient.

This should include Government:

1. Acting in partnership. To be enduring the policy approach must be created in partnership with Iwi/Māori, give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, and align with the He Ara Waiora framework.
2. Developing the policy approach in collaboration with the building and construction sector.
3. Upgrading existing buildings and constructing new buildings that are low emissions, healthier and climate resilient. Measures should include:
    a. Continuous improvements to minimum Building Code requirements such as energy efficiency standards.
    b. Encouraging construction based on low-emissions designs and practices to reduce building energy use and embodied emissions.
    c. Scaling up energy efficiency assistance to low-income households to enable them to benefit from lower emissions, lower energy costs and healthier buildings.
    d. Mandating participation in energy performance programmes for existing commercial and public buildings.

Recommendation 22

Provisional progress indicators

1. Government to have, by 31 December 2022, implemented measures to improve the energy performance of existing buildings, such as mandating participation in energy performance programmes.
2. Government to have, by 30 June 2022, scaled up energy efficiency assistance to low-income households.
3. Government to report annually, from 31 December 2022, on a suite of indicators, including residential and commercial energy intensity.

Assessment of our recommendations against our policy approach

Recommendation 20	Action to address barriers	Pricing to influence investment & choices	Enable innovation & system transformation
Decarbonise the energy system and ensure the electricity sector is ready to meet future needs			
Develop and implement a national energy strategy	✓		✓
Scale up investment in energy efficiency	✓		
Support the evolution to a low-emissions electricity system	✓		✓
Design regulatory settings that meet the needs of diverse communities	✓		
Enable a fast-paced and sustained build of low-emissions electricity generation and infrastructure	✓		✓
Assess consequences of significant changes in the balance of supply and demand of electricity	✓		
Support development and deployment of low-emissions fuel options	✓		✓
Determine how to eliminate fossil gas use in residential, commercial and public buildings	✓		✓

Recommendation 21	Action to address barriers	Pricing to influence investment & choices	Enable innovation & system transformation
Reduce emissions from industry			
Accelerate industry switching to low-emissions fuels for process heat and energy efficiency measures	✓	✓	✓
Ensure no new coal boilers are installed and set timetable for the phase out of fossil fuels used in boilers	✓		
Support innovation for decarbonising hard-to-abate industrial sectors	✓		✓

Recommendation 22	Action to address barriers	Pricing to influence investment & choices	Enable innovation & system transformation
Reduce emissions from buildings			
Upgrade existing buildings and construct new buildings that are low emissions, healthier and climate resilient	✓		✓

Chapter 16

Aronga Kaupapa – Ngā Tukupara Policy direction for waste and fluorinated gases

Summary

Waste accounts for 9% of biogenic methane emissions in Aotearoa. New Zealanders have told us they want to see better waste management to reduce biogenic methane emissions.

Aotearoa has one of the highest rates of waste generated per person in the OECD and low recovery rates of waste, such as to recycling, anaerobic digestion (energy recovery) or composting.

Aotearoa can learn from what has been tried and tested overseas. This means putting the waste hierarchy of reducing, reusing and recycling waste at the centre of decision making. Any landfills that accept the remaining organic waste should capture the resulting methane emissions.

We have made the following recommendations to reduce both biogenic methane and embodied emissions from waste:

- **Revise the waste strategy with ambitious goals** to reduce waste emissions and increase resource recovery.
- **Redesign processes to take out waste at the production stage** where possible - for example unnecessary packaging for consumer products and more efficient building processes that use fewer materials.
- **Invest to make it easier for New Zealanders to reuse and recycle.** There should be an increase in funding for resource recovery infrastructure, research and development. This will also provide support for community groups that run composting and waste education programmes.
- **Regulate so those who produce and import products are responsible for minimising their environmental** impact. This means expanding product stewardship schemes and exploring other measures, such as right to repair legislation.
- **Mandate gas capture at all landfills that accept organic waste.** Most of the waste emissions in Aotearoa come from organic waste decaying at landfills. Just 25% of these emissions are from sites that have landfill gas capture.
- **Reduce emissions from fluorinated gases** through reducing leakage and enabling low-climate impact alternatives.

Changes in our final advice

We have increased our ambition in waste, setting a target to decrease biogenic waste methane emissions by at least 40% by 2035, up from the 15% emissions reduction target in our *2021 Advice Draft for Consultation*. Some of this is because of updates to *New Zealand's Greenhouse Gas Inventory* (released in April 2021), but we also recommend more action in this sector based on what we heard through consultation and further analysis.

We have also moved our circular economy recommendations from the waste section to the multisector strategy section. This was a more appropriate reflection of what we heard from submitters about the potential for emissions reductions through a more circular economy extending beyond waste.

Introduction

1 Waste is made up of the remnant of materials used in other products or processes that usually go to landfills for disposal. Fluorinated gases (F-gases) are mainly used for heating and cooling, and are mostly hydrofluorocarbons (HFCs).

2 Our advice focuses on emissions from solid waste, as they make up most waste emissions in Aotearoa. These come predominantly from the decay of organic material, usually in landfills. However, there are also emissions from the wastewater sector.

3 Reducing waste is important to New Zealanders. This was reflected as a strong theme during consultation.

4 Addressing waste emissions is important in helping to achieve 2050 emissions reduction targets (2050 targets). In 2019, waste accounted for about 9% of biogenic methane emissions, and F-gases accounted for around 4% of long-lived greenhouse gas emissions. Reducing and effectively managing waste can also reduce emissions across the broader economy.

5 The policy direction in this chapter focuses on the three pillars of our policy approach. Appropriate pricing to influence investments and choices in the sector, addressing barriers, and investing in the sector will all be important.

6 The waste hierarchy is an internationally recognised evaluation tool that shows the preferred pathways to maximise resource recovery through the different stages of waste management:

- **Reduce:** Actions to reduce waste at source, through prevention and by redesigning products and processes to create less waste, sit at the top of the hierarchy and should be the highest priority for action.
- **Recover:** Recovery options such as composting, recycling, and anaerobic digestion that use the waste product (for example, turning food waste into compost) come next.
- **Dispose:** Disposal – either at landfill or through incineration – sits at the bottom of the hierarchy.

7 All of Aotearoa can help address waste across this hierarchy. Businesses can reduce the waste they generate and increase their use of recovered material. Households can increase their use of second-hand and more durable goods. Local governments can make investment decisions to prioritise waste reduction, for example supporting community resource recovery centres.

8 However, central government has the critical role in reducing emissions from the waste sector as it holds most of the policy levers to address key issues and incentivise the right behaviours. Additional action is also needed to prevent HFCs from entering the atmosphere.

9 As a package, we have designed our policy direction with the waste hierarchy in mind. We also see the upcoming review of the New Zealand Waste Strategy as a key vehicle for enabling changes.

10 Aotearoa should take the opportunity to set ambitious goals to reduce waste at source and increase resource recovery across waste streams. These goals will require support through accelerated government investment in the sector and supportive regulatory settings.

16.1 Reduce emissions from waste

11 Aotearoa currently generates one of the largest amounts of waste per capita in the OECD and has a low rate of resource recovery.

12 The waste hierarchy of reduce, recover, and dispose should be used as a guiding principle for action. Aotearoa has an opportunity to embed the hierarchy at the centre of the New Zealand Waste Strategy during its upcoming update. This will support the transition to a more circular economy, which would ultimately generate zero waste.

13 A large number of submitters supported action on waste by applying this hierarchy, which would contribute towards the more efficient use of resources and support a more circular economy. It would reduce emissions across the broader economy as well as in the waste sector itself. Some submitters highlighted the opportunities for waste to be a feedstock for the bioeconomy.

14 Submitters across businesses, individuals, and councils wanted Aotearoa to do more to reduce the amount of waste generated and increase the amount of waste recycled and increase gas capture at landfill, including to generate electricity.

16.1.1 Stronger ambition and more government investment are needed

15 The update of the New Zealand Waste Strategy offers an opportunity to put Aotearoa on a track towards a more circular economy, where ultimately zero waste is generated.

16 To support this, the strategy should set goals, across waste streams and aligned with the hierarchy, that will help Aotearoa reach the 2050 targets.

17 The waste hierarchy should be the guiding principle, which means focusing first on maximising what can be reduced at source. This relies on individuals, communities, businesses, and others to change behaviour. Low waste and low emissions choices can be provided and made accessible through actions such as:

- Designing out excess packaging
- Resource sharing
- Waste education programmes (like Para Kore).

18 Change also needs to happen at a system level. Systems need to evolve to provide durable low-waste products, and to process resources once they have been used. For example, improved collection facilities can provide cleaner waste streams that can be more efficiently processed for resource reuse.

19 Some submissions noted food and garden organic waste collection systems as an example of a way to minimise cross-contamination of organic waste. The material collected can also be used to generate high quality compost.

20 Feedback received during consultation noted the need for more investment in the waste sector across the board. This includes investments in local community activities like education, household waste reduction and composting, and in new waste reuse and recycling infrastructure.

21 Some submitters expressed concern that the emissions associated with the collection and transportation of waste could outweigh the emissions reduced through reuse and recycling.

22 While overall emissions should be considered, evidence suggests that the additional transportation emissions are generally significantly smaller than emissions avoided through reuse and recycling. Transportation emissions will also reduce as vehicles are decarbonised.

23 Direct investment will be needed to develop coordinated waste collection and processing infrastructure, and to collect better data. There should also be coordination across regions so that there is consistency in the way waste streams are sorted and separated.

24 These improvements come with an initial cost. The Infrastructure Commission recently highlighted that between $2.1-2.6 billion of additional capital investment and about $0.9 billion in operational funding is needed in the waste sector over the next 10 years.

25 Local government, particularly smaller councils, lack the resources to make the necessary capital investments in waste infrastructure. Much of this investment will need to come from central government.

26 All remaining organic waste should be sent to landfills with high performance landfill gas (LFG) capture. This could be through fitting LFG capture systems to more landfills, or through consolidating waste into landfills that already have LFG capture.

27 Regular monitoring and auditing of landfills to ensure that their gas capture systems are high performance will also be needed.

28 At the moment, larger municipal landfills are required by the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 to have LFG capture systems installed. Municipal sites without gas capture are usually older, regional landfills that were exempted from gas capture requirements because of low waste volumes.

16.1.2 Emissions pricing and regulation will both be important

29 Landfills are owned by a mixture of local governments and businesses. Large municipal and provincial landfills are covered by the New Zealand Emissions Trading Scheme (NZ ETS).

30 Less than a quarter of waste emissions come from landfills covered by the NZ ETS. For the sites that are covered, the NZ ETS provides a significant incentive to reduce emissions.

31 For sites that are not covered by the NZ ETS, significant emissions reductions could be achieved by regulating for, or incentivising, LFG capture.

32 Many landfills also pay a waste disposal levy – this includes all landfills that are covered by the NZ ETS, as well all other municipal landfills. Most non-municipal landfills are not currently covered by the levy. However, the Government is in the process of increasing the levy, and all landfills (except farm fills) will eventually pay it. Municipal landfills will pay more than other landfills.

33 Some local governments receive proceeds back from the waste disposal levy via the waste minimisation fund.

34 The NZ ETS and the waste disposal levy serve different purposes. The NZ ETS incentivises reducing emissions, while the waste disposal levy incentivises reducing the amount of waste going to landfill.

35 However, as waste disposal levy and NZ ETS costs increase for municipal landfills, this could lead to organic waste being diverted to non-municipal landfills that do not have LFG capture. This would lead to higher emissions.

36 Mandating LFG capture for all landfills that accept organic waste (except farm fills), whether inside or outside the NZ ETS, would prevent this.

37 Regulation can also help address other barriers to reducing emissions from waste. For example, one approach suggested in submissions was 'right to repair' legislation, which requires manufacturers to make certain products repairable. This can reduce upstream emissions by reducing the need to manufacture new products.

38 Regulation could also include product restrictions or phase outs for certain types of waste. Some submitters called for phase outs of excess packaging, for example.

39 Some submitters told us that more products should be added to the six 'priority products' covered by the product stewardship scheme, which makes producers and importers responsible for the environmental footprint of their products. The six priority products currently included in the scheme are plastic packaging, tyres, electrical and electric products, agrichemicals, refrigerants, and farm plastics.

40 Increasing the waste types covered by product stewardship regulation would help reduce waste at source and provide avenues to recover resources at the end of that product's life. Suggestions from submitters included textiles, batteries (including from vehicles), paper waste, and more complex waste streams such as organics, and construction and demolition waste.

41 Data collection in the waste sector also needs to be urgently improved to support more informed decision making. For example, the amount of waste (particularly organic) going into farm dumps and non-municipal fills is not well understood, which means that it is difficult to create efficient policies.

42 Some submitters expressed concern that there are higher rates of organic waste going to these landfills than currently estimated.

43 Investment in research and development can also realise new ways of reducing waste. Some submitters noted that waste from construction and demolition can be sorted and sent to appropriate facilities for reuse.

44 The increased waste levy will provide additional revenue to fund activities to reduce emissions from waste. Further investment needs may be identified as the strategy develops, and recycling of NZ ETS auction proceeds could provide an additional funding source.

16.2 Action is needed to reduce HFCs

45 Refrigerants are essential chemicals that enable perishable food to be transported and stored, and which are used for the heating and cooling of interior spaces. HFCs are the most common type of refrigerant used in Aotearoa. HFCs are potent synthetic greenhouse gases with long atmospheric lifetimes. They are present in low atmospheric concentrations.

46 The Government has restricted the import of HFCs in line with the Kigali Amendment to the Montreal Protocol (an international agreement controlling ozone depleting substances).

47 However, there is currently no import limit in Aotearoa of HFCs contained in finished products (such as air conditioning in vehicles). Some submissions supported the placing of restrictions on the import of HFCs in finished products.

48 Many businesses and consumers will need assistance to transition away from HFCs, particularly if equipment needs to be replaced.

49 There are some alternatives to HFCs with a low climate impact, but much existing equipment is not compatible with them. Because of the large amount of HFCs in existing products, there will be a lag between taking action to replace HFCs and achieving emissions reductions.

50 Aotearoa also has an ageing stock of refrigerators and air conditioning units. This equipment is often disposed of, or serviced, improperly, which leads the HFCs contained within them to leak into the atmosphere. These emissions could be reduced by assisting technicians to upskill, or through a technician licensing system. Some submissions noted the need for better training for technicians, and for the tracking of refrigerants.

51 In 2020, the Government declared refrigerants one of six priority products under the Waste Minimisation Act, which means a product stewardship scheme is required for imports of HFCs. This requires manufacturers and importers to take responsibility for the emissions associated with HFCs, including disposal.

Recommendation 23

Revise the waste strategy so it will deliver emissions reductions in the waste sector

We recommend that, in the first emissions reduction plan, the Government commits to:

Revising the New Zealand Waste Strategy so that it will deliver emissions reductions, and implement measures to reduce HFC emissions.

1. The revised New Zealand Waste Strategy should include:
   a. Acting in partnership with Iwi/Māori, giving effect to the principles of Te Tiriti o Waitangi/ The Treaty of Waitangi, and aligning with He Ara Waiora framework.
   b. Acting in collaboration with local government, community groups and industry to leverage cross-sector action and finance.
   c. Shaping plans in line with the 'waste hierarchy' to:
      i. Significantly decrease waste generation and increase resource recovery across waste streams.
      ii. Reduce emissions via specific, time-bound goals.
      iii. Identify and implement regulatory changes to assist people to take actions to reduce waste emissions.
   d. Accelerating investment in:
      i. Research, development, and demonstration to reduce waste through more efficient processes.
      ii. Infrastructure for waste collection, processing, and resource recovery.
      iii. Support for consumers to reduce waste emissions through switching to low-waste or low-emissions alternatives.
      iv. Improved data collection across the waste sector, including farm dumps, non-municipal fills and wastewater treatment plants.
   e. Setting a date by which high performance gas capture systems are mandated for all landfills that accept organic waste.
2. Measures to reduce HFCs should include:
   a. Expanding import restrictions where feasible.
   b. Improving industry practice to reduce leakage.
   c. Enabling businesses and consumers to switch to low climate impact alternatives.

Recommendation 23

Provisional progress indicators

1. Government to have, by 31 December 2022, finalised the revised waste strategy with goals to:
    a. reduce biogenic methane waste emissions to at least 40% below 2017 levels by 2035.
    b. Ensure, by 31 December 2026, that all landfills (except farm fills) that accept organic waste have effective gas capture systems.
    c. prioritise and fund ongoing data collection across the waste sector.
2. Government to publish, from 31 December 2023, annual waste statistics that track waste flows from generation to disposal across all landfill types.

Assessment of our recommendations against our policy approach

Recommendation 23	Action to address barriers	Pricing to influence investment & choices	Enable innovation & system transformation
Revise the waste strategy to deliver emissions reductions from the waste sector			
Update the New Zealand Waste Strategy, in line with the waste hierarchy, to deliver emissions reductions	✓	✓	✓
Measures to reduce HFC emissions	✓	✓	✓

Chapter 17

Aronga Kaupapa – Ahuwhenua
Policy direction for agriculture

Summary

Aotearoa has been an agricultural world leader over recent decades, putting it in a strong position to continually improve and contribute to meeting the 2050 targets.

Our analysis shows that even without new technologies, Aotearoa can reduce agricultural emissions through efficiencies on farms, and by switching some pastoral land to forestry and horticulture. Investing in research and development now could provide more flexibility, and potentially make it possible to meet the more ambitious end of the 2050 biogenic methane target.

Farmers have already made progress in reducing emissions, but further changes can lower emissions on farm while maintaining, or even improving, productivity. This includes reducing animal numbers and using better animal, pasture and feed management. Policy support is needed to make this happen.

We recommend that the Government:

- **Follow through on its commitment to implement a pricing mechanism to incentivise on-farm emissions reductions.** The Government must make a decision on this by 2022 so farmers can feel confident to start taking action. The mechanism should consider the unique circumstances of Iwi/Māori collectively-owned land, and the rights and interests of Māori-collectives within the agriculture sector.
- **Work with industry to develop advisory services** to support farmers to adopt emissions-efficient practices and make the most of opportunities to diversify land use and income. This must include services tailored for Iwi/Māori.
- **Improve rural digital connectivity** to give farmers access to information and online tools to monitor and improve farm performance and reduce emissions.
- **Remove barriers to the deployment** of emerging technologies that reduce emissions – such as streamlining food safety legislation.
- **Support systems and infrastructure for alternative, lower emissions land uses** so that there is more potential to convert land to low emissions uses in future. This includes, for example, infrastructure and supply chains for horticulture.

- **Invest in research and development** to deliver technology, such as methane vaccines and inhibitors, that would enable bigger emissions reductions in the future. If developed, these technologies could provide more flexibility for farmers in achieving emissions reductions and enable Aotearoa to increase ambition.

Changes in our final advice

During consultation we heard from some that we weren't ambitious enough in agriculture, while others said we were being too optimistic in the assumptions about the potential for emissions reductions. We have adjusted our assumptions about the emissions that can be reduced through on-farm improvements. We also tested paths with more land-use change to horticulture.

We have been clearer on our role over the next year to assess the progress of *He Waka Eka Noa* and to assess the readiness of the sector for pricing emissions.

We reviewed the limited evidence available on the potential emissions reductions impacts of phasing out synthetic nitrogen fertiliser on dairy farms. We will be providing advice related to agricultural emissions pricing in 2022, and will be better able to assess these options, and how they might work alongside a pricing mechanism, at that time.

Introduction

1 Agriculture accounts for 91% of biogenic methane emissions in Aotearoa, and 19% of long-lived gases.

2 Agriculture is a major part of the emissions profile, economy, and landscape of Aotearoa. Reducing emissions from agriculture will be critical to achieving the target to reduce biogenic methane by at least 10% by 2030 and between 24 – 47% by 2050. Reducing nitrous oxide from agriculture can also make an important contribution to achieving the 2050 net zero target for all other gases.

3 An integrated package of policies will be required to drive these reductions while balancing the economic and social impacts of changes to the sector, as well as adaptation needs. While recent policy changes to address water quality concerns will also reduce greenhouse gas emissions, further action is required to reach the 2030 biogenic methane target, and the 2050 target.

4 The recommendation in this chapter draws on the three pillars of our policy approach: actions to address barriers; pricing to influence investment and choices; and enabling innovation and system transformation.

5 Ensuring effective pricing of agricultural emissions must be a priority and is central to our advice. There is also a range of barriers that currently hinder improvements to on-farm efficiency, including access to information about how different management approaches affect emissions.

6 In our policy direction we recommend improving advisory and information services for farmers and land managers to enable immediate actions that reduce emissions in the first three emissions budgets.

7 Action is also needed to help spur innovation and lay the groundwork for more systemic change and deeper emissions reductions. Our policy direction recommends improvements to regulatory regimes, developing a targeted research and development plan, investment in infrastructure to support low-emissions land uses, and demonstrating the environmental credentials of low-emissions products.

8 Policy approaches need to consider the unique characteristics and historical circumstances that constrain management of Māori collectively-owned land, and must give effect to the Treaty

principles of partnership, protection, participation, and equity while also recognising the guarantee of rangatiratanga and kaitiakitanga under Te Tiriti o Waitangi/The Treaty of Waitangi.

17.1 Reduce biogenic agricultural emissions through on-farm efficiency and technologies

9 Emissions from agriculture include biogenic methane from livestock and nitrous oxide from animal excreta and fertiliser use. Changing the way farms are managed can help to reduce these emissions.

10 Our analysis suggests that agricultural emissions can be reduced in line with the 2030 biogenic methane target by making changes to on-farm management practice alongside some land-use change. These actions will also contribute to nitrous oxide emissions reductions, which are largely related to the amount of nitrogen added to the land through urine, dung, and fertiliser – which in turn is correlated to animal numbers and feed.

11 Biogenic methane emissions are largely a function of the amount and type of feed a ruminant animal eats. Reducing methane emissions therefore relies on management practices that reduce the total amount of feed consumed across a farm system.

12 More efficient herds and flocks use less feed for maintenance (keeping animals alive and healthy), with a greater proportion of feed being used for production (milk, meat and wool). This means that reducing the total amount of feed consumed across the farm system does not necessarily reduce overall production. There are opportunities to improve general efficiency and reduce emissions across the system, although this is a challenging task that requires changes across complex farm systems.

13 On-farm changes that can reduce emissions include adjusting stocking rates, managing supplementary feed and nitrogen inputs for emissions efficiency. Breeding low-emissions sheep into the national flock and using low nitrogen feeds can also reduce emissions.

14 These changes will be important for reducing emissions right across the sector. However, the best approach will vary from farm to farm depending on a range of factors – for example, soil type, and farm intensity.

15 To reduce emissions across the sector, farmers need know what their emissions are, and how the changes they make on farm affect emissions. Measuring progress towards emissions budgets and targets will require actions that are implemented on farm to be tracked. Those actions will also need to be incorporated into emissions monitoring in *New Zealand's Greenhouse Gas Inventory*.

16 During consultation, many farmers and industry groups noted how challenging it will be to achieve the scale of change required through changes to management practice alone. Leading farmers will need to share their knowledge to help all farmers implement changes to reduce emissions. Advisory services rely on this type of information to provide evidence-based advice tailored to individual farms.

17 Recent changes to freshwater policy will have an impact on the way many farms are managed. Many actions that farmers take to address freshwater will also reduce emissions. However, more policies are needed to incentivise further adoption of on-farm practices that lower emissions.

18 Climate policy approaches will need to consider other policies that effect on-farm management – such as those aimed at climate, freshwater, soils and biodiversity – to ensure they are mutually supportive and can achieve multiple outcomes (see also Recommendation 9, *in Chapter 12: Policy direction to create an enabling environment for change*). The importance of taking such a holistic approach came through strongly during consultation.

17.1.1 Reducing biogenic emissions requires skilled farm management

19 Farmers are often able to improve animal performance and produce more from fewer animals. Improving herd productivity has been a strong national trend for many years and we heard a desire from many submitters for historic improvements in agricultural emissions efficiency to be better recognised. While there are eventual limits to such improvements, there remains significant scope for them to continue.

20 However, achieving emissions reductions of the scale that is needed will require highly skilled farm management and high-quality data to support decision making.

21 The Biological Emissions Reference Group (BERG) found that a variety of mitigation options already exist across the sector, which can collectively reduce biological emissions by 5–10% without necessarily reducing on-farm profitability.

22 The BERG noted that actual economic outcomes for each farmer will depend on a range of factors, including how mitigation options are implemented, the level of skill required to implement the different options, the nature of different farm systems, as well as commodity and emissions prices.

23 The Government's agritech industry transformation plan seeks to increase use of technologies on farm. Technologies will also help to improve efficiency and reduce environmental impacts. For example, some submitters supported improving rural digital connectivity. This will make it easier for farmers to access the information and data they need to measure and monitor emissions and can support the use of more efficient precision agriculture approaches.

24 Some livestock operations could also reduce emissions by shifting to systems that are less intensive. For example, certified organic dairy farms tend to have lower emissions because they have fewer animals and inputs – including no use of synthetic nitrogen fertiliser. Such farms produce less than conventional farms do, but often remain profitable because of their ability to reduce inputs and attract product premiums.

25 A large number of submitters, particularly NGOs and individuals, were in support of phasing down synthetic nitrogen fertiliser as a way to reduce emissions and improve water quality. It may be economic for some farmers to significantly reduce synthetic nitrogen use, whereas for other farms it may impact their financial viability. Some farmers and industry bodies expressed concern about the impact reduced fertiliser use would have on farm profitability.

26 Regenerative farming systems often have some similar characteristics to organic farms, though with fewer input controls. We heard considerable interest in regenerative agriculture during consultation, but there is not yet a robust evidence base to understand the emissions benefits of regenerative farming in Aotearoa, nor a credible certification market for products.

17.1.2 Agricultural soils are an important source of emissions and removals on farm

27 There are significant soil carbon stocks in pastoral farmland across Aotearoa, which good farming practices can help to maintain. However, farming on drained peatlands is already leading to ongoing loss of carbon from these organic soils. Restoring these peatlands would avoid these emissions – although they are not currently accounted for in our targets.

28 There is significant interest in the potential for certain farming practices to store more carbon in soils. This theme came through strongly during consultation, including in submissions from farmers, NGOs and a range of individuals.

29 Much of this discussion is centred around regenerative agriculture. While there is not yet a robust evidence base for understanding the potential for this in Aotearoa, work is underway to better understand it. This is discussed further in *Chapter 18: Policy direction for forests and other carbon stocks.*

17.1.3 Effective advisory services can support farmers to reduce emissions

30 Effective advisory services support farmers to develop new skills and learn about and adopt practices and technologies that reduce emissions. They help farmers to learn from each other, support good decision making, and can also help improve economic, social and broader environmental outcomes.

31 Reducing emissions across the agricultural sector will require that farmers know what their emissions are. Comparing across farms will improve understanding of what good looks like and accelerate emissions reductions across the sector.

32 For the industry to meaningfully compare across farms, consistency of measurement will be important. A quality evidence base is needed for effective advisory services to draw from when providing tailored advice to individual farms.

33 We heard through submissions that one area where farmer advisory services will be particularly important is to support farmers to develop farm environment plans that have a greenhouse gas management component.

34 Existing education, training, and advisory programmes will need to be scaled up to meet the growing demand for these services, which will be critical for achieving the emissions reductions required from the sector. Further investment will be needed.

35 There is also growing demand for farm advisers who are resourced and trained in measuring and monitoring agricultural emissions. To meet the *He Waka Eke Noa* target of all farmers knowing their emissions by the end of 2022, farm advisors need to be upskilled and new skill bases developed. This will take time. Better data, information, and tools would also help farmers and farm advisors make decisions that support emissions reductions.

36 We also heard during consultation that the current mainstream models of agricultural education, training and advisory services are not fit for purpose for Iwi/Māori needs. Due to the complexities around collective land ownership structures and governance, Māori-collectives working in the agriculture sector need bespoke solutions to support emissions mitigation.

37 There is some support targeted for Māori-collectives, for example Te Ahu Whenua and Te Tumu Paeroa, but this needs to be expanded.

38 There have been recent initiatives to make the sector more sustainable low emissions, such as the Primary Sector Council's *Fit for a Better World*, which has a vision where the health of the climate, land, water, and living systems comes first.

17.1.4 New technologies could support more ambitious emissions reductions in the future

39 The successful development of new technologies and practices would provide greater flexibility for how to meet the 2050 biogenic methane target. It would also allow Aotearoa to meet the more ambitious end of the target range without reducing agricultural production. However, some submitters emphasised that emissions reductions cannot be delayed based on hopes that new technologies will be developed.

40 There are several promising options currently being researched, including a methane inhibitor that would be compatible with pastoral farming, and a methane vaccine. These technologies aim to break the link between livestock feed intake and methane emissions.

41 Research, development, and demonstration (RD&D) focused on farm systems is also important, as it will improve understanding of how different farm practices impact emissions. Some submitters supported continued RD&D focused on agricultural emissions reduction, paired with effective communication with farmers about how to implement practices and technologies that reduce emissions.

42 Some mechanisms supporting RD&D in the agricultural sector will end in the coming years. For example, the Pastoral Greenhouse Gas Research Consortium's contract with Government ends in August 2021.

43 Government investment into RD&D focused on agricultural biogenic methane emissions is currently secured out to 2025, but there is no long-term plan beyond then. A clear long-term plan that lays out where investment should be targeted is needed, including mechanisms to implement that plan.

44 Several submissions proposed genetic engineering (GE) as an approach to reducing emissions, while others were very wary about the market and environmental consequences of using GE in Aotearoa. Some submissions discussed the need for more evidence of effectiveness in farming systems in Aotearoa.

45 The regulatory environment must not hinder the roll-out of effective new emissions-reducing technologies and practices.

46 The country's food safety system serves an important role ensuring products are safe and trusted internationally. However, recent experiences have shown it can take some time to get new mitigation technologies through the system. Streamlining the system would ensure effective new technologies and practices to reduce agricultural emissions can be implemented in a timely manner.

17.1.5 Pricing emissions from agriculture will be critical

47 The Interim Climate Change Committee (ICCC) found that emissions pricing should be a key part of the policy package to reduce agricultural emissions. We support this finding.

48 In contrast to direct regulatory approaches, pricing emissions allows farmers to choose how best to reduce emissions, based on the characteristics of their farm business. Farmers who can reduce emissions at a cost lower than the emissions price will generally do so, while others may choose to pay for their emissions. Pricing can reward farmers who do more, as every tonne of emissions reduced is a tonne that they do not have to pay for.

49 In 2020, a process and timetable was established to prepare the agricultural sector for emissions pricing at a farm level. This included setting milestones in the Climate Change Response Act (the Act) for *He Waka Eke Noa*. These milestones are aimed at fully implementing a system for farm-level accounting and reporting of greenhouse gas emissions, and farm-level plans to measure and manage greenhouse gas emissions, by 1 January 2025 (see Box 17.1).

50 Alongside this, *He Waka Eke Noa* is aiming to provide recommendations on core design features of a farm-level emissions pricing mechanism to Ministers by early 2022.

51 Agricultural activities could still be brought into the New Zealand Emissions Trading Scheme (NZ ETS) at processor level, if insufficient progress is made on primary sector climate change commitments. The Commission is required to report to Ministers by June 2022 on *He Waka Eke Noa's* progress towards its milestones, and the readiness of the sector for pricing.

52 The Act sets out that by the end of December 2022, the Ministers of Climate Change and Agriculture must release a report outlining a system for pricing agricultural emissions at farm level.

53 During consultation many submitters expressed concern about the continued exclusion of agricultural emissions from the NZ ETS, and the time it would take to create an alternative farm-level pricing system. There was also concern from submitters that the farm-level emissions pricing scheme would have such high levels of free allocation that the incentive to reduce emissions would be severely weakened, limiting the scheme's effectiveness.

54 The Commission will assess these issues in its review of *He Waka Eke Noa's* progress and sector readiness in 2022. We expect that further policies will be needed alongside emissions pricing to reduce agricultural emissions. However, what is needed will depend in part on the proposed farm-level tools and pricing mechanism and should be considered alongside them.

55 Successfully implementing farm-level emissions pricing for emissions from livestock will take time, due to the challenges of accurately calculating emissions and building systems for farmers to report and comply.

56 In contrast, there do not appear to be any technical or feasibility barriers to pricing synthetic nitrogen fertiliser emissions at the manufacturer and importer level in the NZ ETS as soon as practicable, as recommended by the ICCC.

57 Some submitters suggested other policies, such as regulating agricultural inputs and limiting the area of land used for dairy farming. There is limited analysis available on the impacts these approaches would have. More work would be needed to understand whether these are a suitable way to address agricultural emissions, taking into account distributional impacts in particular.

58 The sector needs to start acting now to reduce emissions. However, we heard through consultation that some farmers are delaying action because they think they could be 'benchmarked' against their emissions in 2025.

59 Ministers should therefore follow through on their commitment to decide on the design of the pricing mechanism by the end of 2022, as outlined in legislation – including decisions about how assistance will be provided to participants. This would give farmers confidence that they will not be penalised for taking action now to reduce emissions.

Box 17.1: ***He Waka Eke Noa*** **– the primary sector partnership**

In 2019, *He Waka Eke Noa* was formed as group of 13 partners from Government, industry, and Iwi/Māori to advance work on climate change action in the primary sector.

Role of *He Waka Eke Noa*

The primary sector, Iwi/Māori and government are working in partnership to:

- Implement a framework by 2025 to reduce agricultural greenhouse gas emissions and build the agriculture sector's resilience to climate change.
- Empower farmers and growers to measure, manage, and reduce on-farm emissions; recognise, maintain or increase integrated sequestration on farms; and adapt to a changing climate.

He Waka Eke Noa is early in a five-year programme aiming to equip farmers with the information, tools and support they need to reduce emissions and build resilience to climate change.

He Waka Eke Noa has milestones set in legislation, including working towards farmers and growers:

- Including the mitigation of greenhouse gas emissions and adaptation to climate change in their farm business and environment plans by 2025
- Having farm-level accounting and reporting systems in place by 1 January 2025

Its Terms of Reference also require *He Waka Eke Noa* to provide recommendations on the core design features of a farm-level pricing mechanism by early 2022.

Te Aukaha

Te Aukaha/the Māori Agribusiness workstream of *He Waka Eke Noa* is in the process of being established to ensure that Iwi, hapū and whānau perspectives are incorporated throughout the development and delivery of the work programme. Te Aukaha is being led by the Federation of Māori Authorities (FOMA).

***He Waka Eke Noa* and the Climate Change Commission**

Under the Climate Change Response Act 2002, by the end of June 2022 the Commission is required to report to the Government on progress towards farm-level emissions pricing obligations. This must include advice on the progress made towards the milestones of *He Waka Eke Noa* and the readiness of farmers to comply with a farm-level emissions pricing mechanism.

If progress has been insufficient, the Government can bring the agriculture sector (livestock and fertiliser) into the NZ ETS at processor level prior to 2025.

17.2 Create options for alternative farming systems and practices

60 Different land uses have opportunities, risks and implications that have not yet been fully explored and understood in the context of the low-emissions transition. Land is an important resource with the potential to support many important outcomes across environmental, social, cultural, and economic domains.

61 Better data, information, and tools at the national and regional scale would help landowners, Iwi/Māori, local, and central government make decisions across a range of outcomes.

17.2.1 Diversifying land use could reduce emissions

62 Diversifying land uses and switching some land that is currently in livestock agriculture to horticulture or arable cropping could reduce emissions.

63 However, there are significant barriers to changing land use – such as a lack of existing markets, supply chains, access to resources such as water, and a lack of experience, skills, labour, support, and infrastructure. This was reiterated in submissions from the horticulture sector. Investment in new farming systems is higher risk if infrastructure like packhouses, transport and water storage do not already exist.

64 These barriers mean conversions to horticulture and cropping are unlikely to play a large role in the first few emissions budgets, as the land area converted is likely to be a small percentage of that currently in pastoral farming. However, work done in the next few years to address these barriers can unlock options for shifts towards these farming systems to play a bigger role in future emissions budgets.

65 Measurement and verification of the emissions footprint and broader sustainability of products can help show which products meet customers' environmental requirements and could provide a market driver for lower emissions practices.

66 Some submitters, including many individuals, emphasised the importance of giving consumers low-emissions choices, supported by trustworthy information. Providing verifiable, sustainable, low-emissions food and fibre products could help secure and maintain customer relationships and encourage landowners to move to lower emissions land uses.

67 Moving to more horticulture and arable systems will have broader implications for climate adaptation, the need for water availability, along with potential impacts on water quality. Reform of resource management legislation, for example via a Strategic Planning Act, provides an opportunity to take a more holistic, landscape approach.

68 During consultation we heard a lot about the opportunity and importance of integrating trees into farms. Afforestation will be required to meet and maintain our net zero emissions target, and some of this could be integrated onto farms through 'mosaic' land-use systems.

69 Some steep and erosion-prone land can revert to native forest if it is near a seed source – fencing and pest control will be important to support this. Farmers can also plant small blocks of production forest on accessible parts of their land. This will be a particular opportunity for farms that can reduce stock numbers by improving animal productivity.

70 Agroforestry systems are another option. These systems integrate trees into cropping or pasture systems. Approaches will vary by farm, but in many cases agroforestry can enhance on-farm sequestration while also diversifying income. It can also generate significant co-benefits for biodiversity and climate resilience, by providing shade and shelter. *Chapter 18: Policy direction for forests and other carbon stocks* provides more detail on forestry.

Recommendation 24

Reduce emissions from agriculture

We recommend that, in the first emissions reduction plan, the Government commit to:

Accelerating reductions in agricultural emissions by rolling out policies, incentives and tools, and investing to create future emissions reduction options.

This should include the Government:

1. Following through on its legislated commitment to decide in 2022 on a pricing mechanism for agricultural emissions, to avoid ongoing uncertainty which will deter farmers and growers from reducing emissions in the short term. The design of this pricing mechanism:
    a. Must be both suited to the characteristics of the sector and capable of driving emissions reductions in line with emissions budgets and targets.
    b. Must not disproportionately disadvantage or compound historical grievances for Iwi/Māori and must factor in the unique characteristics of Māori collectively-owned land and Māori-collectives. This is particularly important in the design of any methods for providing assistance to participants in the pricing mechanism.
2. Supporting farmers and growers to identify and implement changes on farm to reduce emissions by:
    a. Collaborating with industry to further develop and fund effective advisory services.
    b. Partnering with Iwi/Māori and Māori-collectives to further develop and fund Māori-focused advisory services targeting the specific needs of Māori-collective landowners.
    c. Resourcing and prioritising rural digital connectivity.
3. Removing barriers to the deployment of new technologies to reduce emissions on farm by ensuring relevant regulatory regimes, such as the Agricultural Compounds and Veterinary Medicines Act, do not unnecessarily hinder their adoption.
4. Facilitating domestic and international market acceptability of proven low emissions food and fibre products, by working with the sector, including Māori agribusinesses, to demonstrate their environmental credentials to international customers.
5. Investing to create options for deeper emissions reductions in future by:
    a. Developing a long-term plan for targeted research and development (and uptake/deployment) of technologies and practices to reduce biogenic emissions from agriculture.
    b. Supporting farmers, growers and local government to make well-informed land-use decisions by investing in nationwide land and climate information and decision-making tools, including information and tools relevant for Māori collectively-owned land.
    c. Supporting deployment of the systems and infrastructure needed for alternative lower emissions farming systems and products, including enabling Māori-collectives to participate in these new opportunities.

Recommendation 24

Provisional progress indicators

1. Government to have, by 31 December 2022, developed and published a long-term plan for funding research and development to support reductions in agricultural emissions. Note: The Commission will also be assessing the progress made towards the milestones of *He Waka Eke Noa.*
2. Government to annually, from 31 December 2022, report information on the total investment into research and development into reducing agricultural emissions.

Assessment of our recommendations against our policy approach

Recommendation 24	Action to address barriers	Pricing to influence investment & choices	Enable innovation & system transformation
Reduce emissions from agriculture			
Follow through on legislated commitment to decide on a pricing mechanism for agricultural emissions		✓	
Support farmers and growers to identify and implement changes on farm	✓		✓
Remove barriers to the deployment of new technologies to reduce emissions	✓		
Facilitate market acceptability of proven low emissions food and fibre products	✓		✓
Invest to create options for deeper emissions reductions			✓

Chapter 18

Aronga Kaupapa – Ngā Ngahere me Ngā Repo Mauwaro
Policy direction for forests and other carbon stocks

Summary

In Aotearoa, forests are the only option available now for removing carbon dioxide from the atmosphere at scale.

Our advice prioritises stopping emissions at source. This means strategically managing forests to provide a long-term carbon sink for Aotearoa, rather than using them as a primary tool to meet our 2050 emissions reduction targets (2050 targets).

To achieve this, we recommend:

- A comprehensive national programme to establish more native forests. Native forests will remove emissions beyond 2050 and provide multiple co-benefits, including cultural, biodiversity, erosion control and water quality benefits.
- Amendments to the New Zealand Emissions Trading Scheme (NZ ETS) and other climate policies to manage the amount of forests planted due to climate policies. While our advice recommends planting more exotic production forests, we recommend fewer than the country would see under current NZ ETS settings.
- Effective, integrated pest management to help establish new forests and maintain carbon in existing forests. Pests such as deer and goats can quickly destroy new forests and reduce the carbon stored in existing forests.
- Government clarify the role of permanent exotic forests in our transition and develop and amend policies to deliver against this. Some stakeholders are concerned about permanent exotic forests being established at scale in a way that does not contribute to local economic activity and employment, and that may cause environmental risks.
- Encouraging additional carbon storage in smaller blocks of trees on farms.
- Preventing loss of carbon from drained peatlands and the destruction of wetlands.
- Maintaining and increasing the carbon stock in existing pre-1990 forests through activities like pest and fire control, and enrichment planting.

Changes in our final advice

Our final advice is more explicit about changing the NZ ETS to manage afforestation. This is critical to make sure that gross emissions in Aotearoa reduce.

We heard that Māori-collectives face a range of constraints that limit their scope to manage their whenua in alignment with their rangatiratanga and collective aspirations. We now have a recommendation for the Government to consider ways to give more flexibility for Māori-collectives with pre-1990 forest on their whenua.

We received submissions about the negative impacts of large-scale permanent exotic forests, particularly those planted solely for carbon, on rural communities and the wood processing industry and about the higher potential of alternative exotic species for carbon sequestration.

We heard through consultation that forests cannot be established with the current prevalence of pests, so we recommend effective, integrated pest management.

Introduction

1 Forests play a significant role in the history, culture, economy, and biodiversity of Aotearoa. Forests will play an important part in helping Aotearoa to meet emissions budgets and the 2050 emissions reduction targets, because they are the only way to remove carbon dioxide from the atmosphere ('emissions removal') that is currently available at scale.

2 Different types of forest will play different roles. New exotic production forests will be important to help meet emissions budgets and targets and to help sustain a thriving, low-emissions bioeconomy. At the same time, establishing new native forests will be key to maintaining net zero long-lived greenhouse gases in the long term, balancing emissions from hard-to-abate sectors, while providing multiple co-benefits.

3 The role that emissions removals from forests play must be balanced with the need to make gross emissions reductions, and consider potential impacts of land conversion on rural communities and the broader food and fibre sector.

4 Establishing new forests provides a one-off opportunity to remove carbon from the atmosphere. However, land converted to forestry needs to be kept in forests for the indefinite future, to keep that carbon stored. Continuing to remove emissions through forests would require ongoing land conversion. We have heard through consultation concern about extensive land conversion to forestry.

5 Our policy direction recommends a package of policies to support the establishment of forests to provide a long-term carbon sink for Aotearoa. Our advice draws on the three pillars of our policy approach: actions to address barriers; pricing to influence investment and choices; and enabling innovation and system transformation.

6 Adjusting pricing instruments to deliver the appropriate mix of incentives for reducing gross emissions and emissions removals by forests is central to our advice.

7 We also recommend action to incentivise native afforestation, manage localised impacts of afforestation and to maintain and increase existing carbon stocks. Investment is also needed to help improve knowledge and reduce the costs of establishing new native forests.

8 Fast-growing species (usually exotics) can be used to balance emissions over the next few decades, while slower growing species can balance future emissions.

9 It takes time to establish forests and for them to start sequestering carbon. Work is urgently needed to develop the incentives for native forests so they can remove sufficient carbon as Aotearoa gets closer to the 2050 target.

18.1 Manage forests to provide a long-term carbon sink

10 Forests act as a **sink** – they remove carbon from the atmosphere while they are growing. This adds to their carbon **stock** – the amount of carbon stored within the forest.

11 Forests will play an important role in meeting the country's emissions budgets and targets. Our demonstration path assumes 300,000 hectares of new native forests and 380,000 hectares of new exotic forests are established between 2021 and 2035.

12 This would provide sufficient biomass feedstock for the bioeconomy, and several analyses show that there is enough suitable land available to support this level of forestry.

13 Reliance on exotic forests as a carbon sink beyond this could divert action away from reducing gross emissions in other sectors and could make maintaining net-zero greenhouse gas emissions after 2050 challenging. However, new native forests could provide an enduring carbon sink that would help to offset residual long-lived emissions from hard-to-abate sectors over the long term.

14 There are many other worthwhile reasons to establish forests beyond climate change. Decisions about incentives for forestry should be considered alongside other strategic outcomes for the country's land including water, biodiversity, cultural, social, and economic outcomes.

15 There may be implications for Iwi/Māori who already experience constraints managing collectively-owned land, such as ownership, access, and cultural impacts. It will be important to ensure Iwi/Māori rights and interests are understood and recognised.

16 To support an equitable transition, the Crown needs to work in partnership with Iwi/Māori-collectives to understand their existing barriers and aspirations for land use in relation to forestry.

17 Policy approaches need to consider the unique characteristics and historical circumstances of Māori collectively-owned land, and must give effect to the Treaty principles of partnership, protection, participation, and equity while also recognising the guarantee of rangatiratanga and kaitiakitanga under Te Tiriti o Waitangi/The Treaty of Waitangi. See *Chapter 19: Policy direction for an equitable transition for Iwi/Māori* for more detail on implications for Iwi/Māori.

18 There are risks to relying on carbon stored in forests. Future changes in climate may affect tree growth rates, increase wind throw and wildfire, and enable more pathogens to spread. It will be important to explore approaches to mitigate these risks across different types of forests, including the use of silvicultural techniques such as mixed species, diverse age classes, and continuous cover forestry.

19 Browsing pests, such as possums, goats, and deer, as well as invasive weeds, pose a significant threat to the establishment of new forests. They can also pose a risk to the health of existing forests, and the carbon sink they provide. Pests will need to be effectively managed, including through efforts such as Predator Free 2050, to make sure forests can play the role that we recommend in our advice.

Box 18.1: There are different types of forest with different characteristics

Native forests:

Native forests are comprised of indigenous species. They are typically multi-age, multi-species forests that grow slowly and continue to remove carbon dioxide for centuries. Harvesting is generally prohibited in existing native forests that are publicly owned.

High-value native trees, however, can be **selectively harvested** on private land. Native forests can be established through methods such as **reversion** (setting up the conditions for land to revert through activities like pest control and fencing) and **planting** seedlings. **Enrichment** planting of additional plants within these existing forests can increase their carbon stock.

Exotic forests:

Exotic forests consist of tree species that are not native to Aotearoa. Most exotic forests in Aotearoa are conifers, mainly radiata pine, with some Douglas fir and redwoods. There are also other species, such as eucalyptus, oaks, and acacia.

Most exotic forests are planted as single species, though some self-seed. Conifers that have self-seeded in undesirable locations are termed wilding pines, wilding conifers, or tree weeds.

Production forests:

Production forests are planted to be harvested. Production forests in Aotearoa currently are largely exotic trees planted as a **single species** which are then usually **clear felled** (completely removed) after the trees have reached the desired age.

Permanent forests:

Permanent forests are established with no intention of clear-fell harvest. These could be established through either reversion or planting and might be native or exotic species.

While many of these forests are established with no intention to harvest, some permanent forests are established with the intention of selective harvest or to act as **nurse crops** transitioning to mature native forests.

A forest can be registered in the New Zealand Emissions Trading Scheme (NZ ETS) as permanent if it meets certain conditions, such as maintaining canopy cover.

Some forests are planted as **mixed species** (sometimes a mix of exotic and native), and these forests are more likely to be selectively harvested rather than clear felled, due to the different ages of trees. Forests selectively harvested in this way can still be considered permanent.

Pre- and post-1990 forests:

For accounting and policy purposes, a distinction is made between forests established prior to 1990 (**pre-1990** forests) and forests established after 1989 (**post-1989** forests).

For further information about this, please see *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets.*

18.2 New native forests can provide an enduring carbon sink

20 Native forests remove carbon at slower rates than exotic planted forests, but can continue to sequester carbon for hundreds of years. Native afforestation needs to start now to provide enough removals to maintain net zero long-lived greenhouse gas emissions beyond 2050.

21 A large number of submissions were very supportive of establishing new native forests, with some noting that native forests also offer other benefits, such as improving biodiversity, providing habitat for birds and other native species, as well as recreational and spiritual benefits.

22 However, there are currently limited incentives for landowners to change less-productive farmland to native forests – this was also highlighted in some submissions including many from farmers and other landowners.

23 Depending on location, new native forests can be established either by assisting land to revert naturally back to native forests, or through planting. Both approaches come with a cost for landowners, including fences, planting, weed and pest control, and some land would be lost from grazing.

24 There is an estimated 1.2 to 1.4 million hectares of erosion prone land in Aotearoa, some of which is government owned. Much of this is not suitable for production forestry but could be suitable for native forest.

25 For land to revert to native forest, most locations would require active pest control. Reversion is a lower cost method for establishing forests compared to planting, although there is evidence that growth and carbon removal rates are lower.

26 Manaaki Whenua estimated in the Aotearoa Circle *Native Forests Report* that there is around 740,000 hectares of less versatile private land, which is not suitable for commercial forests but could naturally revert if pests are managed. Some of this will be pockets of land within existing farming system that might be steeper and/or erosion prone.

27 In some places, if managed appropriately, there is also potential for new native forests to be selectively harvested to provide high-value timber and non-wood forests products, while still being considered 'permanent'.

28 Some submissions, including from the forestry sector, individuals, and farmers, noted that establishing the amount of native forest recommended in our policy direction presents a considerable challenge. Ensuring the survival of planted seedlings, including protecting them from pests like deer and goats, will be difficult. The costs could also be significant.

29 The rates of native afforestation included in our advice are a significant step up from what has been seen in the past. Costs for landowners will need to be reduced for Aotearoa to deliver this.

30 Potential ways of doing this include through government mechanisms like direct grants, which could be linked to carbon removals, or to the broader ecosystem services these forests provide. Incentives will need to be carefully designed, and guided by experiences gained through initiatives like the One Billion Trees programme.

31 Establishment costs could also be reduced over time through activities like research and development into seedling production and establishment methods (including mātauranga Māori), and sharing this knowledge among practitioners. Information on the rates at which different types of native forest remove carbon is also limited, which makes it hard to reflect the carbon benefits of native forests in policy.

32 Existing native forests store a large amount of carbon, including a large amount on the conservation estate. However, in many regions the younger trees are at risk from browsing pests, which threaten the future forests' health and stored carbon.

33 The population of browsing pests, particularly goats and deer, has increased significantly over the last decade. Urgent and ongoing pest management is required to maintain the integrity of forests and the carbon stored in them. Enrichment planting within degraded forests can also be a cost-effective way to increase the carbon stored.

34 Expanding and restoring native forests aligns with restoring the mauri of the land. Consideration of how to balance the multiple aspirations of Iwi/Māori will be needed. For example, it is important that new forests align with Iwi/Māori rights to exercise kaitiakitanga and rangatiratanga, and their economic aspirations.

35 More broadly, delivering this level of native afforestation will require stable policy, to reduce uncertainty for supporting industries and infrastructure providers – including to increase native seedling nurseries, and to grow the labour force for planting and pest control. Adequate governance arrangements will be important, as will investment in scaling up capacity and expertise.

18.3 Production forests could play multiple roles in the transition to low emissions

36 Production forestry can be an important carbon sink in the short to medium term and can provide a feedstock for the bioeconomy (see Recommendation 15 in *Chapter 13: Policy direction that cuts across sectors*). Mature production forests also have other benefits including for erosion control, water quality, biodiversity and providing recreational value.

37 Exotic production forests sequester carbon quickly. However, they only contribute towards meeting emissions budgets and targets until they reach their long-term average carbon stock – which is around 23 years for the most common species, *Pinus radiata*.

38 Because of this, production forests planted over the next decade will contribute towards emissions budgets until only about 2050. Production forests planted after 2030 will contribute to removals in the longer term.

39 There is a considerable amount of pre-1990 forest on the whenua of Māori-collectives, such as whenua returned under Treaty settlements as well as Māori freehold land. This land is effectively locked into commercial forestry due to NZ ETS liabilities, coupled with capital constraints. The objective for Māori-collectives is to retain the whenua for future generations so it cannot be used as collateral for development, which contrains their ability to raise capital.

40 Māori-collectives with limited access to capital or other land resources would find it difficult to make use of offsetting provisions in the NZ ETS, which allow pre-1990 forest land to be deforested without a unit surrender liability if an equivalent forest is planted elsewhere.

41 The Government should consider allowing more flexibility to enable Māori-collectives to change land use to support other social, cultural, environmental or economic priorities for the intergenerational wellbeing of their members – such as food sovereignty and papakāinga development. This would also support more equitable treatment for Māori-collectives who have been prevented from making decisions over their whenua.

42 There is a risk that deforestation of post-1989 forests could lead to several million tonnes of carbon dioxide being emitted from forests over budget periods (see *Chapter 7: Demonstrating emissions budgets are achievable, Section 7.10*). Around half post-1989 forests (around 320,000 hectares) are not registered in the NZ ETS and so face no disincentive to deforestation.

43 There are also many post-1989 forests that were registered in the scheme well after the forest was planted, for which the costs of harvest and deforestation are the same, and for which remaining in the NZ ETS for future rotations gives no net benefit. This means they could change land use away from forestry (deforest) without any further NZ ETS cost.

Current NZ ETS settings will incentivise more production forestry than needed

44 A significant increase in exotic afforestation is needed to meet the first three emissions budgets. Some submissions noted that achieving this will require supporting infrastructure such as nurseries, planting, and silviculture services to be expanded.

45 However, current NZ ETS settings will incentivise more planting of fast-growing exotic species, such as pine, after 2030 than is desirable to meet the 2050 targets in a way that is consistent with our budget advice (see *Chapter 5: Recommended emissions budgets*).

46 The NZ ETS does not differentiate between carbon removals by forests and reductions in gross emissions. Therefore, in its current form the NZ ETS will drive the relatively low-cost option of planting pines rather than more costly gross emissions reductions. Submissions were largely supportive of the need to make changes to the NZ ETS to align more closely with our advice.

47 There are several ways the NZ ETS could be amended to manage incentives for afforestation so that the scheme delivers outcomes that align with our advice.

48 This includes, for example: reducing demand by limiting how many forestry units non-forestry participants can surrender, or requiring them to pay an additional fee when surrendering forestry units; reducing the rate at which units can be earned by exotic forests; or limiting the overall area of forest that can be registered in the NZ ETS each year, or otherwise amending the eligibility criteria. There may also be other options.

49 Each option will have different impacts on different groups, and the Government will need to identify and work through the risks and benefits of different approaches during the policy development process. This should include engaging and consulting with people affected by the proposed changes, to understand the implications and avoid unintended consequences.

50 Ideally, this process would proceed in a timely manner, to avoid prolonged uncertainty about how the NZ ETS will operate. This would risk the perverse outcome of discouraging investment in the forests that are needed.

51 The implementation of any approach to manage the NZ ETS incentives for afforestation should also take into account forests that are not covered by the NZ ETS, on both private and public land.

52 During consultation a number of submitters expressed concerns about the impacts of permanent pine forests planted only for carbon purposes. This includes concerns about impacts on rural communities and provincial centres that rely on the food and fibre sector for work (see *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable*). Some submitters thought that these forests provide no local economic benefits and that they may not be managed well over the long term, creating environmental risks.

53 There was also concern that as the NZ ETS price rises, shifting production pine forests to become permanent carbon forests would become more attractive than harvesting, with negative impacts on wood supply and employment. Some suggested that only native forests should be permitted to register into the NZ ETS as permanent forests.

54 There are some legitimate concerns about impacts and risks from large scale permanent pine forests. However, there are also other permanent exotic forest types that could provide benefits. For example, unharvested exotic forests that are actively and appropriately managed could transition to native forests over time.

55 Other exotic species, such as redwoods or oaks, could also be selectively harvested to provide economic benefits and carbon income while still being considered 'permanent'.

56 Permanent forests must be kept as forest to maintain their carbon stock. There are penalties if permanent forests registered in the NZ ETS are deforested. Many areas of land permanently in forest are also covered by covenants, such as with the QEII trust.

57 The Government should develop a clear position on the role of different types of permanent exotic forests. This should flow through to how they are treated in climate policy, for example whether land converted to fast growth exotic forests can register as permanent in the NZ ETS.

58 During consultation we also heard concerns that whole farms are being planted in exotic production forests, sometimes encouraged by Overseas Investment Act provisions that facilitate foreign investment in forest land. If this is done at significant scale, there could be negative impacts on rural communities that rely on the food and fibre industry for employment.

59 Constraining the NZ ETS incentive could help reduce the scale of afforestation nationally, but influencing where afforestation happens, including how much in specific regions, would likely require a regulatory approach, for example through planning rules.

60 There are multiple pieces of legislation that affect how land is used in Aotearoa. Resource Management Act (RMA) tools such as National Environmental Standards and provisions for Significant Natural Areas are designed to manage environmental impacts.

61 However, some submitters told us that these are not sufficient to manage the full impacts of afforestation. The current revision of the Resource Management system provides an opportunity to align environmental policies to achieve multiple outcomes.

18.4 Areas of forest interspersed with other land uses provide multiple benefits

62 Smaller areas of forest interspersed with other land uses can create a 'mosaic' type landscape that can provide multiple benefits, including supporting biodiversity, erosion control, water quality and animal welfare.

63 New areas of permanent trees and vegetation can be established in locations that are less suited for livestock (such as gullies). This would help to create diverse silvopastoral productive landscapes at farm, catchment, and regional levels (for more information see *Chapter 17: Policy direction for agriculture*).

64 The additional carbon removed by small areas of vegetation on farms and in urban green spaces is not currently recognised in target accounting, though it is in *New Zealand's Greenhouse Gas Inventory*. However, ongoing technology developments may make it more possible to robustly estimate emissions from these areas in future.

18.5 Soil carbon, wetlands and oceans can also provide significant climate benefits

65 Aotearoa soils are naturally rich in carbon and it is important we retain this to support climate benefits and soil health. Changing land use (for example, from pastoral to cropping) can reduce soil carbon. However, the evidence base for how different management practices (for example, irrigation) impact on soil carbon is still being built.

66 Some soils in Aotearoa are losing carbon stock rapidly. This is particularly the case for drained peatlands, some of which are shrinking and dropping below sea levels. While this is a small percentage of all soils in Aotearoa, they are concentrated in particular regions such as Waikato, Manawatu and Southland.

67 Rewetting peat soils can halt and reverse these losses, and would have co-benefits, particularly for climate adaptation, biodiversity, water quality, and managing extreme rainfall. However, carbon losses or gains from peatlands are not currently captured in target accounting (for more information see *Chapter 10: Rules for measuring progress towards emissions budgets and 2050 targets*).

68 Carbon in the ocean ('blue carbon') could also be a source and sink of emissions. Some submissions referred to a recent study concluding bottom-trawling releases carbon from the seafloor. Other submissions noted that marine protection could help maintain stores of carbon in marine environments such as sea grasses, salt marshes and marine sediment.

69 While human actions can directly impact the amount of carbon stored in the marine environment, more work needs to be done to understand and quantify this. Building the evidence base on this would improve the Government's ability to factor carbon impacts into its decisions about managing the marine environment.

Recommendation 25

Manage forests to provide a long-term carbon sink

We recommend that, in the first emissions reduction plan, the Government commit to:

Developing a framework of actions to deliver a mix of exotic and native forest sinks, and manage these and other carbon stocks, to provide flexibility to meet emissions budgets and targets.

This should include:

1. Establishing a long-term carbon sink through a comprehensive national programme to incentivise the reversion and planting of new native forests to maintain net zero long-lived greenhouse gas emissions beyond 2050.
2. Designing a package of policies to reduce reliance on forestry removals and manage the impacts of afforestation including:
    a. Amendments to the NZ ETS to manage the amount of exotic forest planting driven by the scheme (see also Recommendation 11 on the NZ ETS).
    b. A clear position on the role and desirability of different types of permanent exotic forests as carbon sinks, and amending the NZ ETS and other policies accordingly.
    c. Land-use planning, direction and tools to help local government manage afforestation, mitigate localised impacts of afforestation and to achieve environmental co-benefits.
3. Managing pests in an integrated way, to ensure forests are successfully established and all forests are maintained long term.
4. Considering ways to allow more flexibility for Māori-collectives with pre-1990 forest on their whenua, to give them more scope to manage their whenua in alignment with the intergenerational aspirations of their members. This could include, for example, assisting capital-constrained Māori-collectives to offset deforestation on pre-1990 forest land.
5. Maintaining and increasing other carbon stocks through:
    a. Improving and enforcing measures to reduce deforestation of pre-1990 native forests.
    b. Noting that emissions and carbon dioxide removals may not currently be reliably quantifiable or accounted for in targets (see Recommendation 5 on rules for measuring progress), taking steps to:
        i. Protect and increase the carbon stocks of pre-1990 forests through activities such as pest and fire control, and enrichment planting.
        ii. Encourage carbon removals by new and additional small blocks of trees and vegetation.
        iii. Preventing further loss of carbon from organic soils, particularly due to the degradation of drained peatlands and the destruction of wetlands.

Recommendation 25

Provisional progress indicators

1. Government to have, by 31 December 2022, developed proposals for incentives for native forests and for managing the amount of exotic forest planting driven by the NZ ETS, with amendments to be effective by 31 December 2024.
2. Government to report, from 31 December 2022, on the hectares of exotic and native forest that are afforested and deforested at least annually.
3. Government to report at least annually, from 31 December 2022, on a suite of indicators including information on labour, nurseries, land purchases, pest eradication data (area to which 1080 has been applied or farm management plans).

Assessment of our recommendations against our policy approach

Recommendation 25	Action to address barriers	Pricing to influence investment & choices	Enable innovation & system transformation
Manage forests to provide a long-term carbon sink			
Develop a national programme to incentivise the reversion and planting of new native forests	✓	✓	✓
Design a package of policies to reduce reliance on forestry removals and manage impacts of afforestation	✓	✓	
Manage pests in an integrated way	✓		✓
Consider ways to allow more flexibility for Māori-collectives with pre-1990 forests on their whenua	✓	✓	
Maintain and increase other carbon stocks	✓	✓	

Chapter 19

Aronga Kaupapa – Te Whakawhiti hei oranga mō te Iwi Māori
Policy direction for an equitable transition for Iwi/Māori

Summary / Policy direction for an equitable transition for Iwi/Māori

This chapter responds to the significant feedback we received about the need to see Iwi/Māori views reflected in our advice.

We heard clearly that the Government must uphold its commitments and obligations under Te Tiriti o Waitangi/The Treaty of Waitangi and the Crown-Māori partnership in its response to climate change. Māori and non-Māori submitters told us that emissions reduction plans must be firmly rooted in the principles of partnership, participation, protection, and equity.

Achieving an equitable transition for Iwi/Māori

The transition to a low-emissions society in Aotearoa must be equitable for tangata whenua and all New Zealanders. To achieve this, the impacts of the transition on Iwi/Māori need to be understood from a te ao Māori view.

The Commission has looked closely at the direction of policy needed to ensure government can support proactive partnership with Iwi/Māori and advance a Māori-led approach to an equitable transition for Iwi/Māori. Part of this is providing for the recognition of Iwi/Māori perspectives, including recognising tikanga and mātauranga Māori alongside Western science.

Central and local government must ensure emissions reduction plans comply with the Treaty and do not compound historic grievances and further disadvantage Iwi/Māori. Climate action that does not support Iwi/Māori to exercise rangatiratanga, kaitiakitanga and mana motuhake over their whenua, and other cultural assets will exacerbate inequity for Iwi/Māori.

Iwi/Māori expressed their concern that if existing barriers inhibiting Māori economic development and cultural vitality are not addressed, climate action will further impact the social and cultural wellbeing of Iwi/Māori.

In working towards equitable partnerships with Iwi/Māori, it is important that government understands te ao Māori values and perspectives regarding taonga tuku iho and whenua, including land-use decision-making. A stronger emphasis on investment into local and regional low-emissions economic development will better prepare Iwi/Māori communities to respond to local and regional environmental and economic shocks caused by the effects of climate change.

This chapter highlights that Iwi/Māori co-decision making is needed across all levels of government along with an enabling policy direction that advances a Māori-led approach to ensure an equitable transition.

We make the following recommendations:

- Government to work in partnership with Iwi/Māori and local government to develop a strategy to ensure the principles of the Treaty are embedded in subsequent emissions reduction plans.
- Central and local government work in partnership with Iwi/Māori to develop a mechanism to build authentic and enduring partnerships that result in equitable outcomes for Iwi/Māori.
- Government work with Iwi/Māori to develop a strategy, including timebound measures for progress, to advance a Māori-led approach to an equitable transition to a low-emissions society for Iwi/Māori and the Māori economy.

Changes in our final advice

This is an additional chapter to our *2021 Draft Advice for Consultation* in response to the significant feedback we received that Iwi/Māori need to be visible in the Advice report, and about upholding Te Tiriti o Waitangi/The Treaty of Waitangi.

This chapter provides context to support *Chapter 11 - Approach to developing advice on policy direction*, and *Chapter 12*: *Policy direction to create an enabling environment for change* to ensure our advice to Government reflects what we have heard to support an equitable transition for Iwi/Māori.

Introduction

1 The response to climate change in Aotearoa must be firmly rooted in the principles of partnership, participation, protection, and equity which underpin the unique relationship between the Government and tangata whenua under Te Tiriti o Waitangi/The Treaty of Waitangi.

2 The transition to a low-emissions society in Aotearoa must be equitable for tangata whenua and all New Zealanders. To achieve this, it will be important to understand the impacts of the transition on Iwi/Māori from a te ao Māori view.

3 This chapter looks more closely at the direction of policy needed to support this. It looks at how government can support proactive partnership with Iwi/Māori, and advance a Māori-led approach to an equitable transition for Iwi/Māori.

4 The next chapter (*Chapter 20: Policy direction for a fair, inclusive and equitable transition*) then goes on to look at the policy and systems needed to support a fair, inclusive, and equitable transition.

5 The importance of ensuring an equitable transition for Iwi/Māori was a key theme during consultation, emphasised across Iwi/Māori submissions. We heard a range of concerns, including:

- **Te Tiriti o Waitangi/The Treaty of Waitangi**: Concerns were raised that climate action which fails to comply with the Treaty will compound historic grievance, further disadvantage Iwi/Māori, and fail to achieve an equitable transition.
- **Te ao Māori:** We heard that tikanga and mātauranga Māori need to be recognised as equal, particularly in the following areas: the Treaty Partnership, climate leadership, and the science and knowledge base we draw from to address climate change.
- **Whenua Māori (taonga tuku iho):** Many Iwi/Māori are concerned that climate action will compound historic grievances and further obstruct Iwi/Māori from exercising rangatiratanga, mana motuhake, and kaitiakitanga. Iwi/Māori have a whakapapa connection to whenua, and it is important that government understands land-use decision making from a te ao Māori view.
- **The Māori economy:** We heard that action which constrains Māori-collectives from exercising rangatiratanga and mana motuhake over their whenua and other cultural assets, will have flow-on effects that will compound historic grievance and increase disadvantage for Māori-collectives compared with private landowners and corporations.
- **Local and regional development:** There were calls for a stronger emphasis on local and regional development, which would promote more resilient Iwi/Māori communities, better prepared to respond to environmental and economic shocks.
- **Disproportionate impacts**: We heard concerns that if existing barriers inhibiting Māori economic development and cultural vitality, which have flow through effects to social and environmental wellbeing, are not addressed, there is a risk climate action will further disadvantage Iwi/Māori – who already experience disproportionate impacts across a range of areas including health, skills and education, employment, and household wealth.

6 The sections that follow in this chapter outline the key areas of concern, which are interrelated and must be addressed coherently.

19.1 Te Tiriti o Waitangi/The Treaty of Waitangi

7 During consultation there was unamimous feedback from Iwi/Māori, echoed by some non-Māori submitters, telling us we need to do more to ensure Te Tiriti o Waitangi/The Treaty of Waitangi underpins our advice and recommendations.

8 We heard that all efforts to address climate change must uphold Te Tiriti o Waitangi/The Treaty of Waitangi, and be carried out in partnership with Iwi/Māori, to avoid further inequity as a result of addressing climate change.

9 Our Recommendation 6 in *Chapter 12: Policy direction to create an enabling environment for change*, responds to this feedback.

10 It recommends the Government work with Iwi/Māori to develop a strategy to ensure that the principles of the Treaty are embedded in subsequent emissions reductions plans and includes an evaluation framework outlining agreed accountability milestones and measures.

19.2 Te ao Māori

11 The impacts of climate change transition for Iwi/Māori must be understood from a te ao Māori view.

12 A te ao Māori view is integrated and recognises that the ira tangata (the human realm) exists in an ecosystem. Effective policy design should balance what is good for people, the whenua, water, and climate, as well as protect whakapapa, enhance whanaungatanga, and ensure intergenerational sustainability and prosperity. Aspects of the system should not be considered in isolation from the interrelated parts.

13 Through consultation and submissions Iwi/Māori raised concerns regarding historic injustices, legislative constraints, and other barriers across all levels of local and central decision-making bodies that inhibit the full expression of te ao Māori.

14 Key issues raised in submissions include:

- Climate action needs to take a whole of systems approach to minimise unintended consequences of future action. A te ao Māori view is integrated and tikanga helps to maintain balance across the system. From a te ao Māori view, climate action should be addressed in parallel with wai (water) and whenua (land).
- Tikanga and mātauranga Māori offer insights and solutions to climate change issues that reflect an integrated worldview. Feedback from Iwi/Māori emphasised the need to invest in research and development that will improve access to mātauranga Māori and, in turn, lead to a more equitable knowledge base that Aotearoa can draw upon to inform decision making and policy design.
- Iwi/Māori leadership models are based on tikanga values such as whakapapa, tikanga, and hapū rangatiratanga. Equitable outcomes for Māori will depend on Treaty partnership and climate leadership that ensures the right decision makers are involved, enables tikanga based decision making, and takes an integrated systems approach.

15 Iwi/Māori have a kaitiaki relationship with the taiao, which they exercise as rangatira. As such, Iwi/hapū leadership need to think about land-use options that align with the intergenerational aspirations of their members. Climate change action will compound disadvantage for Māori if it does not address policy, legislative, or other barriers that prevent Māori from exercising their rights under the Treaty.

19.3 Whenua Māori

16 Māori-collectives (e.g., Iwi, hapū, Māori land trusts, Post-Settlement Governance Entities, etc.) with rangatira responsibilities to their taonga tuku iho, have obligations to the whenua, the taiao, and their whanaunga based on whakapapa and tikanga.

17 Tikanga provides guidance to help maintain balance, which can place cultural and commercial limitations on behaviours and decision making, depending on the Iwi or hapū.

18 For example, many Māori-collectives cannot sell land, and some opt to preserve indigenous biodiversity or prioritise other environmental, social, and cultural benefits rather than pursue land uses that would maximise economic gains. This is because their overall aim is intergenerational wellbeing across the whole system.

19 Whenua Māori typically has a large ownership base, and decision making (by either a mandated body or consensus of owners) can be complex and take time due to tikanga or legislative barriers. Some of the challenges for Iwi/Māori managing collectively-owned land include:

- An exponentially increasing ownership base, as land is passed down through generations, related challenges identifying and connecting with owners, and owners' succession.
- Need for consensus from the majority of owners when making key decisions. This is difficult when they are not known and challenging if owners are not engaged or actively participating in hapū activities.
- Historic intervention in land ownership, such as land awarded through the Court system to some whānau and not others, or land parcels amalgamated. This causes costly ongoing issues for under resourced whānau, many of whom cannot afford to work through the Māori Land Court processes (cost of surveying, valuation, and identifying and meeting with all the owners) to have their decision-making rights reinstated.
- Capacity and capability around governance and management.
- Lack of access to capital for conversion or development.
- Lack of cashflow to cover operational costs, such as council rates.
- Lack of access to information and high-quality advice.
- Barriers to exercising authority over whenua, such as land that is land-locked (land with no reasonable access to it) and long-term leases.
- Lack of reliable infrastructure to support commercial activity.

20 Historic disruptions in whenua Māori ownership and management have meant some Iwi/Māori owners are only recently reinstated to their whenua, in the process of being reconnected, or are waiting for incumbrancers to be removed (e.g., recent settlements and expiring leases). This includes unjust acquisition, confiscation, and Crown imposed management that sold land, committed land in perpetual leases, or locked Iwi/Māori into industries such as forestry or agriculture.

21 Many of these Māori-collectives, who have been denied access to their whenua and associated benefits for many years, will initially prioritise connecting with owners/members to co-design culturally appropriate strategies moving forward. They may also prioritise building capability and resourcing to manage existing operations.

22 Some of these entities will be asset rich but cash poor and experience significant barriers to low-emissions economic development. This includes lack of access to quality information, advice, resourcing, and lack of access to the capital required to change land use, improve land management practices, or invest in other low-emissions options.

23 Te Puni Kōkiri (TPK) research has indicated that Māori whenua is underutilised (defined in terms of hectares and capital value). Government policy needs to address barriers for Māori landowners, as identified by TPK, and provide resources to enable Māori to realise opportunities, including the transition to a low-emissions economy.

24 Iwi/Māori feedback from submissions stressed that outcomes will be inequitable for Iwi/Māori if these basics of Māori collectively-owned land are not understood and factored in to policy design and decision-making. This will also be the case if Iwi/Māori are not supported with adequate tools and enablers to participate in climate change decision-making, planning, and action.

25 Another concern that was raised is the excessive amount of whenua Māori, acquired by the Crown through historical injustices, that now counts towards national assets, infrastructure, conservation lands and carbon sink.

26 Settlement redress falls well short of the value of those assets and does not factor in the time value of money, or the cost of opportunities denied to the hapū. Iwi/Māori expressed concerns that while Māori assets are retained for the national benefit, with little or no benefit to the hapū, the contribution is uncompensated and unrecognised.

27 Historic inequities are often compounded through contemporary policy, legislation, and regulations. For example, local council powers to classify whenua Māori returned in settlement as reserve land, which perpetuates the disconnection from rangatiratanga.

28 The Resource Management Act (RMA) also enables local government to classify whenua Māori (taonga tuku iho) as Significant Natural Areas (SNAs).

29 We heard from Iwi/Māori that this practice undermines Iwi and hapū rights to exercise rangatiratanga, which includes developing land to restore traditional uses or to address competing priorities to meet the needs of the hapū and the haukāinga – such as housing, food sovereignty, economic development, and environmental initiatives. This means SNA classification on Māori-collective land threatens Iwi and hapū sustainability and cultural vitality.

30 The impacts of SNA restrictions on Māori-collectively owned whenua significantly reduces the returns to owners, compared with SNAs allocated on privately owned land.

31 To prevent further disadvantage and inequality, the Government should work in partnership with Iwi/Māori to understand the issues and identify the barriers that restrict Māori from exercising rangatiratanga and kaitiakitanga in their transition to a low-emissions future.

32 Iwi/Māori should also be supported to quantify their emissions profile, to understand their contribution to the national emissions profile, including from confiscated conservation lands. Without a full account of the Iwi/Māori contribution to our national emissions profile, it will very difficult to design equitable policy.

33 Submissions feedback was largely supportive of a developing a Māori emissions profile. However, some submitters stressed that this should not be a government-owned tool, rather that the Government should work with Iwi and support them to build the data within their takiwā to align with Māori data sovereignty and rangatiratanga.

19.4 The Māori economy

34 The term 'The Māori Economy' captures a broad range of inputs which includes Iwi entities, Māori trusts and incorporations, Māori Authorities, Māori self-employed, and Māori employers.

35 For the purposes of this report, we refer only to the component of the Māori economy comprised of Māori-collectives (definable by Iwi and hapū entities (such as PSGEs), Māori trusts and incorporations, and Māori Authorities).

36 As noted previously, in addition to whenua Māori being managed in accordance with tikanga and whakapapa, they are also subject to various legislation and regulations, which are often at conflict with Māori cultural values.

37 Whenua Māori and associated operations account for a significant portion of the Māori-collectives asset base. For this reason, and because whenua Māori has been the target of numerous government initiatives over the years, Māori-collectives are heavily invested in primary industries (forestry, fisheries, agriculture), and tourism.

38 These industries inherently require large capital outlay and associated commitments, or long lifecycles (e.g., production forestry) that lock in Māori-collectives. Whenua retained by Māori-collectives or returned in settlement is typically taonga tuku iho, which, for cultural reasons, is very rarely sold.

39 Landowners that do not have a whakapapa connection to land have the flexibility to sell up and exit an industry. However, tikanga Māori is not equally recognised in legislation, and therefore Māori-collectives that operate in accordance with their rangatiratanga and kaitiakitanga rights, do not compete on a level playing field within our domestic economy.

40 For many Māori-collectives, it is difficult to raise capital, and this presents another barrier to economic advancement. Typically, the objective for Māori-collectives is to retain the whenua for future generations so it cannot be used as collateral for development. This can be very limiting for Māori-collectives that are asset rich but cash poor.

41 Over the years central and local government have driven regional planning initiatives that have constrained development, and in some instances, restricted development to singular industries.

42 We heard from Iwi/Māori that these initiatives (for example, designating Taupō and Queenstown for tourism) constrained productivity, disrupted local supply chains, reduced employment or replaced skilled employment with low-skilled employment. This has left some communities, particularly Māori communities, vulnerable to shocks.

43 Zoning restrictions can enshrine this rationale and constrain Iwi/Māori from using land in a way that aligns with traditional kainga and kaitiaki models. These models focus on developing resilient communities able to withstand shocks while fostering sustainability and prosperity in alignment with the needs of a growing population.

44 We also heard a lot of feedback from Iwi/Māori specific to particular sectors, as well as suggestions for more equitable and/or more sustainable policy options. We have taken this feedback on board in our sector specific policy direction.

45 As Aotearoa transitions to a low-emissions society, the Government should work in partnership with Iwi/Māori to identify options that enable Māori-collectives to compete on a level playing field. This can be done by taking into account the cultural and legislative constraints, which, combined, stifle Iwi/Māori economic development and will likely lead to an inequitable transition for Iwi/Māori.

46 The Government should also make suitable tools and enablers available to assist Iwi/Māori to an equitable economic transition. This would include resourcing to build Iwi/Māori capability and capacity, enabling Public-Māori Partnerships to ensure Iwi/Māori are able to participate in new infrastructure, low-emissions investments, and social procurement.

47 Addressing existing barriers for Māori-collectives is essential for an equitable transition. However, the Māori economy also presents an opportunity for Aotearoa to learn from Iwi/Māori leadership. The Māori economy is driving kaupapa Māori values and innovative land-use models that can lead to more sustainable low-emissions outcomes.

19.5 Local and regional development

48 Māori communities are traditionally structured on the kāinga model, which promotes local productivity and supply chains and builds resilience into communities. COVID-19 demonstrated the strength of Iwi/Māori communities. It also highlighted areas of vulnerability to environmental and economic shocks.

49 Co-investment in local and regional low-emissions development with Iwi/Māori would build more resilience into Iwi/Māori communities, and support an equitable transition to low-emissions productivity and better prepare communities to adapt to climate change.

50 Sufficient capability, capacity, and resourcing will be critical for successful co-investment in local and regional low-emissions development.

51 Iwi and hapū must be able to actively participate in council planning processes, such as long-term plans. This includes ensuring they have a clear understanding of their rights, and of the levers available to them to assert rangatiratanga and kaitiakitanga – as guaranteed under Te Tiriti o Waitangi/The Treaty of Waitangi.

52 At the same time, local government staff must be able to understand Iwi and hapū rights and the tikanga of the tangata whenua within the rohe, in the context of relevant legislation. This is particularly important for obligations set out in Treaty settlement legislation.

19.6 Disproportionate impacts

53 As a priority, the Government needs to address existing barriers resulting from historical injustices. These barriers systematically deprive Iwi/Māori of equitable outcomes in the areas of health, education, employment, household wealth, and land use.

54 During consultation we heard that to achieve an equitable transition, the Government needs to take into account the way historic injustices have led to disproportionate impacts for Iwi/Māori which is evidenced in the following statistics:

19.6.1 Skills and education

55 A 2019 report from Business and Economic Research Ltd. (BERL), *Education Awa: Education Outcomes for Māori,* identified that Māori experience persisting inequalities in education and skill levels, influenced by the cumulative effects of colonisation and structural systems that advantage non-Māori.

56 The report shows that more Māori leave school without gaining a level of qualification that will enable them to access higher levels of education, compared with non-Māori. The flow-on effect is that Māori are overrepresented in lower-skill jobs than non-Māori.

57 These jobs are more likely to have low job security and be subjected to automation. Also, advances in technology (for example, robotics) could replace a lot of manual based labour – particularly in horticulture and production forestry.

58 As the Government takes measures to reduce emissions, this will influence the labour market; jobs will be created, eliminated, substituted or transformed. Education and skills are linked to accessing high-income jobs.

59 Comprehensive education and labour market policies that support Iwi/Māori to develop relevant skills will be needed to ensure Iwi/Māori transition equitably. This is also related to Recommendation 24 in *Chapter 17: Policy direction for agriculture*.

60 It is important that Crown initiatives, and Māori-led decision making and investments, give consideration to the opportunities new and emergent technologies will create, as well as the disproportionate representation of Māori in labouring jobs.

19.6.2 Whānau Māori households

61 During consultation many Iwi/Māori raised concerns that action to address climate change could have disproportionate impacts on whānau Māori who are in low-income households.

62 The 2018 BERL *Income Inequity Gap* report showed average incomes for Māori are significantly less than for all New Zealanders.

63 At 50 years of age, Māori on average earn nearly $15,000 less than non-Māori a year. There is also a major wealth disparity between Māori and total New Zealanders; the mean value of individual Māori net worth is $204,000 compared to $411,000. This is a difference of $207,000.

64 These income and wealth gaps mean that it is likely to be more difficult for Māori in lower-income bands to uptake low-emissions technology if not given the support to transition.

65 The BERL report also found that there has been a significant increase in the Māori population and workforce. While the Māori population has increased by 30%, compared to 8% in the non-Māori population, the Māori workforce has increased by 40%, compared to 8% of non-Māori. These increases are set to continue.

66 'By Māori for Māori'-led solutions and actions tailored to each region to reflect economic, social, and cultural needs will be important to support an equitable transition for Iwi/ Māori.

19.7 Equitable and proactive partnership with Iwi/Māori

67 The key themes and concerns we heard from Iwi/Māori during consultation stem from inadequate recognition of Te Tiriti o Waitangi/The Treaty of Waitangi. An enduring transition to a thriving, climate-resilient, low-emissions Aotearoa can only be achieved with more deliberate effort to address the way Aotearoa gives effect to the Treaty and the Crown-Māori relationship.

68 The recommendation in this section is focused on creating a strong foundation to underpin our national efforts to address climate change. The efficacy of government action will be enabled or constrained by the supporting structure and systems in place to implement the strategy and take action to achieve the outcomes identified.

69 The recommendation focuses on ensuring that key decision-making bodies at every level of the system are enabled with the appropriate framing, capability, and capacity to collaborate with Iwi/Māori through a te ao Māori view to address the issues raised by Iwi/Māori for an equitable transition.

Recommendation 26

An equitable transition for Iwi/Māori

In the context of the transition to a low-emissions society, we recommend that central and local government work with Iwi/Māori to develop a mechanism to build authentic and enduring partnerships that results in:

1. Recognition and active protection of Iwi/Māori rights and interests.
2. Equitable decision-making with Iwi/Māori at all levels, through Māori representation on local, regional, and national bodies, and robust engagement and consultation process with Iwi/Māori.
3. Equitable access for Iwi/Māori to information, resources, services, and funding.
4. The development of climate change policy that draws on mātauranga Māori as well as western science.
5. Equitable outcomes for Iwi/Māori in alignment with Iwi/Māori aspirations for intergenerational wellbeing.
6. The embedding of the He Ara Waiora Framework throughout the development of climate change related policies.

19.8 Enablers to advance a Māori-led approach to an equitable transition for Iwi/Māori and the Māori economy

70 Effective Te Tiriti o Waitangi/The Treaty of Waitangi partnership upholds the principles of the Treaty through actions such as co-decision making, co-design, and effective and competent governance.

71 Due to historic inequities, Iwi/Māori are often resource constrained (in terms of time, finances, information, etc.) and inundated with competing priorities, which creates a significant barrier to participation.

72 Participation is critical to ensure an effective partnership. To support this, inequity across all aspects of the system will need to be addressed.

19.8.1 Enablers to support Iwi/Māori

73 The Government needs to ensure that Iwi/Māori have the tools and resources they need to participate in the transition to low emissions. Māori-led solutions and initiatives will be important.

74 Tools and enablers that would support an equitable transition for Iwi/Māori include:

- Access to relevant information made available in te reo Māori and in English
- Equitable access to education and skills to support low-emissions jobs and industries
- Support to transition to higher-paid, low emissions jobs to ensure whānau Māori are not locked into low-paying jobs that will have a flow through effect on the ability for their households to adopt low-emissions technologies
- Funding for Iwi/Māori-led initiatives that support whānau to transition, e.g., low-emissions waste and recycling options, and infrastructure to enable Māori communities, particularly remote and rural communities, to have their own energy supply
- More Māori-led regional and local low emissions development

19.8.2 Enablers to support Māori-collectives within the Māori economy

75 There is a diverse range of Māori-collectives who participate in the Māori economy. Some of the larger Iwi and well-established Māori land trusts are sufficiently resourced to participate in transitional activities.

76 However, many Māori-collectives are significantly under resourced so the combination of existing barriers and resourcing constraints will significantly impact their ability to particate and experience an equitable transition.

77 The Government should also consider ways to create an enabling environment, for example to give flexibility to Māori-collectives with pre-1990 forests on their whenua (see Recommendation 25 in *Chapter 18: Policy direction on forests and other carbon stocks*).

19.8.3 Establishing a Māori emissions profile

78 There was large support accross Iwi/Māori submissions (including 94% support through the 100 Coastie Voices submissions) for government to support Iwi/Māori to develop their own Māori emissions profile.

79 Throughout engagement and consultation Iwi/Māori expressed frustration at the inequity in the evidence and information used to inform policy. Some Māori-collectives, in particular, felt there was no accessible tool to quantify how much Iwi/Māori already contribute to national emissions reductions.

80 Māori-collectives expressed that taonga taken from their hapū, by the Crown, and used for conservation purposes, hydro-energy generation, our carbon sink, and other eco-system services provide a national benefit yet there is no corresponding recognition or compensation to the hapū who have lost out intergenerationally.

81 In addition, legislation and regulations such as grandparenting the introduction of nitrate discharge allowances and SNA restrictions, compound historic grievance and further disadvantage Māori-collectives who are already operating in accordance with tikanga Māori and exercising their rangatira and kaitiaki roles.

82 Some Māori-collectives, particularly Iwi whose redress assets included a large allocation of fisheries quota but minimal whenua, will be signifantly more disadvantaged compared with Iwi who were able to retain their whenua for use in forestry.

83 Based on these concerns Iwi/Māori identified the need for a Māori emisisons profile through engagement. This was tested more broadly through consultation and received a lot of support.

84 An important caveat was that in alignment with Māori data sovereignty initiatives, tikanga, and commercial sensitivity, this should not be a tool owned or controlled by government. Rather the Government should support Māori-collectives, particularly Iwi, to work within their takiwā to develop their own tool and data source.

85 This could be used internally by Iwi to improve decision making and emissions management, and could support information sharing with government to more effectively manage emissions.

86 Other tools and enablers that would support an equitable transition for Iwi/Māori include:

- Removal of legislative and other barriers that disadvantage Māori-collectives
- Recognition of tikanga Māori and kaitiaki operating models in our policy and legislative environment to enable Māori-collectives to operate in a more competitively neutral domestic environment

- Access to funding to support Māori-collectives who are not economically enabled to access quality information, capability, and other resources necessary to participate in an equitable transition
- Access to funding for Iwi/Māori to remediate contaminated land
- Access to quality advice and information that supports governance and operational decision making
- Opportunities to enable Māori-collectives to participate in new low-emissions infrastructure where there is a direct link between the whenua being utilised and the Iwi/hapū with mana whenua
- Time and flexibility to ensure new policy developed to address climate change does not unfairly disadvantage Māori-collectives or compound historic grievance
- Use of tax instruments and policy levers to alleviate existing disadvantage for Māori-collectives and support an equitable transition
- Recognition of Iwi and hapū whenua that was acquired by the Crown and contributes towards national emissions reductions

Recommendation 27

A Māori-led approach to an equitable transition for Iwi/Māori and the Māori economy

We recommend that the Government work with Iwi/Māori to develop a strategy to advance a Māori-led approach to an equitable transition for Iwi/Māori and the Māori economy. The strategy should focus on:

1. Removing existing barriers that disadvantage Iwi/Māori particularly where they undermine the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, compound historic grievance, and/or prevent Iwi/Māori from an equitable transition.
2. Creating opportunities and mechanisms for Iwi/Māori to actively participate in co-decision making, co-design, investment in infrastructure and new clean technology, knowledge contribution, and leadership as Aotearoa takes action to address climate change.
3. Funding research and development in mātauranga Māori to enable developing policy, strategy, technology and innovation to be informed from an equitable knowledge base.
4. Making funding available to assist Iwi/Māori that are not economically enabled to transition equitably.
5. Including timebound measures for progress for each of the elements of the strategy.

Recommendation 27

Provisional progress indicators

1. Government to start working with mandated representatives for Iwi and other relevant Māori collectives to determine an approach to support Iwi/Māori collectives to build an emissions profile within their respective takiwā that quantifies total Iwi/Māori contribution to national emissions and emissions reductions, including hapū lands that were taken for conservation purposes and allocated to SNAs (Significant Natural Areas), by no later than 30 June 2022.

19.9 Other policy considerations

87 In addition to tools and enablers that can support an equitable transition, Iwi/Māori expressed that if existing behaviours and legislative barriers that compound disadvantage are not addressed, they cannot be confident that Government's efforts to address climate change will be equitable.

88 To prevent further disadvantage, submitters offered a range of suggestions to guide policy development. Some of these are captured in Box 19.1 below.

Box 19.1: Suggestions from submitters to guide policy development, to prevent further disadvantage for Iwi/Māori

Ensure policies do not disrupt or apply limitations to whānau aspirations for land use

Policies need to align with tikanga

Put marae and hapū at the heart of solutions and policy design

Incentives to protect the indigenous forest on Māori land

Consider payment for eco-service systems

Explore carbon sink opportunities that hapū can benefit from

Provide opportunities for Iwi to tender in infrastructure investment

Rights and interests of tangata whenua are recognised in all policy relating to climate change solutions particularly where they will impact wai and whenua

Transport policy needs to consider improving options for rural areas not just in the major cities

Historically the Crown used unfair policies to acquire Māori land, need to ensure new policies do not disadvantage Māori

Chapter 20

Aronga Kaupapa – Te Matatika, Te Whakakotahi, Te Whakawhiti Ora Policy direction for a fair, inclusive and equitable transition

Summary

A fair, inclusive and equitable transition is one that will endure. This means approaching the transition in a way that is considered and includes people in the process.

To do this, the Government needs to plan, involve other people in its planning, and support others to make decisions that guide their own transitions. We have heard very clearly that Iwi/Māori want real partnership. Business, industry, local government, NGOs and community are ready to co-design emissions reductions plans to reflect their experience and needs.

This chapter recommends the Government develop an equitable transitions strategy that makes sure impacts on people are thought about during planning, programme development and policy development, not after. We have also asked the Government to outline how it intends to prioritise and fund the strategy. This should enable:

- Genuine partnership with Iwi/Māori to give effect to the principles of the Treaty. This is crucial across all aspects of the transition.
- Proactive planning that is co-designed across Aotearoa. This includes different regions, business, workers and unions that may feel the economic impact. It also includes community, people with disabilities and young people who may face unintended consequences.
- An education system that gives New Zealanders the skills they need to participate in a low emissions economy. This should include strategies for identifying and building the skillsets needed to support sectors key to the move to a low-emissions economy.
- Support for workers that have jobs in high-emissions sectors to retrain or move into new roles in low-emissions sectors.
- Robust distributional impact assessment for all climate policy and strategy. This will provide a detailed understanding of how climate policy can impact different groups, positively and negatively. This should be prioritised, proactive and well resourced.

Changes in our final advice

We have suggested transition planning be used more widely, particularly for different industries. This recognises how industry and the regional economy are connected. More details on specifics are in each sector chapter, where we have pointed out some key strategic decisions that will need to be made by business and industry.

We have strengthened our advice to reflect feedback on the importance of education and skills in the transition. We had a lot of feedback saying we needed to recommend specific policies to address impacts on people. We have been clearer that the Commission's role is to set the direction of policy, not draft policies.

Introduction

1 Aotearoa must act quickly to reduce emissions. At the same time, the transition must be fair, inclusive and equitable. This is important to make sure that changes can be sustained.

2 A 'just transition' (see Box 20.1) supports the principles of kaitiakitanga and intergenerational equity. We must consider not just the impacts on society today, but also the impacts on our mokopuna, and on their mokopuna. The need to care for, and be active stewards and custodians of, our whenua and taonga for future generations must be central to our approach.

3 Intergenerational equity is reflected in the He Ara Waiora framework (see *Chapter 11: Approach to developing advice on policy direction*). Placing the tikanga values from this framework at the forefront of the transition will help to ensure it is inclusive, equitable and improves the wellbeing of everyone who lives here now and in the future. The four tikanga values are manaakitanga, tikanga, whanaungatanga and kotahitanga.

4 The importance of a just transition came through as a strong theme during consultation, including in submissions from all stakeholder groups as well as individuals. Some focused on the importance of making sure policies do not place an unfair burden on low-income communities.

5 A large number of submitters emphasised the importance of a transition that is well-managed, proactive and planned. This will be good for the wellbeing of all New Zealanders – socially, economically and environmentally. A transition that is not managed well risks creating painful economic shocks, and risks costs falling disproportionately on those least able to bear them.

6 *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable* shows that the transition can be economically sound and socially acceptable. However, some groups of society will be more impacted than others. Policy will be needed to address this.

7 The previous chapter looked at the direction of policy needed to ensure an equitable transition for Iwi/Māori. This Chapter looks more closely at the direction of policy that is needed, and the systems that need to be set up to ensure that the transition is fair, inclusive and equitable.

8 The exact impacts will depend on how the policies the Government chooses to put in place are designed. Our recommendations are focused on building the systems to enable that to happen.

9 The sections below outline four key areas for the direction of policy. These areas are inter-related and must be addressed cohesively.

Box 20.1: A just transition

The need for a 'just transition' has been included in the Paris Agreement. The term originated from the labour union movement, but its importance has built internationally and is now well established in international literature.

A just transition is one that is fair, inclusive and equitable. In Aotearoa this means:

- Honouring and giving effect to the principles of Te Tiriti o Waitangi /The Treaty of Waitangi
- Working collaboratively and inclusively when planning the transition and taking a co-design approach to policy, in line with kotahitanga and tikanga. This includes working with local Iwi/ Māori along with community, including local government, regional economic development agencies, businesses, workers, unions, people with disabilities, and community groups
- Ensuring the low-emissions transition takes opportunities to reduce inequities, builds strong communities, and meets the needs of current and future generations over time
- Prioritising support to those most adversely impacted and least able to adjust
- Sending clear and stable policy signals to provide predictability for communities and businesses and allow time to plan and respond
- Investing in people, their skills, and providing opportunities for viable work that is environmentally and socially sustainable
- Acting now to ensure a thriving, productive and climate-resilient economy

During consultation we heard from many submitters, and particularly from unions, that use of the term 'just transition' is important, because it is internationally recognised and commonly used.

20.1 Proactive transition planning

10 Some industries, regions and communities of Aotearoa will be more affected by the climate transition than others. It is important that the speed and nature of the transition is well-signalled to allow time to plan.

11 Some industries face particular challenges when it comes to reducing emissions. These industries are large employers in the regions and are fundamental to the economy, yet solutions for decarbonising these industries are further off. Some of these industries have announced strategic reviews, citing many reasons beside climate policy.

12 Aotearoa needs to make key strategic decisions about the future of these industries. Long-term strategies will be needed for hard-to-abate industries and affected regions, as well as for emerging or growing low emissions industries. These discussions need to start happening now so there is time to plan and put in place processes for whatever eventuality.

13 The Government is also partnering with businesses, workers and Iwi/Māori in certain industries to develop industry transformation plans, which lay out a series of actions for growing the industry, improving productivity and global competitiveness. These plans address investment, innovation and skill needs. Climate change needs to be a core part of these plans.

14 The agritech and construction sectors now have industry transformation plans in place. Similar plans are being developed for the digital technologies, advanced manufacturing, food and beverage, and forestry and wood processing sectors. It is vital that there are clear timeframes for delivering on actions in these plans.

15 Industry plans must be linked to regional transition planning. It is inevitable that some regions will see the closure of large businesses that provide significant employment for the community. Transition planning should take a long-term view on how to diversify the economic and employment base of the region.

16 It should also consider short-term policies to support workers in high-emissions industries to retrain and/or redeploy into new areas. Major job losses at a local level can lead to entire communities being left vulnerable and dislocated. Some affected workers may have the mobility and means to acquire new jobs in other industries and regions, while others may not. Affected communities can end up 'stranded', where workers with particular skills and expertise are no longer in demand.

17 We heard throughout our engagement and consultation about the importance of ensuring transition planning is co-designed with the local community. While co-designed processes take longer, transparent, inclusive and co-designed processes, and active social dialogue, are key to achieving a transition that is broadly accepted and enduring.

18 Local government, regional economic development agencies, local Iwi/Māori, businesses, workers, unions, the disability community and community groups will all need to work together to ensure that climate change policies are tailored to regional and local circumstances, and that they address the rights, needs and aspirations of different groups within the community. The approach should align with the United Nations Convention on the Rights of Persons with Disabilities.

19 Government investment decisions need to be aligned with transition planning. Aligning priorities will be important. In some situations, businesses and Māori-collectives will only invest if they know that complementary investments are being made – for example, to supporting infrastructure.

20 For co-design to work well, there will need to be clear leadership. Central government may be best placed to take the lead in making key strategic decisions for Aotearoa as a whole, in partnership with Iwi/Māori.

21 For localised transition planning, the co-design process would be best led from within the community. It may vary from region to region who is best placed to lead localised transition planning. However, clear leadership should be outlined when initiating the co-design process.

22 This kind of co-created and strategic transition planning is already underway in Taranaki. However, these processes were initiated only after major Government decisions and announcements on oil and fossil gas had already been made. A similar process is being initiated in Southland.

23 The Government needs to take a more proactive approach in the coming years to identify regions where localised transition planning must be a priority. It is important that government continues to build on existing models and knowledge from the experiences in Taranaki and Southland.

24 The Government should set up systems so that all regions can learn from the experience in Taranaki and other regions when undertaking transition planning – both what has worked well and what has not worked well.

25 Transition planning will need to be linked closely linked to relevant plans and strategies. This includes the national energy strategy (see *Chapter 15: Policy direction for energy, industry and buildings*), the strategy to advance a Māori-led approach to a thriving, low emissions, climate-resilient Māori economy (see *Chapter 19: Policy direction for an equitable transition for Iwi/Māori*), and the Government's economic plan.

20.2 The education system and future workforce

26 New Zealanders, and their skills and ideas, will be the bedrock of the transition. Businesses will need to innovate, adopt new low-emissions technologies and commercialise new ideas. However, they will only be able to do so if they have the workers with the right skills and capabilities.

27 During consultation, a number of businesses voiced strongly that the education system will be critical for setting workers up with the skills needed to deliver a thriving, low emissions Aotearoa. In particular, we heard that the cost to the country could be significant if the education system is not agile enough to continually adjust and evolve as skill needs change.

28 There is much uncertainty in how the transition will unfold. As a result, education and training providers will need to be nimble in order to set New Zealanders up with transferrable skills, and the ability to adapt, upskill and learn as the way we work evolves.

29 Some skills are likely to be in high demand in the transition to low emissions, and the education system will need to support people to develop those skills. This includes, for example, engineering and technical skills to support for jobs in key growth areas such as in renewable electricity and new farming skills. Some of these growth areas are discussed in more detail in *Chapter 7: Demonstrating emissions budgets can be fair, inclusive and equitable*.

30 The education system will need to focus on all layers of education and training – not just on pre-employment training, but on lifelong learning that enables people to upskill as opportunities and demand evolve. Education in schools will also be important to set New Zealanders up with knowledge about the changes occurring due to climate change.

31 The education system also needs to address barriers that currently restrict participation in education and training. Research indicates that education and training providers are not serving Māori well, and that these providers have low levels of engagement from Māori (see *Chapter 19: Policy direction for an equitable transition for Iwi/Māori*). This is likely to have a particular impact on Māori who need to retrain or learn new skills.

32 Education and training developed by Māori for Māori will be important for reducing existing inequities and in ensuring an equitable transition. One example of this is the Crown–Māori Economic Development Strategy, He Kai Kei Aku Ringa, which has a goal of growing the future Māori workforce into higher-wage, higher-skilled jobs.

33 The Government needs to work with education providers, unions, businesses, Iwi/Māori and communities, to build a high-level vision of the workforce that will be needed in the future. There is much uncertainty in how the transition will unfold, so the Government needs strategies for quickly responding to skill needs as needs evolve. It will also be important to signal the megatrends, like climate change, automation and technological disruption, that will impact future workforce needs to help New Zealanders to adapt to the changing nature of work.

34 As a first step, the Government needs to identify the types of skillsets needed to support the transformation of key sectors over the next decade. It also needs to signal the future workforce needs to help New Zealanders adapt to the changing nature of work, and put in place strategies for building those skillsets over time.

35 Government must consider what type of jobs may be created, how secure they are, who has access to them, whether they pay a decent wage, and the education and skills required to do those jobs.

36 While our focus is on the climate transition, this work must be done in the context of the broader labour market. In particular, some sectors are already experiencing labour supply shortages, and many are anticipating the impacts of an aging workforce and technological disruption. The labour market in Aotearoa will also become more diverse as demographics change. Young people coming into the workforce have different expectations and aspirations than previous generations.

20.3 Support for workers transitioning out of jobs in high emissions industries

37 Employment and jobs will inevitably change as Aotearoa moves towards a low-emissions society. Many workers will need to learn new skills to continue practising their profession in a low-emissions environment. However, for some it will mean moving into jobs in other industries.

38 For example, during consultation we received many submissions that were concerned about the potential impacts of a future ban on fossil gas use. In particular, we heard from many gas-fitting businesses who were concerned about impacts on employees, small businesses and the potential to recruit and train apprentices in the face of perceptions of fossil gas as a declining industry.

39 Workers in industries that extract and use fossil fuels will be particularly affected by the transition. These workers will increasingly need to move into new industries. The affected workers have important skills that will be in demand in growing and emerging low emissions industries – including renewable energy, energy efficiency, hydrogen, the bioeconomy and fuels, and the circular economy. *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable* provides more detail on the impact of emissions budgets on jobs in these industries.

40 The Government should consider what policies and programmes are needed to support these workers through change. Again, this must be done in an inclusive way, through co-design with workers, unions, businesses, Iwi/Māori, the disability community, and broader community to understand what would work for their situations.

41 Where possible, workers should be provided with opportunities using similar skills in their current location and/or at the same income level. However, skillsets, location, timing, and income of new jobs will not always align. In these cases, workers should be supported to redeploy into new areas of work, and provided opportunities to retrain and build new skills.

42 Education and retraining services should be provided in a way that recognises workers' existing skills and allows them to build on those, pursue their interests, improve their employability and wages, and enhance their overall wellbeing.

43 Some submitters raised the importance of creating 'decent' work - a term used in the international labour movement to mean quality jobs that are productive, secure, delivers fair income and are respectful to communities.

44 It is important that all New Zealanders have access to education and training. Emphasis should be on supporting workers who are most adversely impacted and least able to adjust, particularly workers on lower incomes.

45 Internationally, there are examples of approaches that Aotearoa can learn from. We received a number of submissions highlighting the need for unions to be involved in the transition.

46 In designing what works best in different situations, those involved in the co-design process could consider active labour market policies that help to connect people to jobs. These policies should build on existing work and programmes. This could include, for example:

- Job placement and brokerage programmes to match people's skills to job vacancies. For example, programmes could support workers in the oil and fossil gas industry to find new work by specifically targeting low-emissions industries that need workers with engineering skillsets.
- Increasing access and funding for those in high-emissions industries to retrain in low-emissions industries, including while still employed in high-emissions industries.
- Relocation assistance for workers in high-emissions industries that need to move location to take up work in a low-emissions industry.

47 In some circumstances, it may also be appropriate to provide direct financial support to displaced workers. For example, this could include the option of early pensions for workers in high-emissions industries who are reaching retirement age.

48 The Government will make decisions about what policies and programmes to put in place, in collaboration with workers, unions, businesses, Iwi/Māori, the disability community, and broader community. However, these policies should be designed to build on the needs identified in sector and localised transition planning, and align with the future workforce needs (Section 20.1 and 20.2).

20.4 Building the tools for distributional impact assessment of climate policies

49 The transition to a low-emissions society will not lead to lasting change if it creates or exacerbates social inequities. However, the transition can be economically affordable and socially acceptable if it is well-paced, planned together with communities, and well-signalled. Society will benefit from improved health and wellbeing.

50 While overall the costs of the transition are manageable, they will not be evenly felt. Some New Zealanders will be more impacted than others. This could especially be the case for those on low incomes, women, the elderly, people with disabilities, and some Māori and Pacific Peoples.

51 These impacts can be managed through careful policy design, so must not be used as a reason for delay. Government must put policies in place to support those who are most disadvantaged and least able to adjust. This will be important for ensuring an equitable and inclusive transition that does not compound existing inequities or historic grievances. Impacted groups must be included from the start in co-designing policy.

52 The co-benefits of climate policy, such as improved health and wellbeing, are often overlooked in policy design despite their significant potential.

53 During consultation, some submitters highlighted the link between climate action and public health benefits, and requested the establishment of a multidisciplinary health advisory group to advise on the link between health and climate.

54 When co-designing climate policies, the first step is to understand the potential distributional impacts and how policies fit in the broader structural context of health, employment, housing affordability and energy affordability.

55 Government Regulatory Impact Statements currently include an assessment of a policy's impacts, costs and benefits. In recent years, the assessment of the distributional impacts of climate policies has improved.

56 For example, government agencies assessed the impact on household bills before making recent New Zealand Emissions Trading Scheme (NZ ETS) reforms, and the impact on the cost of owning a vehicle before announcing the Clear Car Standard. Government has also started to estimate and disclose the emissions impact of certain policies through the Climate Implications of Policy Assessment.

57 However, the Government needs to further build up the evidence base and tools to improve its assessment of the distributional impacts of climate policies over people, place and time. This should include quantitative assessments of the potential direct and indirect impacts of a climate policy on Aotearoa society as a whole, different households, different businesses, workers and employment, population groups and different communities and regions.

58 Government must work with health experts to build tools for quantitatively assessing the benefits of emissions reduction actions and specific policies on New Zealanders' health. Many actions to reduce emissions, such as supporting a shift away from private vehicles to walking and cycling more, will have broader benefits to health and health equity, and will reduce burden on the health system (see *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable*).

59 These benefits are likely to be immediate and add to the case for taking climate action. This aligns with the World Health Organization's Health in All Policies framework. However, Aotearoa does not yet have tools for quantitatively assessing the total benefit across the economy.

60 Such tools should be used to understand the distributional impacts across every proposed climate policy. Government agencies should use these tools to understand who will be most impacted, how those people will be impacted, and to inform policy design so that disadvantaged groups are not further disadvantaged and, where possible, reduce existing inequities.

61 Specific examples of how impacts could be managed are included within our policy direction for different sectors, and include:

- Ensuring transport policies are focused on delivering accessible, affordable and integrated transport systems so that people can easily get around no matter their means or where they live (see *Chapter 14: Policy direction for transport*)
- Ensuring that energy remains reliable and affordable for households and businesses (see *Chapter 15: Policy direction for energy, industry and buildings*)
- Providing assistance to those on lower incomes to install insulation, more efficient heating and other energy efficiency measures so they can benefit from cost savings and improved health (see *Chapter 15: Policy direction for energy, industry and buildings*)
- Ensuring that land policies do not exacerbate historic grievances and prevent Māori-collectives from exercising rangatiratanga on whenua Māori (see *Chapter 17: Policy direction for agriculture*)
- Managing the extent, type and location of afforestation to reduce negative impacts on rural communities and provincial centres (see *Chapter 18: Policy direction for forests and other carbon stocks*)
- Mitigating potential emissions leakage risk through industrial allocation in the NZ ETS (see *Chapter 13: Policy direction that cuts across sectors*).

20.5 An Equitable Transitions Strategy

62 The transition to a low-emissions society can be economically affordable and socially acceptable. To achieve this, it must be well-paced, well-planned, well-signalled and co-designed alongside Iwi/Māori, local government, regional economic development agencies, businesses, workers, unions, the disability community and community groups.

63 Through our engagement and consultation, we heard consistently that it will be vital to work alongside people to co-design policies that maximise the benefits and reduce the negative impacts. Transparent, inclusive and co-designed processes, and active social dialogue regarding the transition, are key to achieving a transition that is accepted by all parts of society and enduring as a result.

64 How the climate transition will impact different groups of society will depend on the exact design and timing of policies the Government chooses to put in place. In providing advice on the direction of policy, we have focused on building the systems so that happens in a way that is proactive, well-planned and well-signalled.

Recommendation 28

A fair, inclusive and equitable transition

We recommend that, in the first emissions reduction plan, the Government commit to:

Developing an Equitable Transitions Strategy that aims to deliver a well-signalled and inclusive transition, so it maximises opportunities, and minimises disruption and inequities.

Objectives of the strategy should include:

1. Acting in partnership with Iwi/Māori, giving effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi, aligning with the He Ara Waiora framework to align with Iwi/Māori perspectives on wellbeing, and co-designing climate policies and strategies with Iwi/Māori.
2. Undertaking proactive transition planning that aligns with tikanga values and is co-designed with Iwi/Māori, local government, regional economic development agencies, workers, unions, businesses, and community groups with particular regard to those most disadvantaged.
3. Strengthening efforts to support a nimble and responsive education system with equitable access that sets New Zealanders up with skills needed for a low emissions future. This should include putting in place strategies for identifying and building the skillsets needed to support sectors key to move to a low-emissions economy over the next decade, and education pathways by Māori, for Māori.
4. Supporting workers to transition from high-emissions sectors to low-emissions sectors, including redeploying and upskilling workers. This will need to be developed in conjunction with workers, unions, education providers and businesses.
5. Factoring distributional impacts into how climate strategies and policies are designed and implemented so that they minimise negative impacts, maximise co-benefits and take opportunities to reduce inequities. This will need to include a plan for improving the evidence base and tools for quantitatively assessing the distributional impacts and benefits in line with Treasury's Living Standards Framework and He Ara Waiora.
6. Clarifying how the Government is going to prioritise and fund the work laid out under the Strategy.

Recommendation 28

Provisional progress indicators

1. Government to have, by 31 December 2021, outlined in their emissions reduction plan how they will prioritise and fund work on a fair, inclusive and equitable climate transition.
2. Government to have, by 30 June 2023, delivered a draft for consultation, and, prior to June 2024, published an Equitable Transitions Strategy linked to the Iwi/Māori strategy, economic plan, and national energy strategy.

Part 3

Advice on requests from the Minister of Climate Change

Requests from the Minister of Climate Change

One of the purposes of the Climate Change Response Act 2002 (the Act) is to provide a framework by which Aotearoa can develop and implement clear and stable climate change policies that:

> *contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels.*

The Paris Agreement states that it aims to strengthen the global response to climate change by:

> *Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change*

Under section 5K of the Act, the Minister of Climate Change may, at any time, request that the Commission prepare reports to the Government on matters related to reducing emissions of greenhouse gases and adapting to the effects of climate change.

The Minister of Climate Change requested two reports as part of this first package of advice:

1. A report on the country's first NDC (Nationally Determined Contribution) under the Paris Agreement, that includes:
   a) advice on whether the NDC is compatible with contributing to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels.
   b) recommendations on any changes to the NDC required to ensure it is compatible with global efforts under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels.
2. A report assessing biogenic methane emissions in Aotearoa. This report must provide advice on the potential reductions in biogenic methane emissions which might eventually be required by New Zealand as part of a global effort under the Paris Agreement to limit the global average temperature increase to 1.5°C above preindustrial levels. In providing this advice the Commission must:
   a) leave aside considerations on the current target range for biogenic methane
   b) consider the available scientific evidence on the global biogenic methane emissions reductions likely to be required to limit global average temperature increase to 1.5°C above pre-industrial levels
   c) consider New Zealand's potential contribution to global efforts to limit biogenic methane emissions, reflecting its national circumstances
   d) consider a range of potential scenarios for economic, social and demographic changes which might occur in New Zealand and globally until 2100.

This section includes the Commission's advice on these matters.

The full text of these requests and the terms of reference can be found on our website at: https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/reviewing-new-zealands-nationally-determined-contribution-and-biogenic-methane/

Chapter 21

Te ekenga 1.5°C me Te Ahungaroa o Aotearoa
The global 1.5°C effort and Nationally Determined Contribution for Aotearoa

Chapter 21 and 22 summaries

The global 1.5°C effort and Nationally Determined Contribution for Aotearoa and Factors relevant to setting the level of the Nationally Determined Contribution

The Minister of Climate Change asked us to review the current Nationally Determined Contribution (NDC) for Aotearoa (2021-2030). This was to determine whether the current NDC is compatible with contributing to global efforts to limit global warming to 1.5°C above pre-industrial levels.

Our assessment is that the current NDC is not compatible with contributing to global efforts to limit global warming to 1.5°C.

Aotearoa has committed to reducing net emissions to 30% below 2005 gross emissions levels, over the 2021-2030 period.

For the NDC to be compatible with the 1.5°C goal, it would need to reflect emissions reductions much more than 36% below 2005 levels by 2030.

The Climate Change Commission has not provided a specific recommendation on what the NDC should be. This is a political and ethical issue, which will require elected representatives to make decisions on the importance of factors that contribute to the 1.5°C goal. Factors include the cost Aotearoa is willing to bear, social and economic impacts, international expectations and reputation, relative comfort with climate risk, and the balance of how much we do at home versus how much we do internationally.

There is a big gap between what we can do domestically and what we must do to meet our international commitment with the NDC. This is because to meet previous climate change targets, Aotearoa has relied on offsetting through forestry and offshore carbon credits, rather than reducing total emissions. This gap will need to be bridged with offshore mitigation.

Changes in our final advice

Our assesment of the NDC has not changed, however, we have added more detail and updated some numbers.

We have provided more explanation around how we account for forests, how we have used modelling from the Intergovernmental Panel on Climate Change (IPCC) *Special Report on Global Warming of 1.5°C*, and why the current NDC is hard to meet domestically, including historical context around the use of forest offsets in Aotearoa.

In updating the numbers, we have reflected the latest Ministry for the Environment (MfE) *New Zealand's Greenhouse Gas Inventory* (published in April 2021) in our assessment of how much the current NDC allows Aotearoa to emit, and our assessment of pathways that would be compatible with 1.5°C. We have also updated our analysis to treat fluorinated greenhouse gases the same as other greenhouse gases.

Introduction

1 The Paris Agreement includes a collective goal to hold the increase in the global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

2 Each country is required to set successive, and progressively more ambitious, Nationally Determined Contributions (NDCs) which outline their contribution to the global effort to limit the impacts of climate change.

3 In its first NDC, Aotearoa committed to reduce net greenhouse gas emissions to 30% below 2005 levels of gross emissions by 2030. This means Aotearoa can emit net emissions of no more than 596 $MtCO_2e$ over the 2021-2030 period. Further detail on how net emissions are accounted for is set out in ***2021 Supporting Evidence, Chapter 3: Rules for measuring progress.***

4 Under section 5k of the Climate Change Response Act (the Act), the Minister of Climate Change requested advice from the Commission on:

> ***"whether the NDC is compatible with contributing to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels."***

5 There is no universally agreed upon approach to limit the global average temperature increase to 1.5°C above pre-industrial levels (the global 1.5°C effort).

6 Scientific modelling can help inform our understanding of the global emissions reductions that will be required to limit the global average temperature increase to 1.5°C above pre-industrial levels. The Intergovernmental Panel on Climate Change (IPCC) has assessed emission reduction pathways it considers would be consistent with a likely chance (50-66%) of limiting the increase on global average temperature to within 1.5°C above pre-industrial levels (the IPCC 1.5°C pathways).

7 However, science alone cannot determine the share Aotearoa should contribute to those global reductions. Reaching a conclusion on this also depends on social and political judgements about international equity. These should be made by the Government of the day.

8 This chapter responds to the Minister's section 5k request, by:

- setting out the modelled global reductions for each individual greenhouse gas in the IPCC 1.5°C pathways

- converting those global reductions for each individual greenhouse gas to reductions at the national level for Aotearoa
- aggregating those individual greenhouse gas reductions for Aotearoa by using the GWP_{100} metric to compare with the current NDC (which uses the same metric)
- exploring the extent to which Aotearoa should contribute more or less than the global average.

Box 21.3 Feedback on our draft advice on the NDC

We received a considerable amount of feedback on our draft NDC advice. Submitters generally agreed with our advice that the current NDC was not compatible with contributing to limiting the increase in global average temperature to 1.5°C above pre-industrial levels.

Submitters' feedback generally related to three main issues:

- the level of ambition and lack of precision in our recommendation
- the use of offshore mitigation in the NDC
- the way that targets and forests are accounted for.

On the level of ambition submitters were split – some wanted much deeper emissions reductions and some wanted the country to do less on climate change overall. Few submitters engaged on the approach taken to assess compatibility with contributing to the global effort.

Some, who did, commented that scenarios with low reductions of one gas are likely to have higher reductions of other gases, and so the approach of using the lower and upper quartile reductions by gas was inappropriate. We examined the underlying data and consider the approach we are using is still appropriate. The relationship submitters described is not found in the underlying modelling data.

Some submitters wanted us to recommend a precise level that the NDC should be set to, taking account of equity considerations. These submissions generally reflected a desire from those submitters for a greater level of ambition overall.

While we can advise on the technical aspects of compatibility with limiting warming to 1.5°C, the contribution Aotearoa should make to a global effort is a question for elected decision makers. We have commented in chapter 22 on some of the factors the Government may wish to consider when making this decision.

Of the submitters who commented on the NDC, many were opposed to the use of offshore mitigation, either wanting none to be included or for its use to be minimised. Submissions cited concerns around offshore mitigation being used as an excuse to avoid reducing emissions within Aotearoa, along with environmental integrity concerns.

Consequently, many submitters said that we should meet the NDC solely through domestic action. We have considered the implications of excluding offshore mitigation from the NDC in greater detail in section 22.1 and addressed the specific concerns raised about offshore mitigation in section 22.4.

Some submitters argued that the approach used to account for forestry in targets is misleading and we should account for all emissions and removals as reported in the greenhouse gas inventory. Since our first international emissions target began in 2008 under the Kyoto Protocol *New Zealand's Greenhouse Gas Inventory* has included separate figures for reporting and for accounting.

Reporting and accounting are different purposes and separating out subsets of forest ensure that we are accurately accounting for additional action taken on climate change. This approach is also consistent with how Aotearoa has treated emissions targets since 2008 and is in line with international norms and expectations. We discuss this issue in more depth in *Section 3.4 of Chapter 3: How to measure progress in our 2021 Supporting Evidence.*

21.1 Global pathways to 1.5°C

9 The IPCC's special report on 1.5°C assesses different global greenhouse emission pathways that would be consistent with a likely (50-66%) chance of limiting warming to within 1.5°C above pre-industrial levels.

10 These emissions pathways are based on a range of possible future scenarios. Each scenario describes a plausible set of assumptions about economic and social development, and technological and behavioural changes between now and 2100.

11 Some of these pathways allow the increase in global average temperature to exceed 1.5°C above pre-industrial levels before falling below that level later in the century. Climate scientists refer to this as 'overshoot'.

12 Pathways with little or no overshoot are more likely to deliver the best overall social, economic, and environmental outcomes. This is because if warming exceeds 1.5°C above pre-industrial levels, more significant climate impacts and adaptation needs are likely. Pathways with significant overshoot also rely on high levels of emissions removal technologies in the future, such as carbon capture and storage, which may not be feasible.

13 In order to balance achievability with the need to limit the negative outcomes of higher overshoot, we have excluded scenarios with high overshoot (more than 0.1°C above 1.5°C) from this analysis.

14 In all the pathways we considered, limiting warming to 1.5°C above pre-industrial levels requires rapid emissions reductions of all greenhouse gases between now and 2030. The pathways then show somewhat slower reductions out to the end of the century.

15 The pathways have several other features in common:

- Emissions of carbon dioxide and other greenhouse gases peak in the 2020s and then rapidly reduce through the 2030s and 2040s.
- Emissions of nitrous oxide have relatively smaller reductions. This reflects the fewer options to reduce this gas.
- Emissions of methane reduce significantly over the next 20 years, but do not reach zero by 2050 or 2100. This reflects the short-lived nature of the gas, and the smaller range of mitigation options currently available.
- Emissions of long-lived greenhouse gases reduce to be near zero by 2050.

16 Most of the pathways have some gross emissions remaining in 2050. These come from hard-to-abate sectors, like cement manufacturing. As a result, carbon dioxide needs to be removed from the atmosphere to make sure net emissions reach net zero and remain there.

17 Most of the pathways also require more significant carbon dioxide removals beyond what is required to reach net zero and stay there – carbon dioxide emissions need to be net negative. They need this to bring global average warming back below 1.5°C above pre-industrial levels after a temporary overshoot.

18 Table 21.1 below shows the reductions for carbon dioxide, agricultural methane, nitrous oxide emissions and fluorinated gases modelled in the IPCC pathways we considered. It shows the reductions of each of these gases or groups of gases in 2030, 2050 and 2100. Note that the IPCC pathways model agricultural methane rather than biogenic methane (which is used to specify the 2030 and 2050 methane targets in the Act). Biogenic methane also includes methane from the waste sector.

19 The table shows global emissions reductions from global pathways that limit global average warming to 1.5°C above pre-industrial levels. These figures show the 'interquartile range'. The interquartile range represents the middle 50% of modelled reductions. That is, 25% of pathways were characterised by higher levels of emission reductions and 25% of pathways were characterised by lower reductions than the interquartile range. This gives a more conservative, but also more likely, range for the emissions reductions that are needed.

Table 21.1: Reductions in emissions, by gas, in IPCC pathways with no or limited overshoot (interquartile range)

	Percentage change relative to 2010		
	2030	2050	2100
Net carbon dioxide emissions	-40 to -58%	-94 to -107%	-121 to -136%
Agricultural methane emissions	-11 to -30%	-24 to -47%	-37 to -60%
Agricultural nitrous oxide emissions	+3 to -21%	+1 to -26%	-6 to -39%
Hydrofluorocarbon emissions	-65 to -77%	-78 to -90%	-67 to -83%
Perfluorocarbon emissions	-59 to -70%	-83 to -94%	-95 to -98%
Sulphur hexafluoride emissions	-49 to -67%	-74 to -80%	-84 to -96%

Source: IPCC, Special Report on 1.5°C, Summary for Policymakers, Table SPM.3b. Integrated Assessment Modelling Consortium data, hosted by IIASA

21.2 Applying the global 1.5°C pathways to a national level

20 Through the NDC, Aotearoa takes responsibility for emissions over the whole period 2021-2030. Figure 21.1 below illustrates how the 2030 point year NDC target is converted into a total amount of allowed emissions over the NDC period.

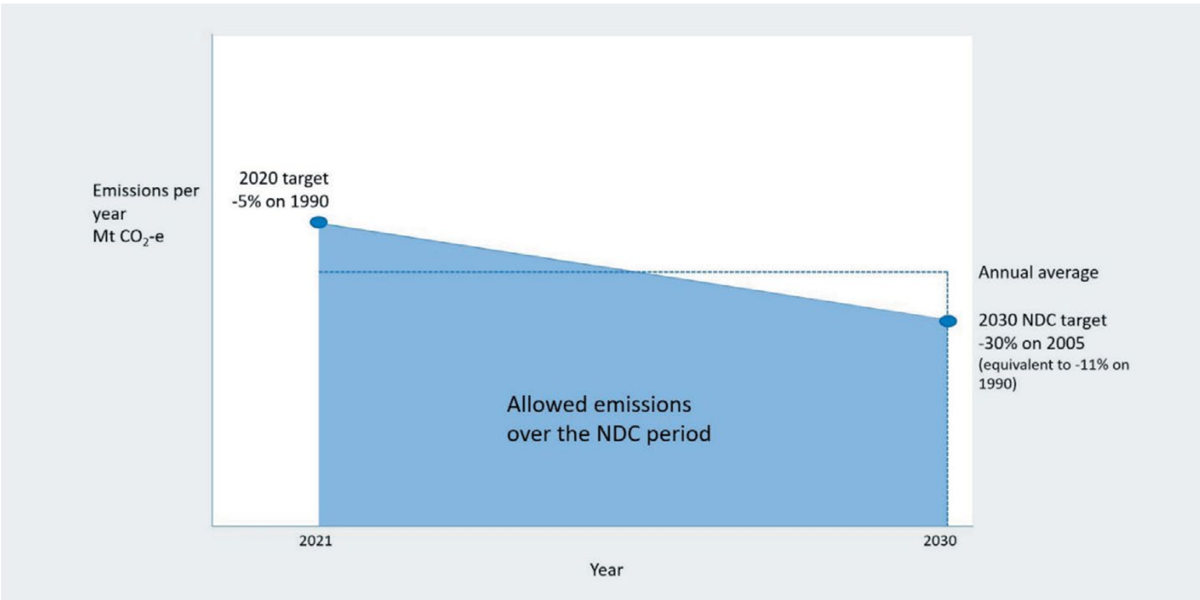


Figure 21.1: Illustration of conversion of the country's existing 2030 NDC target to an amount of allowed emissions

Note: The 2030 NDC target is to reduce emissions to 30% below 2005 levels. Here it is presented as a reduction against 1990 levels for easier comparison to the 2020 target that preceded it.

21 To provide a starting point to assess the compatibility of our NDC with the global 1.5°C effort, we convert the global reductions for each individual greenhouse gas set out in the IPCC 1.5°C pathways (see Table 21.1 above) to reductions at the national level for Aotearoa.

22 We note again here that this is only provided as a starting point. Other considerations should be taken into account when determining the extent to which Aotearoa should commit to greater proportional reductions than the global average. These considerations are discussed later in this chapter.

Box 21.1 Balance of modelling and qualitative judgements in assessing the NDC

The IPCC assessed emissions pathways, for different gases, that are compatible with limiting warming to 1.5°C above pre-industrial levels. However, under the Paris Agreement, emissions reduction commitments in NDCs are expressed using the GWP_{100} metric to provide an equivalence (carbon dioxide equivalence, or CO_2e). See the *2021 Supporting Evidence, Chapter 1: The science of climate change* for more information on emissions metrics.

Our analysis converts the global reductions for each individual greenhouse gas (set out in the IPCC 1.5°C pathways) to reductions at the national level for Aotearoa. We then applied the GWP_{100} metric to reach comparable figures in CO_2e.

The IPCC did not consider reductions for individual countries as part of the pathways it assessed. Applying global-scale modelling to Aotearoa is a blunt approach. However, it does provide a starting point, based on scientific modelling, for addressing the question of whether the NDC is compatible with contributing to the 1.5°C goal.

From this starting point, further assessment of our contribution's compatibility with 1.5°C depends on ethical and political judgements about international equity. The Commission considered some of these judgements in our analysis.

However, recommending a particular level for the NDC is beyond our mandate, and falls under the remit of the Government of the day.

21.2.1 Converting global emissions reductions to reductions at the national level for Aotearoa

23 Table 21.1 shows the global emission reductions needed, by gas, in IPCC 1.5°C pathways with no or limited overshoot (interquartile range).

24 We converted global emissions required to a national level using both upper and lower quartiles of emissions allowed in the IPCC 1.5°C pathways as shown in Table 21.2 below. There is a detailed explanation of this approach and the calculations made in ***2021 Supporting evidence, Chapter 13: Requests under s5K relating to the NDC and biogenic methane – supporting evidence.***

25 Applying this approach to the emissions profile of Aotearoa, emissions would be 527 $MtCO_2e$ (lower quartile) to 608 (upper quartile) $MtCO_2e$ over the 2021-2030 NDC period. This would be made up of:

- 191-225 Mt carbon dioxide
- 10.9-12.4 Mt methane
- 0.194-0.228 Mt nitrous oxide
- 5.4-6.2 $MtCO_2e$ of hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride.

Table 21.2: Equivalent NDCs for Aotearoa applying the upper and lower quartile of reductions in IPCC pathways

	Allowed emissions in NDC period (Mt CO_2e)	Equivalent 2030 target level (% reduction on 2005)
Upper quartile IPCC pathways (higher emissions)	608	27%
Midpoint reductions of interquartile range	568	36%
Lower quartile IPCC pathways (lower emissions)	527	45%

Note: We selected the midpoint of the interquartile range in order to facilitate the assessment of the Aotearoa NDC.

26 The current NDC for Aotearoa works out as an NDC budget of 596 MtCO_2e. This is equivalent to the 67th percentile, putting it towards the higher end of allowed emissions that are compatible with limiting warming to 1.5°C, using this approach.

27 This approach does not account for considerations of how effort should be shared between countries. This is considered in section 21.2.3 and discussed further in the following chapter.

Box 21.2 Quantitative changes made since 2021 Draft Advice for Consultation

We have updated the calculation of the current NDC budget and the comparisons based on applying the IPCC 1.5°C pathways to Aotearoa. These figures have been adjusted to account for the methodological improvements to *New Zealand's Greenhouse Gas Inventory* published in April 2021.

The biggest changes in the new inventory were due to updated data on pasture quality and new research on organic soils. Collectively, the inventory improvements resulted in total reported emissions increasing by 1.0 – 1.7 Mt CO_2e per year in all years between 1990 and 2018.

The increase in the estimation of past emissions changes the base year emissions used to calculate the NDC budget, and the calculations we make to convert the IPCC 1.5°C pathways to a national level for Aotearoa.

In the draft advice we had applied a pathway for all synthetic fluorinated gases that was in line with the reductions required by the Kigali amendment to the Montreal Protocol. We have since elicited emissions pathways for hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride from the modelling for the IPCC's 1.5°C report. We have used this data to apply a consistent methodology across all greenhouse gases. This lowers the allowed emissions under the IPCC pathways by 7.5 – 8.2 MtCO_2e over the NDC period.

21.2.2 The IPCC 1.5°C pathways reflect uncertainty about the future

28 The emissions reductions in the IPCC 1.5°C pathways have a wide range. This reflects the fact that there are multiple possible emissions pathways modelled as compatible with limiting warming to 1.5°C.

29 This range reflects the difficulty of predicting exactly how future drivers of emissions, like global population, wealth, or behaviour change might affect the costs of different mitigations. There is also uncertainty in exactly how the global climate will respond to future emissions – for example, how sensitive temperature responses are to increases in carbon dioxide.

30 Because of these uncertainties, the warming outcomes of the different pathways are expressed as probabilities – how likely it is that they would limit the increase in global average temperature to 1.5°C above pre-industrial levels.

31 In its special report, the IPCC only considered emissions reduction scenarios that had a 50-66% chance of limiting warming to 1.5°C above pre-industrial levels by the end of the century. This means that even if the emissions reductions in the scenarios were achieved, there is still a 34-50% chance that warming will exceed 1.5°C.

32 More ambitious NDCs (closer to the lower quartile of emissions in IPCC pathways) are associated with pathways with larger reductions in emissions, and which are less likely to overshoot. More ambitious NDCs will be compatible with limiting the increase in global average temperatures to 1.5°C above pre-industrial levels in a greater number of plausible future scenarios. The reverse is also true.

33 And while all the pathways in the interquartile range have a 50-66% chance of limiting the increase in global average temperatures to 1.5°C above pre-industrial levels, the pathways that focus on earlier emissions reductions rely less on removing large amounts of carbon dioxide from the atmosphere in later decades.

34 The scale of carbon dioxide removals required in some pathways that focus on smaller or later reductions in emissions may not be achievable. These pathways could also have a range of negative impacts on people, communities, and economies. The IPCC notes that relying on large scale carbon dioxide removals presents a major risk that the world will not be able to limit the increase in global average temperatures to 1.5°C above pre-industrial levels.

21.2.3 Developed countries have agreed to lead the way

35 Developed countries have emitted more cumulative emissions than developing countries, for longer, and have benefited as a result.

36 Under the Paris Agreement, each country's contribution to the collective effort is determined nationally. The Paris Agreement does not specify how emission reductions are to be shared between countries.

37 However, the UN Framework Convention on Climate Change (the UNFCCC) and the Paris Agreement both make reference to developed country leadership in climate change action.

38 One of the core principles of the UNFCCC is stated in its Article 3.1 that:

> *"the developed country Parties should take the lead in combating climate change and the adverse effects thereof."*

39 The point is reinforced in Article 4(1) of the Paris Agreement which states:

> *"In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter…"*

40 With a goal of limiting warming to below a certain temperature, emissions reductions are a zero-sum game. If one country reduces emissions by a smaller amount, another country must reduce emissions by more if the world is to remain on track.

41 Given that emissions in developing countries will peak later, in recognition of their development needs, emissions in developed countries must peak and reduce more quickly than the global average.

42 This obligation is on developed countries in the aggregate and does not imply specific obligations on individual countries. However, it is an important factor to consider when thinking about what a suitable contribution from Aotearoa might be.

43 We consider that if Aotearoa is to contribute to a global effort towards limiting warming to 1.5°C above pre-industrial levels, it should contribute more than the global average required. Adopting an approach that implies the same proportionate reductions of all countries is not sufficient.

21.2.4 The current NDC is not compatible with the global 1.5°C effort

44 The emissions reductions required globally to limit the increase in global average temperature to 1.5°C above pre-industrial levels likely lie within the interquartile range of the IPCC pathways.

45 The current NDC is just above the lower end of the range presented in Table 21.2 – as illustrated in Figure 21.2 below.

Figure 21.2: The current NDC and NDC targets associated with the IPCC 1.5°C interquartile range

46 As noted above (21.2.2), higher levels of emissions are associated with higher risk of overshoot. They are also more likely to rely on potentially infeasible levels of carbon dioxide removals in the latter part of the century to bring the increase in global average temperature back below 1.5°C above pre-industrial levels.

47 This means that the current NDC is aligned with a level of effort that, if adopted by all countries, carries major risks in terms of its ability to limit warming to 1.5°C. As a developed country, Aotearoa has agreed to “take the lead”. To be compatible with contributing to limiting warming to 1.5°C, the NDC needs to reflect deeper emission reductions than the global average necessary.

48 Our advice is that the NDC should reflect emissions much lower than just aligning with the middle of the IPCC interquartile range. This means emissions of much less than 568 $MtCO_2e$ over the 2021-2030 period, or reductions of much more than 36% below 2005 levels by 2030.

49 How much stronger the NDC should be beyond this is a question for elected decision makers, given the social, political and ethical judgements involved.

Recommendation 29

Compatibility of the NDC with contributing to the global 1.5°C effort

We advise that the first NDC is not compatible with Aotearoa making a contribution to global efforts under the Paris Agreement to limit the increase in global average temperature to 1.5°C above pre-industrial levels.

Recommendation 30

Making the NDC compatible with contributing to the global 1.5°C effort

1. We recommend that to make the NDC more likely to be compatible with contributing to global efforts under the Paris Agreement to limit warming to 1.5°C above pre-industrial levels, the contribution Aotearoa makes over the NDC period should reflect a reduction to net emissions of much more than 36% below 2005 gross levels by 2030, with the likelihood of compatibility increasing as the NDC is strengthened further.
2. How much the NDC is strengthened beyond 36% should reflect the tolerance for climate and reputational risk and economic impact, and principles for effort sharing, which require political decisions. Any changes to the NDC should be developed in partnership with Iwi/Māori, to give effect to the principles of Te Tiriti o Waitangi/The Treaty of Waitangi and align with the He Ara Waiora framework.

Chapter 22

Ngā herenga matua kia tika ai te ekenga a Te Ahungaroa o Aotearoa Factors relevant to setting the level of the Nationally Determined Contribution

1 As noted in the previous chapter, in its first NDC, Aotearoa committed to reduce net greenhouse gas emissions to 30% below 2005 gross levels by 2030. This means Aotearoa can emit net emissions of no more than 596 $MtCO_2e$ over the 2021-2030 period.

2 The Minister of Climate Change requested advice from the Commission on the current NDC, including on:

> ***recommendations on any changes to the NDC, required to ensure it is compatible with global efforts to limit the global average temperature increase to 1.5°C above pre-industrial levels.***

3 In the previous chapter we concluded that an NDC for Aotearoa that is compatible with global efforts to limit warming to 1.5°C would require emissions of much less than 568 $MtCO_2e$, equivalent to a reduction of much more than 36% on 2005 levels by 2030.

4 There would be significant challenges reducing emissions in Aotearoa beyond what we have recommended in the first two emissions budgets. For this reason, offshore mitigation will be required to meet the NDC. More offshore mitigation will be needed if the NDC is strengthened.

5 Decisions about the level at which the NDC is set require judgements about the potential social and economic impacts of extending the NDC, the expectations of other countries and their governments, tolerance for climate risks, and the relative importance of investing in greater levels of climate change action compared to other domestic or international priorities.

6 We consider that these judgements are outside the Commission's remit and should be made by the elected Government of the day. However, the Commission can comment on some of the factors the Government should consider in deciding on the level of the NDC.

7 This chapter describes a range of different matters that should be considered. It discusses specific challenges in meeting the NDC, and addresses some questions raised by submitters about the form of the NDC.

22.1 How Aotearoa could meet the NDC

8 The NDC sets limits on net emissions over the period. This comprises all gross emissions, any domestic emissions removals (such as from forestry), as well as any international mitigation that Aotearoa decides to purchase (offshore mitigation).

9 Emissions reductions to meet the NDC will come from a combination of action within Aotearoa and offshore mitigation. This is illustrated in Figure 22.1 below.

10 This is different from emission budgets, which must be met as far as possible through domestic action. The Climate Change Response Act (the Act) limits the use of offshore mitigation in emissions budgets to situations where there has been a major change in circumstances, not accounted for when the budgets were set, which affects the ability to meet the relevant emissions budget domestically.

11 Should Aotearoa wish to increase the ambition of its NDC, it could reduce domestic greenhouse gas emissions faster, increase removals of carbon dioxide, or purchase additional offshore mitigation. The Government would need to carefully consider the challenges associated with these options.

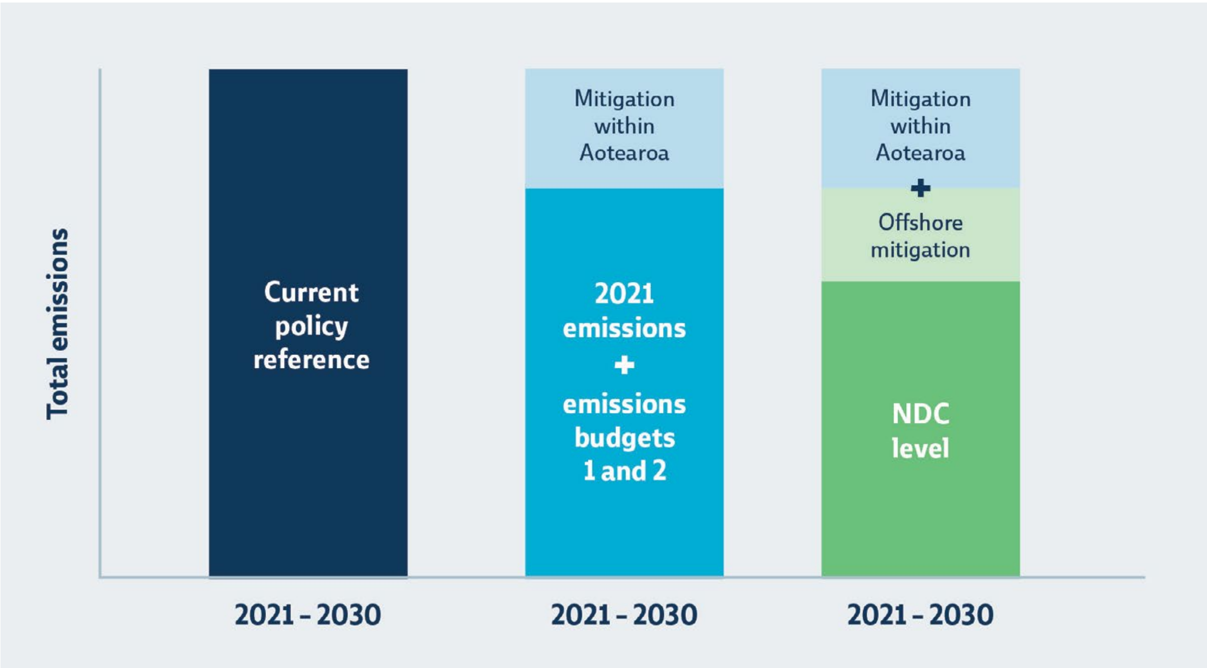


Figure 22.1: Illustration of the role of international mitigation in the NDC compared to emissions budgets

22.1.1 There is a growing gap between the NDC and net emissions in Aotearoa

12 The gap between the NDC and net emissions has arisen because past climate change targets have been met primarily using offsets from exotic production forestry (predominantly pine), rather than reductions in gross emissions.

13 For production forests only the first rotation sequesters additional carbon (under international accounting rules). Subsequent rotations of harvesting and replanting maintain the forest's stock of carbon at its long-term average associated with the offsets that have already been used, but not offsetting further emissions. (See Box 22.3 in *2021 Supporting evidence Chapter 3: How to measure progress*). Only expansion to the area planted in forest will generate new offsets.

14 To meet previous emissions reduction targets, Aotearoa has principally relied on the large area of forests planted in the 1990s. However, the additional area of new forest planted between 2000 and 2020 was relatively small, compared to the level of planting between 1990 and 2000 (see Figure 22.2 below).

15 The last of the forests planted in the 1990s are now reaching their long-term average carbon stock, and are no longer contributing to emissions reduction targets. A smaller area of forest was planted in the 2000s and 2010s. This means that the total amount of emissions offset by forestry is going down. As the total offsetting effect of forests in Aotearoa slows, net emissions will rise significantly between 2019 and 2022.

16 Under the Paris Agreement, each new NDC target must represent a progression in ambition on previous targets – targets must become more stringent over time.

17 This means that at the same time as emissions removals through forestry are dropping off, the level of allowed emissions under the country's NDC is getting stricter compared to previous targets.

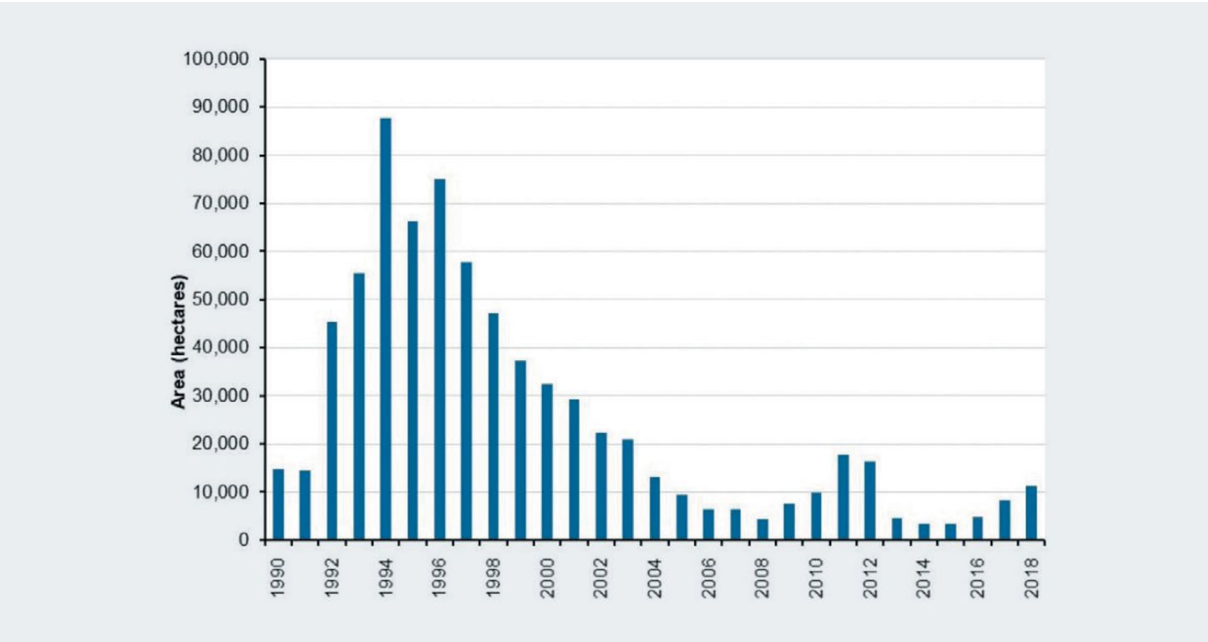


Figure 22.2: Areas of new forest planted in Aotearoa 1990 – 2018

Source: MfE, New Zealand's Greenhouse Gas Inventory 1990-2018

18 Our demonstration path includes the ongoing establishment of areas of new forest. This includes significant areas of exotic production forests in coming years, with increasing areas of permanent native forest over future decades. Native forests generally sequester greater amounts of carbon and over a longer period than exotic production pine so represent a more enduring carbon sink.

19 The current NDC emissions period has already started and runs to 2030. Increasing planting rates now will assist with meeting future targets, but will not contribute much to meeting the current NDC. This is because it takes around 5-7 years for newly planted forest to start removing significant amounts of carbon.

20 Figure 22.3 below shows actual net emissions in Aotearoa (dark blue line) and projected out to 2021 (dotted).

21 Net emissions increase as the amount sequestered by our forests drops. The coloured areas illustrate the country's international commitments, which are getting progressively stricter over time. This figure shows the growing gap between emission budgets and the NDC.

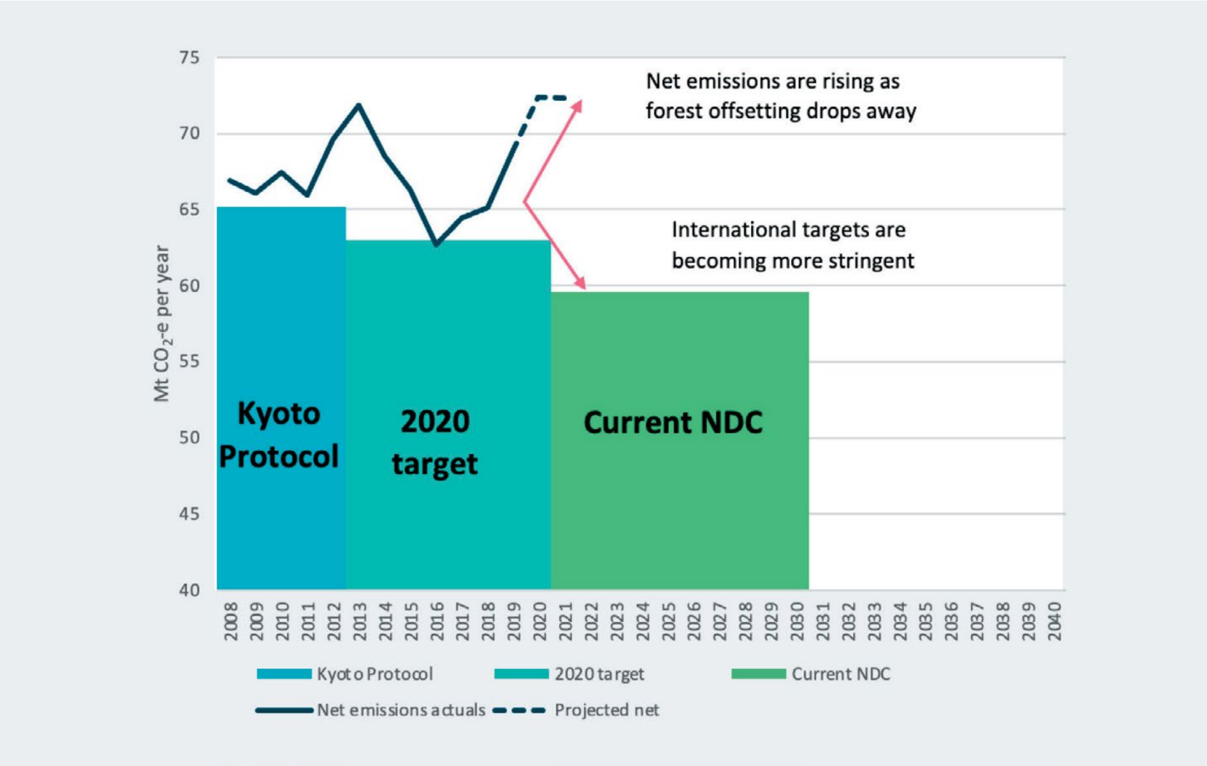


Figure 22.3: New Zealand's past emissions targets and current NDC and projected net emissions (target accounting)

Note: International commitments under past targets presented here have been recalculated to match the current GHG inventory for consistency of comparison.

22.1.2 Meeting the current NDC through domestic action alone would be highly challenging

22 The Act states that emissions budgets must be ambitious but achievable. It also states that emissions budgets must be met as far as possible through domestic actions.

23 Our recommended emissions budgets, described in our ***2021 Supporting Evidence***, ***Chapter 2: What are other countries doing?***, would limit net emissions in Aotearoa to 576 $MtCO_2e$ over the periods 2022-2025 and 2026-2030 together.

24 When forecast emissions for 2021 are included, emissions over the NDC period (2021-2030) would be 648 $MtCO_2e$ – if our proposed emissions budgets are adopted and achieved.

25 Our analysis shows that these emissions budgets are ambitious but achievable and will put Aotearoa on track to meeting the 2050 targets. In recommending these budgets, we have had regard to the matters set out in section 5M of the Act where relevant, and 5ZC (see also Table 3 in *Chapter 3: The role of the Commission*).

26 If the Government were to commit to reducing greenhouse gas emissions faster than we propose in our emissions budgets, there is a risk that Aotearoa could lose production in areas where technological solutions to reduce emissions could be applied, if more time were available.

27 For example, in food processing, replacing a coal boiler with a biomass boiler requires finding a supplier, and undertaking design work to integrate it into the existing process. If time is not allowed for this to happen, some businesses may simply have to shut down.

28 The scale of emissions reductions needed to bridge the gap between emissions budgets and the NDC means that meeting the NDC domestically would likely lead to severe social and economic impacts on communities, people and businesses – far more than would be necessary to achieve the same amount of emissions reductions given more time.

29 The likelihood of achieving larger emissions reductions is another consideration. Our modelling shows that it may be possible to reduce emissions more than our budgets propose, but that this requires technologies that are not yet proven – particularly to reduce biogenic methane. Whether these technologies will be successfully developed and deployed is uncertain.

30 Committing to achieving greater emissions reductions domestically than we recommend through our emissions budgets introduces significant risks. However, if new technologies are developed and proven in time, Aotearoa would be able to meet a larger portion of its NDC through domestic action. It would also be in a better position to set a more stringent second NDC.

Box 22.1 Meeting the NDC through domestic action

A number of submitters from the public and NGO community have proposed setting the domestic emissions budgets at the same level as the NDC.

If we set domestic emissions budgets at the level of the NDC, the scale of the reductions needed mean they could not be met without rapidly shutting down many of our emitting activities. For businesses such as farms and factories, the scale of the closures would need to be severe for the budgets to be met. This is because net emissions are starting at a point much higher than the average NDC level and the trajectory is for projected net emissions to rise over the next few years.

We estimated that if the current NDC had to be met solely domestically, an additional 52 $MtCO_2e$ would need to be reduced over the period *in addition* to the effort required to meet our proposed emissions budgets. Any combination of actions to deliver so much mitigation in so short a time would require large scale cuts to economic output across Aotearoa.

For example, closing iron and steel production from 2025 would bridge less than a third of the gap. In addition, it would require either cuts to all agricultural output of the order of halving output by 2030. Alternatively it would require imposing tight restrictions on private transport use – beyond those that saw the need for carless days in the 1970s – alongside broad cuts to agricultural output.

From an intergenerational equity perspective, excessively fast cuts to emissions would have a legacy impact on the quality of life for younger generations as families are left without employment or essential services.

This pace of change would also disproportionately affect Iwi/Māori in terms of the Māori economy, given its large agricultural base, and Māori workforce who are disproportionately represented in agricultural and manufacturing industries.

We consider that the impacts on people and communities of setting our budgets at the same level as the NDC would be unmanageable.

22.1.3 Offshore mitigation will be required to meet the NDC

31 Offshore mitigation refers to where one country funds emissions reductions in another country and counts those reductions towards its own emissions reduction target.

32 This is a valid contribution to addressing climate change, as long as the offshore mitigation represents real, verifiable and additional emissions reductions. The benefit to the atmosphere of an emissions reduction is the same, regardless of where it happens.

33 In contrast to domestic emissions budgets under the Act, the NDC explicitly allows for offshore mitigation. This means that Aotearoa can contribute more to the global effort than it is currently able to domestically.

34 The Paris Agreement recognises that international cooperation through market mechanisms can serve the goals of increasing ambition and of promoting sustainable development and environmental integrity.

35 This is consistent with a mātauranga Māori view of the interconnectedness between the climate and global system, and tikanga – doing the right thing in the right way. The NDC represents the total mitigation contribution to the world, beyond just what we can do at home.

36 Due to the challenges, risks and likely impacts of meeting the NDC through domestic action alone, offshore mitigation will be critical to meeting the current NDC.

22.2 The first NDC is part of a broader, longer-term contribution to the climate effort

37 It is important not to isolate the ambition of the current NDC from the context of the country's longer-term climate objectives.

38 In advising on the first three emissions budgets we have placed them in their longer-term context out to 2050 and beyond. The first two emission budgets represent the Commission's recommendation of the emission reductions that are achievable within Aotearoa up to 2030. The current NDC covers the period 2021-2030.

39 It takes time to develop policies, and there is also a lag between when policies are developed, implemented, and when they affect behaviour and result in emissions reductions. This means that the policies established in the first budget period will drive the emissions reductions needed in later budget periods. To an extent, constraints on the current level of the country's ambition have been shaped by the policy settings of the previous several decades.

40 If the Government adopts the domestic emissions budgets we recommend, and implements a comprehensive set of policies to achieve them, it will unlock the possibility of greater ambition beyond 2030. Greater levels of emissions reductions will become possible as government, businesses and communities build momentum in reducing emissions. Aotearoa would then be well placed to adopt a more ambitious second NDC.

41 Our emissions budget demonstration path would see net emissions reduce significantly faster than a linear trajectory in line with IPCC 1.5°C compatible pathways would require (see Figure 22.4 below).

42 Focusing on unlocking greater ambition in our second NDC is not deferring or delaying action – it reflects the reality that policies implemented today will take time to take effect and require policy action now.

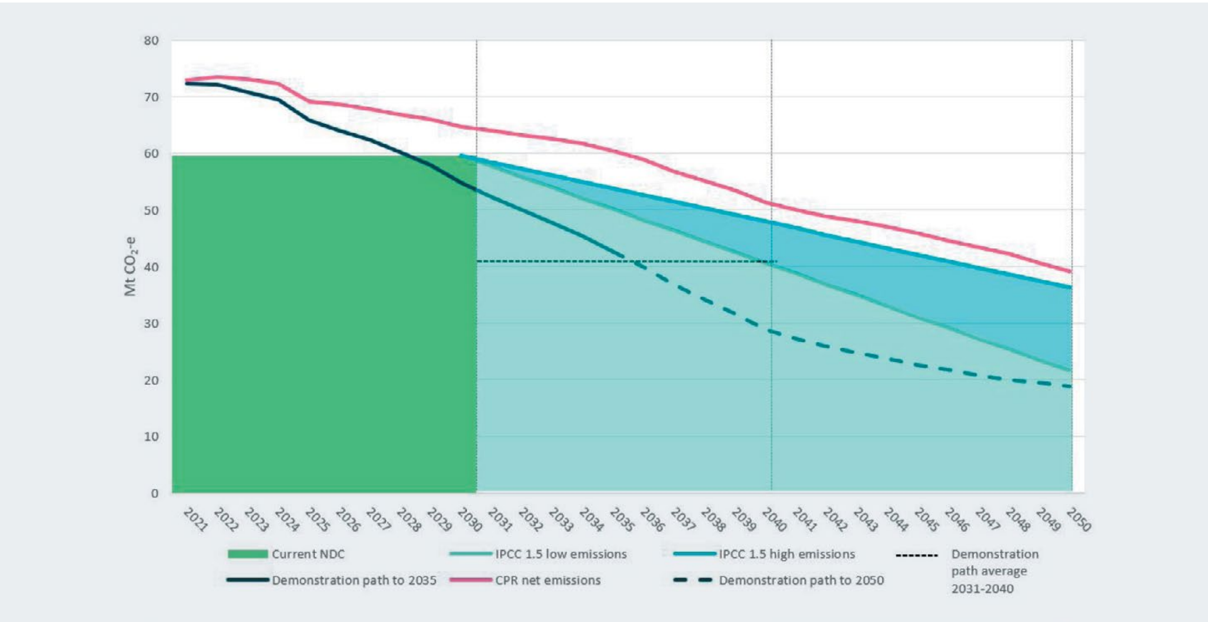


Figure 22.4: Domestic emissions budget demonstration path, against current NDC and linear trajectories to IPCC 1.5 range in 2050

22.3 Aotearoa should plan for how it will meet the NDC

43 As noted above, offshore mitigation will be required to meet the NDC (see section 22.4 for more detail on how much will be required).

44 Under Article 6.2 of the Paris Agreement, mitigation can be traded between countries by bilateral agreement so long as countries are clear as to how standards of environmental integrity and avoiding double counting will be met.

45 Article 6.4 also provides for a multilateral market mechanism. However, when it will become operational and what processes this mechanism will follow are still unclear. Its establishment depends to an extent on negotiations among all parties to the Paris Agreement. The multilateral mechanism may take some time to develop whereas the bilateral linkages can be established now.

46 The Government has not yet established the bilateral linkages necessary to make this mitigation available. Once these linkages are established, it will become feasible to achieve the current, or a strengthened, NDC.

47 Overreliance on forestry offsets when setting targets has contributed to Aotearoa being in its current position – where there is now a large gap between the country's net emissions and its international commitments.

48 To remedy the situation, the Government should prioritise reducing gross emissions and building a long-term carbon sink within Aotearoa.

49 It is important not to lose focus on putting the policies and measures in place that will drive emissions reductions within Aotearoa over the long term. In setting the NDC, we encourage the Government to also consider its ambitions beyond 2030.

50 The Government must ensure that policies are compliant with Te Tiriti o Waitangi/The Treaty of Waitangi and do not further compound historic breaches. Taking a long-term approach to planning for the NDC and future commitments would be consistent with the longer-term view of te ao Māori. By acting in partnership with Iwi/Māori to develop policies and measures to reduce emissions, the Government can ensure its approach upholds The Treaty and remains focused on the long-term.

51 Should the Government decide to strengthen the NDC, it should consider and describe how the NDC will be met, and put plans in place to do so.

22.3.1 It is not yet clear how Aotearoa will access offshore mitigation

52 As noted in the previous section, there is currently no centralised, UN-overseen market that Aotearoa can easily access – although negotiations are continuing in this area. In the meantime, it is incumbent on individual countries to negotiate market arrangements with each other. Some countries are already making progress – Switzerland, in particular, has already signed agreements to cooperate on reducing emissions with two partner countries.

53 The Government has signalled that it will hold itself to high standards of environmental integrity in the offshore mitigation it applies to the NDC. It is critically important that the Government follows through on this intent.

54 The need for offshore mitigation to meet the NDC also raises the question of how the purchasing will be paid for and managed. Purchasing could be undertaken by the Government or by emitters, and this will depend in part on how Aotearoa secures access to international emissions markets.

22.3.2 Accountability and reporting on the NDC will be critical

55 The credibility of the NDC relies on the Government showing its intent to achieve both the domestic and international emissions reductions required to meet it. Domestic emissions budgets and the emissions reduction plan will fulfil the former, but it is not yet clear how the Government will deliver on the latter.

56 The government should develop a plan for how it will access and purchase offshore mitigation and take steps to implement it. This will demonstrate a credible commitment to meeting the NDC both domestically, and to the international community. It would not be responsible for Aotearoa to wait for others to develop the markets for us, or to leave this until the late 2020s – this work needs to start now.

57 Our domestic and international reporting and accounting framework does not currently provide enough information on how meeting the NDC, including through purchasing of offshore mitigation, may impact on public finances. The NDC is not within scope of the Commission's annual monitoring reports, because these reports are about the 2050 target and emissions budgets.

58 Given that the Government intends to require a range of businesses to disclose climate change risks in their financial reports, it is not unreasonable to expect the Government to do the same. We therefore consider that the Government should hold itself accountable for meeting the NDC through regular transparent reporting, including the disclosure of any fiscal risks that may arise from the purchasing offshore mitigation and its strategy for managing those risks.

22.3.3 Broader contributions

59 NDCs communicate countries' mitigation commitments – how much each will contribute to the collective effort to peak global emissions and rapidly reduce them thereafter.

60 The contributions a country makes to addressing climate change can go beyond the actions taken to deliver the emissions reduction target communicated in the NDC. For example, climate finance to support developing countries to adapt to the effects of climate change and to mitigate their own emissions. Both contribute to the global climate effort.

61 The Terms of Reference for the Commission's review of the NDC refer to limiting warming to 1.5°C, so our analysis has focused on mitigation commitments. However, using the NDC to communicate broader efforts is one option the government could include in its considerations.

Recommendation 31

Planning and reporting on the NDC

We recommend that the Government should:

1. In making its decisions, continue to enable the NDC to be met through a combination of domestic emission reductions, domestic removals, and use of international carbon markets.
2. Report annually on how it plans to meet the NDC, including the balance of planned domestic emission reductions, removals, and offshore purchasing.
3. Clearly communicate its strategy for purchasing offshore mitigation to meet the NDC and how it will identify and manage fiscal and other risks and their consequences.

22.4 The scale and cost of offshore mitigation needed to meet the NDC

62 The gap between the current NDC and our recommended emissions budgets is 52 $MtCO_2e$ over 9 years.

63 There is the possibility that this gap could reduce. For example, our modelling suggests that if a methane inhibitor or vaccine can be developed and deployed by the mid-2020s, this gap could be significantly reduced. As these technologies are not yet commercially available and their future availability is uncertain, we have not included them in our emissions budgets.

64 Table 22.1 below shows the likely quantity of offshore mitigation that would be needed to meet the NDC. It shows this for the current Aotearoa NDC, and for an NDC based on the middle or lower emissions end of the IPCC pathways to 1.5°C.

65 If Aotearoa were to strengthen the NDC to reflect international equity considerations, the resulting NDC would require much deeper cuts to emissions.

Table 22.1: The amount of offshore mitigation needed under different NDC levels

NDC approach	Level (Mt CO_2e)	Implied quantity of offshore mitigation (Mt CO_2e)
2017 estimate of the current NDC	601	47
Latest estimate of the current NDC (-30%)	596	52
Middle of the IPCC interquartile range (-36%)	568	80
Lower quartile emissions IPCC pathways (-45%)	527	121

22.4.1 It is uncertain how much offshore mitigation will cost

66 It is currently uncertain how much offshore mitigation will cost. Its cost will depend on which country, or countries, the Government partners with, the types of mitigation available there, and the volume the Government wishes to purchase.

67 Once the Government has formalised a partnership for offshore mitigation with another country, it will have to decide how the mitigation will be paid for. Offshore mitigation could be paid for by the Government, by emitters or a combination of the two.

68 The overall economic impact of expenditure on offshore mitigation will be greater than the purchase price (the direct cost), due to multiplier effects. Were an equivalent amount to be spent within Aotearoa, it would have a knock-on effect stimulating spending in downstream industries. With offshore mitigation these knock-on effects occur overseas, and so Aotearoa would not get these benefits (indirect costs).

69 However, Aotearoa would gain the benefit of cheaper emissions reductions, and greater availability of mitigation options while the country builds momentum in decarbonising at home.

70 It is uncertain both how much mitigation will cost and what multiplier would be appropriate to account for these terms of trade effects. This means there is a wide range of possible economic costs to offshore mitigation.

71 Our models have been set up to assess paths to meeting domestic emissions targets and are independent of the NDC. The cost of offshore mitigation is therefore additional to the costs modelled to meet recommended emissions budgets.

72 If Aotearoa were to change the NDC to reflect the middle of the IPCC range, or the upper quartile of the IPCC range, then the range of plausible economic costs of this component are described in Table 22.2 and Table 22.3 below.

Table 22.2: Possible economic costs of offshore mitigation used to meet an NDC enhanced to 36% below 2005 emissions

	Price ($/tonne)		
Direct/indirect costs included	$30	$70	$140
Direct cost only	$2.4b	$5.6b	$11.2b
Direct + indirect costs	$4.3b	$10.1b	$20.2b

Table 22.3: Possible economic costs of offshore mitigation used to meet an NDC enhanced to 45% below 2005 emissions

	Price ($/tonne)		
Direct/indirect costs included	$30	$70	$140
Direct cost only	$3.6b	$8.5b	$16.9b
Direct + indirect costs	$6.5b	$15.2b	$30.5b

Note: Estimates of the possible multiplier to account for terms of trade effects vary. Here in Table 22.2 and Table 22.3 we have used 1.8 based on work done by Infometrics to assess the impact of possible NDCs in 2015 – *A general equilibrium analysis of options for New Zealand's post-2020 climate change contribution*.

22.4.2 Offshore mitigation cannot replace domestic action, and should have high standards of environmental integrity

73 During consultation, some submitters raised concerns about the use of offshore mitigation in the NDC. They expressed two main concerns around the use of offshore mitigation:

1. Offshore mitigation could allow the Government to do less to reduce emissions within Aotearoa, delaying the transition.
2. A significant amount of the offshore mitigation in the 2010s was not backed by real emissions reductions.

74 We have considered these issues. We consider that circumstances have changed sufficiently such that both concerns are addressed or addressable, which gives us confidence that Aotearoa can continue to incorporate offshore mitigation into its NDC.

75 First, the way the Act is structured (particularly sections 5Z and 5W), means that the Government is no longer able to use offshore mitigation as a way to do less in Aotearoa.

76 The government must set emissions budgets and plan to meet them entirely domestically. The Act restricts use of offshore mitigation in emissions budgets to when there has been a significant change of circumstances that affects both the ability to meet the emissions budget domestically, and the considerations on which the emissions budget was set.

77 This is a high bar. It means that offshore mitigation cannot be used to compensate for failure to implement domestic policies. The government can only plan to use offshore mitigation to bridge the gap between emissions budgets and the NDC.

78 Second, when meeting its previous emissions reduction targets, Aotearoa relied on compliance with the rules of the centralised Kyoto Protocol framework to ensure the environmental integrity of purchased offshore mitigation. This proved insufficient, as despite compliance with the agreed rules, there were deficiencies in the environmental integrity of many credits that were issued.

79 Given this previous experience, the government must take responsibility itself for ensuring the environmental integrity of any offshore mitigation that contributes to the NDC. The government should also expect heightened international and domestic scrutiny of how Aotearoa uses offshore mitigation.

80 We note that this is in line with use of offshore mitigation under Article 6.2 of the Paris Agreement, which requires that each country ensure the environmental integrity of any offshore mitigation it uses, and be scrutinised on it. It is the responsibility of individual countries to make sure the mitigation is real and has environmental integrity.

81 The Government has indicated strongly through public statements that it supports strict standards for environmental integrity in any offshore mitigation that it does use. We consider it essential that the Government uphold this commitment.

22.5 Key principles and approaches to inform decisions about what a fair contribution would look like

82 In seeking to make the NDC compatible with the global effort to limit warming to 1.5°C, the Government must, either implicitly or explicitly, make assumptions about how its NDC relates to the efforts of other countries.

83 There are a range of different approaches to thinking about sharing the global effort between countries (known as effort sharing, or burden sharing). Each implies a different level of NDC for Aotearoa.

84 There are a range of equity considerations that can be used to help guide decisions about suitable contributions from different countries. Each contains complexities and requires judgements to be made in its application. This means that the same approach can lead to different results if different assumptions, or parameters are used.

85 We provide a high-level overview of some of the considerations, but do not provide detailed figures. It is for the Government to decide which approach it wishes to use, and to describe the judgements it makes in doing so.

86 The IPCC described, in its Fifth Assessment Report, the main set of effort sharing approaches. This includes three main principles, which can be balanced in different ways:

- **Equality.** This principle focuses on equal access to the atmosphere. The remaining global emissions budget is shared between all people equally.

  There are a range of ways to interpret equality. For example, emissions reductions could be equal, with all countries reducing emissions at the same rate. Alternatively, per capita emissions could be equal, with emissions per capita converging to the same level for all countries.
- **Responsibility.** This principle focuses on countries taking responsibility for their historic emissions. Countries that have emitted more historically have to make deeper and faster emissions reductions.

  A key judgement to apply with this approach is the timeframe over which responsibility is to be taken.
- **Capability/need.** This principle focuses on a country's level of economic development. Higher levels of economic development imply a higher capability to reduce emissions. Lower levels of economic development imply a greater need for further development, and need for a greater share of the world emissions budget.

  Based on this principle, richer countries are required to reduce emissions further and faster while less developed countries take more time before cutting emissions, in order to develop economically.

87 In addition to these three main principles, there are a range of approaches that combine the elements in different ways. The two most relevant are:

- **Equal cumulative per capita emissions.** Emissions need to be reduced so that cumulative emissions, on a per capita basis, reach the same level.

  This allows countries with a large population and low historic emissions further time to develop. This approach combines elements of equality and historical responsibility.
- **Responsibility/capability/need.** Countries with the most historical responsibility, and the highest capability to reduce emissions make deeper and faster emissions reductions.

  A range of studies have explicitly used responsibility and capability as the basis for distributing emissions reductions. The approach taken will depend on the relative weighting given to responsibility vs capability.

88 Each of these approaches relies on an assessment of the global emissions budget that is compatible with the goal of limiting warming to 1.5°C, and dividing it between countries in ways that reflect equity considerations.

22.5.1 The emissions trajectory for Aotearoa would look different under different approaches

89 Careful judgements need to be made about how different gases are treated in different approaches to global effort sharing. In particular, care should be taken to consider how short-lived gases are treated in approaches that are based on calculating historic emissions.

90 Various organisations and researchers have analysed targets and NDCs specific to Aotearoa under different effort sharing approaches. This includes Climate Analytics and the New Climate Institute (Climate Action Tracker) and du Pont et al (Paris Equity Check).

91 These analyses generally exclude forestry emissions and removals, and so are not directly comparable with an NDC that includes carbon sequestration in forests. Rather, they are illustrative of the depth of reductions required if these equity approaches are applied.

92 Oxfam New Zealand (*A Fair Target for 2030 for Aotearoa*, 2020) provides a useful overview of the different equity approaches that can be applied, and what they would mean for the Aotearoa NDC specifically. They have noted methodological issues that need to be managed in each case.

93 In general, applying equity approaches implies that Aotearoa should make significantly deeper reductions than the global average.

94 For example, Oxfam estimated that an equitable NDC for Aotearoa would be 80-99% below 1990 levels by 2030. They acknowledge that achieving such high emissions reductions domestically are unlikely to be the most efficient or lowest cost way to reduce emissions from the global total.

95 A key observation in the Oxfam report is that Aotearoa should not set a lower international target because it is expensive to reduce emissions domestically, and then use offshore mitigation to meet it. If Aotearoa uses offshore mitigation, the argument that it is expensive to reduce emissions domestically is seen as no longer relevant by the report's authors.

96 For approaches that draw on the equality principle, the scale of emissions reductions needed depends heavily on just what is being held equal – whether it is the allowed emissions budget per person, or the proportional level of reductions.

97 Holding the proportional emissions reductions equal across all countries is not an equitable approach. It is also not compatible with the international commitments Aotearoa has made, because it ignores differences in national circumstances, including between developed and developing countries.

98 Emissions trajectories for Aotearoa based on the country's relative wealth generally lead to deeper reductions by 2030 than the IPCC 1.5°C pathway range. Emissions reductions would reach net zero all-gases between 2040 and 2050.

99 Emissions trajectories that account for historic responsibility follow a similar path towards net zero in the 2040s. However, net emissions would continue to reduce after reaching net zero (net negative) to address past contributions to climate change.

100 The Government should be clear about any method it uses to determine a fair contribution under the NDC.

22.6 The form of the NDC

101 Under the Act, Aotearoa has a domestic emissions reduction target for 2050 that differentiates between biogenic methane and other greenhouse gases (a split-gas target).

102 Some submitters have questioned whether the NDC should also be expressed in a split-gas format or continue to be expressed as an all-gases target.

103 In considering this question, it is important to keep in mind that the NDC serves a different purpose from the domestic 2050 target. The NDC also includes an international contribution through purchasing offshore mitigation, in addition to domestic emissions reductions.

104 It is also important to keep in mind that the NDC is a commitment under the Paris Agreement, and so decisions on form should take into account the agreed rules and expectations under that agreement.

105 Several alternative forms of the NDC are listed below. These cover a range between a fully all-gas or fully split-gas format:

- **Fully all-gas.** Maintain an all-gas target, with no specific reference to the domestic split gas contribution either in the headline target or elsewhere in the NDC.
- **All-gas with acknowledgement of the split-gas domestic target.** Maintain an all-gas headline target but mention the domestic split gas contribution elsewhere in the NDC.

  This could involve either a general reference in the NDC's supporting information, or could include a more detailed reference that specifies in detail the 2030 biogenic methane sub-target and a gas-by-gas breakdown of emissions budgets one and two.
- **All-gas with the split-gas domestic target incorporated into the headline target.** Bring the split-gas domestic target up into the headline target statement, with the NDC also expressed in all-gas terms overall. The international contribution would remain all-gas.

  For the current NDC, this could be worded along the following lines: "*Aotearoa commits to reduce domestic biogenic methane emissions to 10% below 2017 levels by 2030, reduce domestic emissions of other gases by 42% on 2005 levels by 2030 and cooperate on international mitigation outcomes to reduce emissions overall to 30% below 2005 levels by 2030".*
- **Fully split-gas.** Have an overall split-gas headline target, applying to both the domestic and international contributions by Aotearoa.

  For the current NDC, this could be worded along the following lines: *"Aotearoa commits to reduce biogenic emissions biogenic methane to 10% below 2017 levels by 2030 and all other gases to 42% below 2005 levels by 2030".*

22.6.1 Moving to a split-gas NDC would have significant impacts

106 A NDC expressed as two separate targets would be unlikely to meet current international expectations that a developed country's NDC should be an all-sector, all-gas absolute emissions reduction target.

107 It is also important to be aware that under the Paris Agreement, NDCs can only be revised to enhance ambition, and each successive NDC must show progression on the previous contribution. This process is informed by 5-yearly global stocktakes of collective progress towards achieving the purpose of the Agreement and its long-term goals. The first global stocktake is scheduled for 2023.

108 An important implication of expressing the NDC in a split-gas format would be that these targets would be captured in this collective review process and by the requirement for targets to show increasing ambition over time. This could limit flexibility in how Aotearoa meets its international targets in future, and could place additional costs by requiring mandatory increases in the level of our methane reduction targets.

109 However, there may be some benefit in exploring whether Aotearoa should include information in the NDC that clearly sets out the contribution from the different constituent gases (while clearly maintaining a single, all gases target). This could have the benefit of highlighting to other countries the importance of recognising the different warming impacts between gases.

110 There could also be some reputational impact from this approach if Aotearoa is perceived to be signalling a future intent to move away from the norms and expectations on developed country NDCs.

22.6.2 The GWP values used to express the NDC should be updated if the NDC is revised

111 The submission Aotearoa made to the UNFCCC on its current NDC outlines that it "applies 100-year Global Warming Potentials (GWPs) from the IPCC 4th assessment report".

112 In describing the alternate NDCs based on IPCC pathways to 1.5°C, the Commission has also used GWPs from the ***Fourth Assessment Report*** for consistency of comparison.

113 If the Government revises the NDC, there is a strong rationale, as part of that update, to move to applying the 100-year GWPs (GWP_{100}) from the IPCC's ***Fifth Assessment Report***.

114 This is because for emissions in years from 2021 onwards (reported from 2023 onwards), GHG Inventory reports for Aotearoa must be prepared using that the GWP_{100} values from the IPCC's ***Fifth Assessment Report***, in accordance with guidance adopted under the Paris Agreement (Decision 18/CMA.1).

115 Progress towards meeting the NDC will be tracked using the GHG Inventory and GWP_{100} values for consistency and ease of understanding, in line with decisions under the Paris Agreement.

116 Moving to the use of GWP_{100} values from the ***Fifth Assessment Report*** will have some impact on the overall ambition of the NDC, as it is calculated on an all-gas basis against emissions in a base year.

117 The updates to GWP_{100} values in the ***Fifth Assessment Report*** will change the relative contribution of each greenhouse gas to the CO_2e amount of allowed emissions, if the reductions by gas in the IPCC pathways to 1.5°C are applied to Aotearoa. This effect should be factored into the Government's consideration of any changes it might make to the NDC.

Recommendation 32

Form of the NDC

1. We recommend that the Government should continue to define the NDC on the basis of all greenhouse gases using the most recent IPCC global warming potentials adopted by the Parties to the UNFCCC. If the NDC is updated, the Government should express it on a basis that is consistent with how emissions will be reported in the national greenhouse gas inventory from 2021-2030.
2. We recommend that the Government should continue to contribute to further global mitigation beyond the NDC through the provision of climate finance to developing countries and active participation in mitigation mechanisms, including for international aviation and shipping.

Chapter 23

Ngā mahi whakaheke hauwaro-whakamahana
Eventual reductions in biogenic methane

Summary

The Minister of Climate Change asked us to give advice on the eventual reductions in biogenic methane emissions that might be needed for Aotearoa to contribute to limiting the global average temperature increase to 1.5°C above pre-industrial levels (the global 1.5°C effort).

We are not changing any existing targets – the Climate Change Response Act fixes the current targets which require biogenic methane emissions to reduce by 10% below 2017 levels by 2030 and by 24-47% by 2050. However, our finding will inform future emissions budgets, and we will review the targets in 2024.

We found that looking out to 2100, Aotearoa could be called on to reduce biogenic methane emissions further, to 49-60% below 2017 levels.

Most biogenic methane emissions (91%) in Aotearoa are from agriculture. These emissions are created through fermentation in the stomachs of ruminant animals such as cows and sheep.

Aotearoa can reach the 10% target by 2030 and the 24-47% target by 2050 without using new technology such as methane vaccines or inhibitors in agriculture. It is also likely these technologies will become available. This would increase the speed and efficiency of reducing biogenic methane emissions.

In this chapter we have looked at the emissions reductions needed globally, what Aotearoa might be able to achieve and how agriculture in Aotearoa might fit into a future global economy.

We have also looked at what additional contributions Aotearoa may need to make to global reductions, given the scale of agriculture and the relative expertise and wealth in our country. The contribution for Aotearoa will probably be in the mid-upper quartile of the proportional emissions reductions needed to achieve the the global 1.5°C effort.

Changes in our final advice

This section is largely unchanged from our 2021 Draft Advice for Consultation.

Relatively few people commented in submissions on the long-term reductions in biogenic methane. Those that did gave a range of different perspectives, but did not provide relevant new evidence.

Introduction

1 Under section 5K of the Climate Change Response Act 2002 (the Act), the Minister of Climate Change asked the Commission to provide a report assessing biogenic methane emissions in Aotearoa. Specifically, the Minister has asked the Commission to provide:

2 "advice on the potential reductions in biogenic methane emissions which might eventually be required by New Zealand as part of a global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above preindustrial levels.

3 In providing this advice the Commission must:

a) leave aside considerations on the current target range for biogenic methane specified in section 5(Q)(1)(b) of the CCRA;
b) consider the available scientific evidence on the global biogenic methane emissions reductions likely to be required to limit global average temperature increase to 1.5° Celsius above pre-industrial levels;
c) consider New Zealand's potential contribution to global efforts to limit biogenic methane emissions, reflecting its national circumstances; and
d) consider a range of potential scenarios for economic, social and demographic changes which might occur in New Zealand and globally until 2100."

4 The full text of the request and the terms of reference can be found on our website at https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/reviewing-new-zealands-nationally-determined-contribution-and-biogenic-methane/

5 We have interpreted part (a) to mean the Commission should not provide advice on the target range for biogenic methane emissions set for 2050. This is consistent with section 5T of the Act that sets out the limited circumstances when the Commission can review targets in the Act.

6 As there has not been a significant change in circumstances that would justify changing the 2050 methane target since it was set, the Commission would be unable to recommend a change to the 2050 target.

7 We have structured the analysis in this chapter around the considerations (b) to (d) above. Assessing these elements requires a mixture of quantitative and qualitative analysis. There are no exact numbers that can come out of a formula.

8 Judgements are required regarding trade-offs, where to prioritise efforts, and how the impacts and consequences of acting on climate change are distributed within Aotearoa across people, place, and time. Judgement is also needed to consider opportunities and trade-offs between Aotearoa and the rest of the world. This brings in concepts of equity and fairness.

9 In addition to the terms of reference, we must also consider the matters listed in section 5M of the Act (where relevant). These matters are considered throughout this report.

10 In this chapter we talk about methane, biogenic methane, and agricultural methane. Distinguishing between these three terms is important. Methane refers to all forms of methane emitted, including methane from agriculture, waste and fossil fuel extraction. Biogenic methane refers to methane from agriculture and waste. Agricultural methane refers solely to methane from agriculture.

11 While the request from the Minister requires us to consider the eventual reductions in biogenic methane, analysis that we have drawn on, including by the Intergovernmental Panel on Climate Change (IPCC), refers to agricultural methane.

12 Although these are slightly different, in Aotearoa agricultural methane makes up 91% of biogenic methane. So, for the purposes of our analysis we have applied analysis for agricultural methane as a proxy for biogenic methane. The IPCC does not separately identify biogenic methane from waste.

13 Relatively few submissions commented on the approach taken to assessing the eventual reductions in biogenic methane that may be necessary. Of those that did, submitters were mixed in whether the recommended reductions should be stronger or weaker.

14 Most submissions on this issue reflected submitters' preferences for overall ambition rather than providing new evidence for the level of reductions that might be required to limit the global average temperature increase to 1.5°C above pre-industrial levels (the global 1.5°C effort). As a result the approach and our findings in this chapter have not changed from our *2021 Draft Advice for Consultation*.

23.1 Consideration one: What global reductions of biogenic methane emissions might be required for the global 1.5°C effort?

15 Our first consideration is of the scientific evidence and analysis regarding what global reductions in biogenic methane are likely to be required for the global 1.5°C effort. This analysis is based on the *IPCC Special Report on Global Warming of 1.5°C.*

16 The long-term reduction in global biogenic methane emissions needed for the global 1.5°C effort depends on a number of factors. All the greenhouse gases have different warming properties.

17 Three key factors affect the contribution of different greenhouse gases to global warming: how much is emitted, how long the gases stay in the atmosphere, and the strength of their warming effects. Table 23.1 summarises these for carbon dioxide, methane and nitrous oxide – the three most important greenhouse gases in terms of their contribution to global warming. For further details, see *Chapter 1: The science of climate change* in the *2021 Supporting Evidence*.

Table 23.1: Properties of carbon dioxide, methane, and nitrous oxide

Gas	Quantity of emissions	Duration in the atmosphere	Strength of warming effect
Carbon dioxide	Comprises the majority of global emissions, largely from fossil fuel combustion and deforestation. Increasing by more than 1% per year over the last decade.	Long-lived gas that can last for centuries or milennia in the atmosphere.	Relatively small impact on per-molecule basis, but large effect with accumulation in the atmosphere over time. Responsible for the majority of human-driven warming.
Methane	Accounts for the second largest share of global emissions. Around a third of methane emissions are from fossil fuel extraction, distribution and combustion. Biogenic sources comprise around 60% of total human-caused methane emissions globally. Largely stems from ruminant agriculture, rice cultivation, and organic waste decomposition.	Short-lived greenhouse gas. Breaks down in the atmosphere after around 12 years.	Powerful warming effect on a per-molecule basis. Responsbile for about one-fifth of all human-driven warming. Some longer-term indirect warming effects through climate-carbon cycle feedbacks that endure after atmospheric decay.
Nitrous oxide	Relatively small quantity of emissions. Mainly from industrial processes, agricultural soils, manure management and wastewater.	Long-lived gas with warming dynamics similar to carbon dioxide over decadal to centennial timeframes.	Powerful warming effect on a per-molecule basis. Accumulates in the atmosphere over time.

18 The combination of these factors – the quantity of emissions, their duration in the atmosphere and the warming effect of each greenhouse gas – all interact with each other to affect global temperature. This means the reductions in biogenic methane required for the global 1.5°C effort are dependent on the levels of other greenhouse gas emissions and emissions removals.

19 The global reductions in biogenic methane required for the global 1.5°C effort will depend on the level of carbon dioxide and nitrous oxide emissions over the next century. Therefore, it is not currently possible to know for certain what reductions in biogenic methane will be required. However, it is possible to identify the ranges of reductions of the different greenhouse gases that mean it is likely warming will be limited to 1.5°C above pre-industrial levels.

23.1.1 Global pathways compatible with the global 1.5°C effort

20 The IPCC has assessed a large number of possible emissions reduction scenarios that would limit the global average temperature increase to 1.5°C above pre-industrial levels. Each scenario was designed to reach the temperature goal in the lowest-cost way possible.

21 The scenarios use current understanding of the relative costs of reducing emissions using known technologies. They do not include any direct emissions-reduction technologies applying to agricultural methane. The scenarios contain a range of assumptions about economic growth, technology developments, and lifestyles.

22 The IPCC assessment found 1.5°C compatible scenarios under a broad range of possible futures, with different economic and demographic developments. All of the 1.5°C compatible scenarios assume global population and food demand will increase over the course of the century, although some of the scenarios expect both population and food demand to drop by 2100.

23 Despite these common underlying features, the IPCC scenarios do differ in whether average global temperatures remain strictly within 1.5°C above pre-industrial levels, with some scenarios allowing global average temperature increase to exceed 1.5°C above pre-industrial levels before falling back below that level.

24 The scenarios with little or no overshoot have been estimated to be the most likely to deliver the best overall social, economic, and environmental outcomes. Higher levels of overshoot are associated with higher cumulative emissions and greater climate impacts and adaptation needs. Scenarios with higher overshoot also rely on high levels of emissions removal technologies such as carbon capture and storage that may not be feasible. We have therefore chosen to only consider scenarios with no or limited overshoot.

25 Each of these different scenarios result in different rates of emissions reductions for each greenhouse gas. The interquartile range of emissions reductions ranges for carbon dioxide, agricultural methane and nitrous oxide in these scenarios are summarised below in Table 23.2.

26 We have used the interquartile range as it excludes more extreme model results that are less likely to be feasible. The emissions reductions here are associated with scenarios with a 50-66% probability of limiting the global average temperature increase to 1.5°C above pre-industrial levels.

27 Scenarios closer to the lower quartile range have greater methane reductions and are less likely to lead to global average temperature overshooting 1.5°C above pre-industrial levels. Conversely, scenarios closer to the upper quartile range have smaller methane reductions and are more likely to lead to global average temperature overshooting 1.5°C above pre-industrial levels and rely on carbon dioxide removals in the latter part of the century to bring temperatures back down.

28 The IPCC has noted that relying on large scale carbon dioxide removals represents a major risk that the world will not be able to limit the global average temperature increase to 1.5°C above pre-industrial levels.

29 The benefit of early reductions in methane emissions was reiterated in the work of the UN Environment Programme and the Climate and Clean Air Coalition. Their 2021 report ***Global Methane Assessment: Benefits and costs of mitigating methane emissions*** emphasises that the short atmospheric lifetime of methane means that making emissions reductions early will result in faster reductions in concentrations, and will more rapidly slow the rate of warming.

Table 23.2: Change in greenhouse gas emissions in IPCC pathways with no or limited overshoot

	Percentage change relative to 2010		
	2030	2050	2100
Net carbon dioxide emissions	-40 to -58%	-94 to -107%	-121 to -136%
Agricultural methane emissions	-11 to -30%	-24 to -47%	-37 to -60%
Agricultural nitrous oxide emissions	+3% to -21%	+1% to -26%	-6 to -39%

Note: in some of the scenarios, nitrous oxide stays the same or increases out to 2050. This reflects the lack of mitigation options that exist for this gas, and the fact that some nitrous oxide emissions are an inevitable by-product of agricultural practices.

30 The pathways that had the greatest chance to limit the global average temperature increase to 1.5°C above pre-industrial levels, all required rapid emissions reductions of greenhouse gases between now and 2030 and then somewhat slower reductions out to the end of the century. These pathways have several other features in common:

- Emissions of carbon dioxide and other greenhouse gases peak in the 2020s and then rapidly reduce through the 2030s and 2040s
- Emissions of nitrous oxide have relatively smaller reductions. This reflects fewer options to reduce this gas
- Emissions of methane reduce significantly through the next 20 years, but do not reach zero by 2050 or 2100. This reflects the short-lived nature of the gas, and the smaller range of mitigation options currently available
- Emissions of long-lived greenhouse gases reduce to be near zero by 2050

31 Most of the pathways have some gross emissions remaining in 2050. These come from hard-to-abate sectors like cement manufacturing. As a result,carbon dioxide needs to be removed from the atmosphere to make sure net emissions reach net zero and remain there.

32 Overall, the IPCC scenarios show that at least a 37% reduction in agricultural methane is required to have a 50-66% chance of limiting the global average temperature increase to 1.5°C above pre-industrial levels by 2100.

33 Simply maintaining the current level of warming from methane is not enough, as it would require the world to reach net zero carbon dioxide by 2030 to keep the global average temperature increase below 1.5°C above pre-industrial levels. We consider this to be infeasible and consequentially that the global warming contribution from methane must be reduced if the global 1.5°C effort is to be successful.

34 The reductions in methane assessed by the IPCC used a 2010 base year. The current biogenic methane targets for Aotearoa use a 2017 base year. As the country's biogenic methane emissions in 2010 and 2017 differed by less than 1%, the percentage reduction is essentially the same. In the rest of this chapter we present reductions in biogenic methane against 2017 levels for ease of comparison with the existing targets.

23.2 Consideration two: What reductions of biogenic methane could Aotearoa make to contribute to the global 1.5°C effort, recognising national circumstances?

35 Our second consideration is of the potential contribution Aotearoa could make to reducing biogenic methane emissions, in light of national circumstances. We analyse the sources of biogenic methane emissions, the opportunities for Aotearoa to reduce biogenic methane emissions and key aspects of national circumstances that affect these.

23.2.1 The sources of biogenic methane in Aotearoa

36 In 2019, gross emissions of biogenic methane were about 1.35 $MtCH_4$ in Aotearoa. Agriculture is the largest source of biogenic methane at around 91%, with the remainder from waste (Figure 23.1).

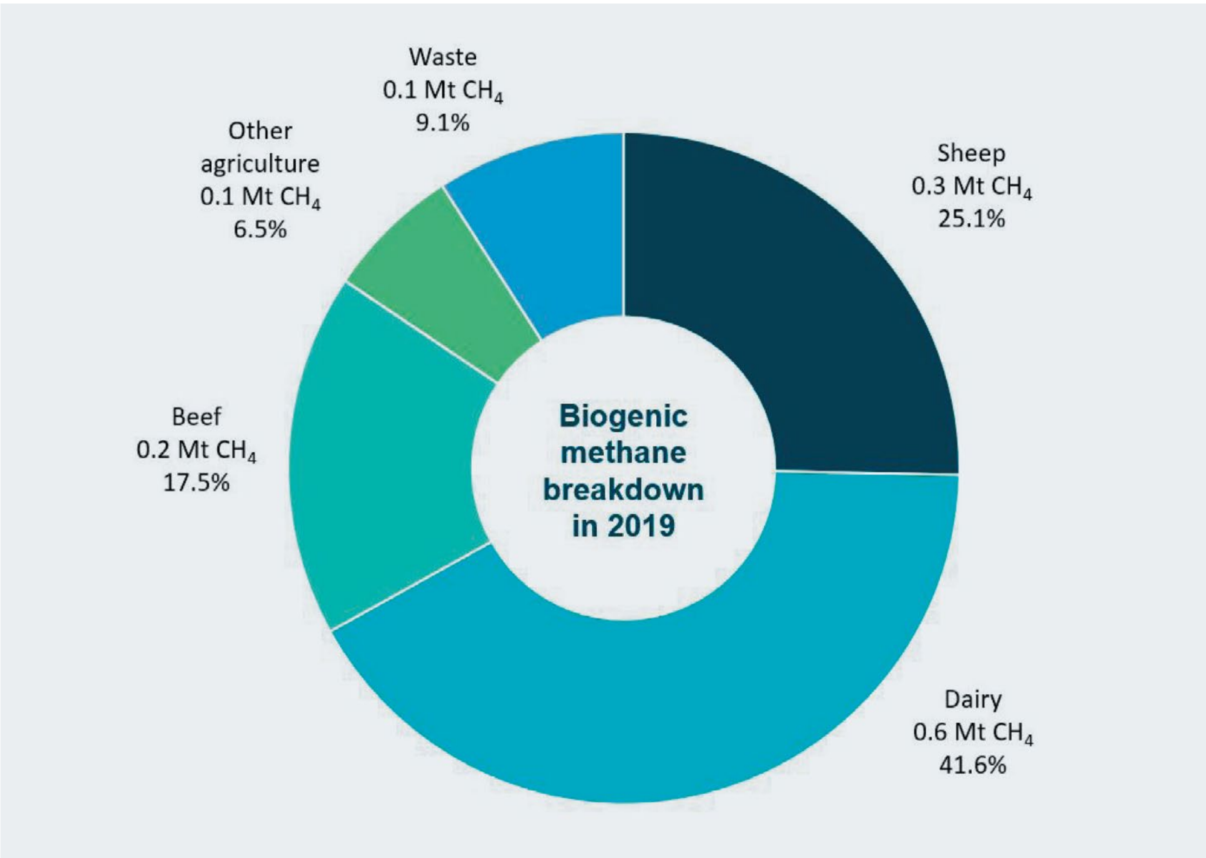


Figure 23.1: Aotearoa biogenic methane emissions by sector 2019.
Source: MfE, New Zealand's Greenhouse Gas Inventory 1990-2019

Agriculture

37 Aotearoa has a well-developed agricultural sector that makes up a much larger part of the economy than in many other developed nations. Around 9.7 million hectares of the 26.8 million total hectares in Aotearoa are used for pastoral agriculture. The main agricultural products by volume are meat, dairy products and wool, with the vast majority being exported.

38 Figure 23.2 shows the breakdown of historic biogenic methane emissions from agriculture and those projected under current policies (termed the Current Policy Reference case). Dairy, sheep and beef farming account for the majority of these emissions, although the former has increased historically while the latter has decreased. For more information on these trends and the Current Policy Reference case see ***Chapter 11: Where are we currently heading?*** in the ***2021 Supporting Evidence***.

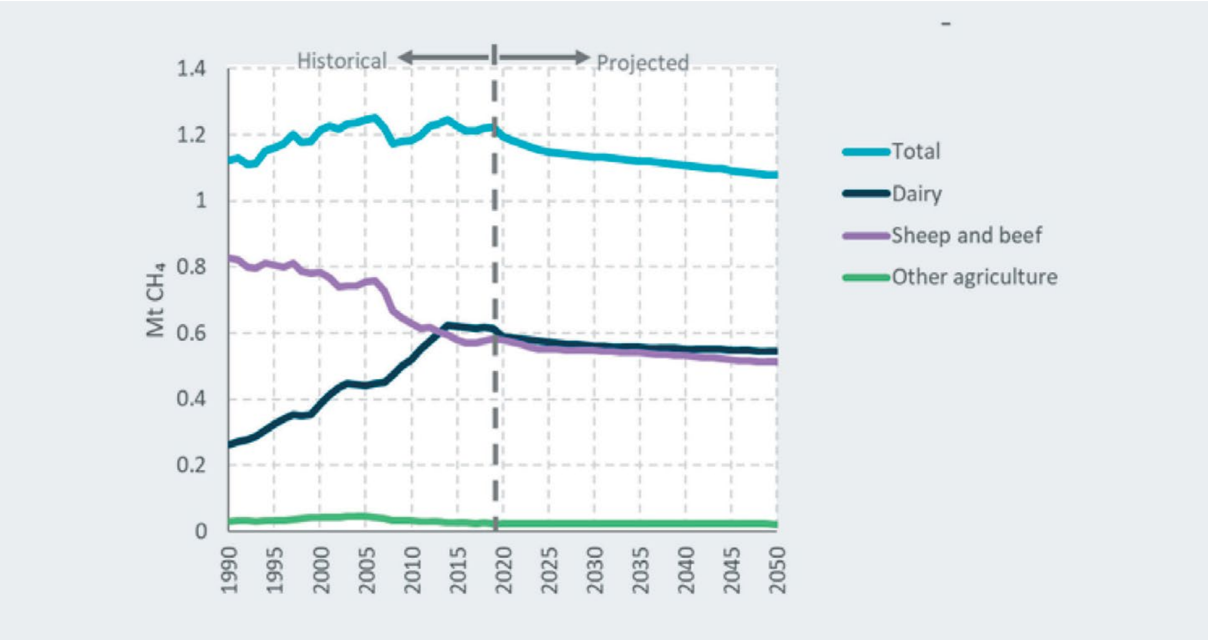


Figure 23.2: Historic and Current Policy Reference case biogenic methane emissions from agriculture

Waste

39 Aotearoa has high per capita waste production and resulting biogenic methane emissions compared to many other developed countries. Figure 23.3 shows the historic biogenic methane emissions from waste and those projected under current policies.

40 The main sources of these emissions are landfills, some of which use landfill gas capture (LFG) technology and farm fills. For more information on these trends and the Current Policy Reference case see ***Chapter 11: Where are we currently heading***? in the ***2021 Supporting Evidence***.

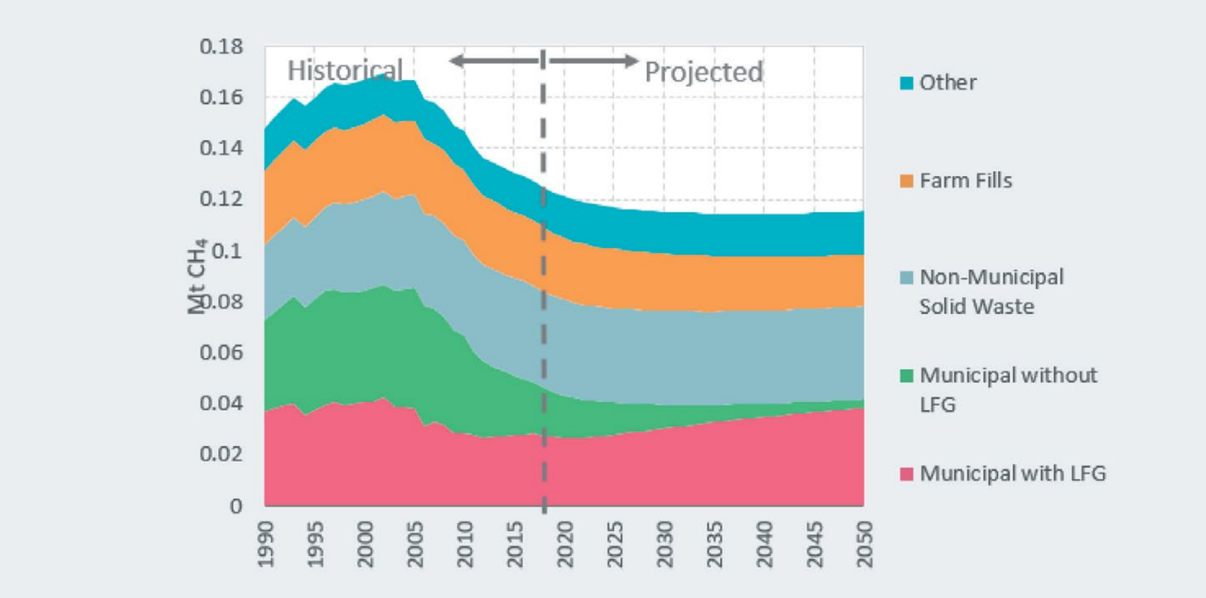


Figure 23.3: Historic and Current Policy Reference case biogenic methane emissions from waste

23.2.2 How much could biogenic methane emissions be reduced?

41 As part of our analysis, we have identified a number of opportunities to reduce biogenic methane emissions from agriculture and waste.

Agriculture

42 In Aotearoa, biogenic methane emissions from agriculture are largely a function of the amount of feed each animal eats and total animal numbers. Reducing methane from agriculture therefore relies largely on changes to farm management practices that reduce total feed being produced and consumed.

43 Adjusting stocking rates, supplementary feed and other inputs can improve emissions-efficiency on-farm. Changing land use to lower emissions activities such as horticulture, could also reduce methane emissions.

44 New technologies also offer potential for reducing methane emissions. Selective breeding of sheep to be low emitting is already being implemented. Breeding these traits through the national flock is estimated to reduce total biogenic methane from sheep and beef farming by 3% by 2035. Breeding for low-emissions cattle has commenced.

45 Other promising emissions-reducing options that could be on the market in the next few years include a methane inhibitor. Research into a vaccine that could supress methane emissions is ongoing. Some submitters particularly Iwi/Māori submitters cautioned about the possible animal health, food safety and environmental effects these options could have.

46 If Aotearoa were to pioneer the development of these methane technologies, Aotearoa would also be able to make significant contributions to global emissions reductions through helping disseminate them internationally.

Waste

47 We have identified three broad opportunities for reducing biogenic methane emissions from waste. These are:

- Reducing total waste generation by improving resource efficiency and supporting consumers to reduce household waste
- Increasing the amount of waste diverted from landfills by, for example, turning what would have gone to landfill as 'food waste' into compost
- Ensuring that landfills that receive organic waste have high efficiency LFG systems, that capture the majority of the methane produced

48 These opportunities are discussed in more detail in *Chapter 8: Reducing emissions from waste* of *2021 Supporting Evidence*.

23.2.3 Overall

49 Our analysis to inform emissions budgets indicates that it is possible to reduce total biogenic methane emissions by between 10-24% below 2017 levels by 2030 and 24-57% below 2017 levels by 2050 through reducing biogenic methane emissions from both agriculture and waste.

50 The lower ends of these reductions (10% by 2030 and 24% by 2050) can be achieved using currently available practices and technologies. The development of new technologies such as a methane inhibitor would provide greater flexibility and unlock the upper range of reductions.

51 Reaching the higher range of biogenic methane reductions (24% by 2030 and 57% by 2050) without new technology would likely require significantly reduced agricultural production from livestock and land-use change. For more details on our scenarios and projected emissions reduction paths see *Chapter 6: Long term scenarios to 2050.*

52 After 2050, there is a high level of uncertainty around what opportunities to reduce biogenic methane may become available and how effective they will be. This makes it difficult to estimate what levels of reductions are likely to be achievable.

23.2.4 Important national circumstances that relate to potential biogenic methane emissions reductions

53 There are several important national circumstances that should be taken into account when considering biogenic methane emissions reductions in Aotearoa.

54 Firstly, there are obligations to uphold the principles of partnership, protection, participation and equity under Te Tiriti o Waitangi/The Treaty of Waitangi. As discussed in *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable*, Iwi/Māori hold approximately $20.4 billion in assets in the forestry and agriculture sectors with potential for further development.

55 Any targets and associated policies should be developed in partnership with Iwi/Māori to avoid compounding historical disadvantages.

56 Secondly, Aotearoa has a responsibility as a developed country to take a leading role in reducing greenhouse gas emissions under the United Nations Framework Convention on Climate Change and the Paris Agreement. This responsibility is discussed further in *Chapter 21: The global 1.5°C effort and Nationally Determined Contribution for Aotearoa*. This responsibility means that the country's contribution to meet a fixed temperature target should be more than the global average.

57 Thirdly, Aotearoa is one of the most greenhouse gas efficient producers of red meat and dairy products in the world. The climate, topography, rainfall patterns and soil types make much of the country suited to pastoral farming.

58 Combined with access to international markets and the need to compete with subsidised international producers, this has helped drive improvements in efficiency across pastoral production systems of Aotearoa. In a low-emissions future where red meat and dairy products continue to be consumed there is good reason to believe that production in Aotearoa would still be globally competitive, and result in less emissions than product from less efficient export competitors.

59 Internationally, Aotearoa leverages its expertise in efficient agricultural production to support emissions reductions and sustainable development in other countries. The Government's role in founding and funding the Global Research Alliance on Agricultural Greenhouse Gases is a key example of this. Its ability to credibly lead such initiatives is enabled and underpinned by the country's innovative ecosystem of farmers, researchers and agriculture experts. The value of these international contributions should also be considered in assessing biogenic methane emissions reductions.

60 Fourthly, the large role played by agriculture in the economy of Aotearoa should also be considered when considering reductions in biogenic methane. Reductions in biogenic methane that come at significant cost to agricultural industries could have negative social and economic consequences as discussed in *Chapter 8: Demonstrating emissions budgets can be fair, inclusive and equitable.*

61 At the same time, the long-term viability of these industries may require reductions in biogenic methane to maintain access to international markets and to meet evolving domestic and international consumer preferences. This is discussed more in the next section of this chapter.

62 On balance, we consider that the country's national circumstances do not provide sufficient reason to reduce biogenic methane emissions by less than other developed countries in contributing to the global 1.5°C effort.

23.3 Consideration three: What social, economic and demographic changes may occur?

63 Our third consideration is of the the key social, economic and demographic factors and changes that may occur until 2100 – both within Aotearoa and globally – that could affect the contribution Aotearoa makes to biogenic methane emissions reductions. This section steps through some of the key trends that we have incorporated into our analysis.

23.3.1 Population growth and food demand

64 The world population is expected to continue to increase over the century, reaching more than 9 billion people by 2050. The growth in the global population is expected to slow over the century, although by how much is uncertain. Estimates used in the *IPCC Special Report on Global Warming of 1.5°C* suggest the global human population is expected to increase to between 9-11 billion by the end of the century.

65 This growing population will need to be fed. As the majority of meat and dairy produced in Aotearoa is exported, changes in global demand for these products could have important consequences for domestic biogenic methane emissions.

66 A number of estimates exist for changes in food demand, which include both an increase in total amount and changes in the type of food required. The Food and Agriculture Organization of the United Nations (FAO), estimated the need to double global food production by 2050 to meet the expected demand of around 9.7 billion people, although this need is not evenly distributed around the world. The FAO also predicts increasing demand for animal products, fruit and vegetables and more processed foods, due to a combination of increasing wealth and greater urbanisation.

67 The majority of global population growth and increased food demand is expected to occur in regions that are not currently major export destinations for Aotearoa, such as sub-Saharan Africa and South Asia. Most of the dairy and meat exports are currently targeted at middle-class and premium consumers in China, Europe, and North America.

68 In addition to global population growth, incomes in many developing countries are expected to rise and bring with them an expanded global middle-class. There is a clear relationship between increasing incomes and consumption of meat and dairy products.

69 In a future where meat and dairy products remain in high demand, there is good reason to expect Aotearoa can continue providing these to the world if Aotearoa can maintain and strengthen its position as one of the lowest emissions producers.

23.3.2 Demand for low-emissions agricultural production

70 Both globally and domestically, there are growing concerns about the environmental impact of food – including for greenhouse gases. In response, a number of agricultural accreditation and sustainability schemes have been established, such as Toitū Envirocare's farm carbon certification programme. A number of producers in Aotearoa have already signed up to such schemes.

71 The rapid development of alternative protein industries has built on consumer preferences for environmentally sustainable products. These include plant-based protein products and synthetic meats grown in laboratories, many of which have lower emissions, water and land-use footprints than conventional animal agriculture products. The rapid expansion of these industries, which often promote themselves as more sustainable alternatives to animal agriculture, could compete with agricultural exports.

72 Overall, the impact of growing alternative protein markets remains uncertain but appears to push in the direction of reducing methane emissions from agriculture, either through reduced demand and production or through the need to reduce emissions per unit of product to help maintain a niche market.

73 Rising consumer expectations could favour producers in Aotearoa if consumers place a premium on lower-emissions varieties of the products they already consume. Red meat and dairy products from Aotearoa are already some of the least emissions intensive in the world but, shifts in preferences for low-emissions products could negatively impact exports if preferences move away from these products entirely.

74 A Gallup poll showed almost 1 in 4 Americans reduced their meat consumption in 2019, with environmental concerns being the second ranked reason after health. These trends are likely to be stronger in Europe and North America than in emerging markets in Asia and Africa.

23.3.3 Other environmental challenges

75 Other environmental challenges are related to waste and agriculture in Aotearoa. These include freshwater quality, soil health, biodiversity loss and soil erosion. The growing pressure of these challenges combined with efforts to address them may have important consequences for efforts to reduce methane emissions.

76 Freshwater quality has been a particular focus of attention over the last few decades as large areas of sheep/beef were converted to dairy. Although rates of nitrogen and pathogen loss into waterways varies with land management, rates of nitrogen loss into waterways are generally higher from dairy operations than from sheep and beef farming and forestry.

77 In some parts of the country where there have been large-scale land conversions, such as Canterbury, Southland and the central North Island, indicators of water quality and ecological health have significantly declined.

78 Declining freshwater quality is a threat to many native species, this is also exacerbated by the clearance and conversion of native habitats – such as forests, wetlands and natural grasslands – often into pasture.

79 High levels of nutrient and pathogen loss from pastoral farms can also have human health impacts. Samples of groundwater used for drinking have found that areas with high livestock numbers are more likely to have nitrate-nitrogen levels in the water that can cause health concerns.

80 Disease-causing bacteria carried by farm animals can include Escherichia coli, Campylobacter, Leptospira, and Salmonella and there is a high risk of these bacteria spreading to farm workers and others in rural communities. The most frequently notified disease in Aotearoa is campylobacteriosis, and evidence shows this disease is diagnosed more often in areas with more intensive animal farming.

81 Waste management is also associated with other environmental challenges. While modern, engineered landfills mitigate some of the environmental impacts associated with their construction and management, they have wider ecological effects which may lead to landscape changes, loss of habitats and displacement of fauna. Waste leaching, particularly from older landfills, can also contaminate nearby soils and aquifers.

82 Changes in the way land and waste are managed could also have impacts on biogenic methane emissions. For example, limitations on land-use change to dairy to protect water quality are likely to limit additional methane emissions, while initiatives that promote diversion of waste from landfills or the retirement of erosion prone land from pastural farming may result in reduced methane emissions.

23.3.4 Overall

83 Overall we assess that there are good reasons for Aotearoa to expect to reduce biogenic methane emissions by at least the global average as part of contributing to the global 1.5°C effort. The country's relatively efficient food production compared to other global exporters of similar products and a growing global population suggest that Aotearoa might be expected to take a smaller than average reduction in biogenic methane.

84 However other factors, such as increasing awareness of the environmental impact of animal-based products, and local environmental challenges, would suggest that Aotearoa could make a greater than average reduction in biogenic methane.

23.4 Findings

85 In summary, we make the following findings in relation to each of the considerations requested by the Minister.

Consider the available scientific evidence on the global biogenic methane emissions reductions likely to be required to limit global average temperature increase to 1.5°C above pre-industrial levels

86 The global reductions in biogenic methane required to limit the global average temperature increase to 1.5°C above pre-industrial levels would depend on the level of carbon dioxide and nitrous oxide emissions over the next century.

87 Therefore, it is not currently possible to know for certain what reductions in biogenic methane will be required. However, it is possible to identify the ranges of reductions of the different gases that mean it is likely warming would be limited to 1.5 °C above pre-industrial levels.

88 Overall, the IPCC pathways show that at least a 37% reduction in agricultural methane is required to limit the global average temperature increase to 1.5°C above pre-industrial levels by 2100.

89 Simply maintaining the current level of warming from methane is not enough, as it would require the world to reach net zero carbon dioxide by 2030 to keep warming below 1.5°C. We consider this to be infeasible and consequentally that the global warming contribution from methane must be reduced if the global 1.5°C effort is to be successful.

Consider New Zealand's potential contribution to global efforts to limit biogenic methane emissions, reflecting its national circumstances

90 Our scenario analysis indicates that it is possible to reduce total biogenic methane emissions in Aotearoa by between 10-24% below 2017 levels by 2030 and 24-57% below 2017 levels by 2050 through reducing biogenic methane emissions from both agriculture and waste.

91 The lower ends of these reductions (10% by 2030 and 24% by 2050) can be achieved using currently available practices and technologies. The development of new technologies such as a methane inhibitor would provide greater flexibility and unlock the upper range of reductions.

92 Reaching the higher range of biogenic methane reductions (24% by 2030 and 57% by 2050) without new technology would likely require significantly reduced agricultural production from livestock and land-use change. For more details on our scenarios and projected emissions reduction paths see *Chapter 6: Long term scenarios to 2050.*

93 On balance, we consider that national circumstances do not provide sufficient reason for Aotearoa to reduce its biogenic methane emissions by less than other developed countries in contributing to the global 1.5°C effort.

Consider New Zealand's potential contribution to global efforts to limit biogenic methane emissions, reflecting its national circumstances and local and global economic, social, and demographic trends

94 The country's relatively efficient food production and a growing global population suggests Aotearoa might be expected to take a smaller than average reduction in biogenic methane. However other factors, such as increasing awareness of the environmental impact of animal based products and local environmental challenges, would suggest that Aotearoa could make a greater than average reduction in biogenic methane.

95 Overall we assess that there are good reasons for Aotearoa to expect to reduce biogenic methane emissions by at least the global average as part of contributing to the global 1.5°C effort.

Where does this get us?

96 Our assessment of the IPCC scenarios has identified the range of global reductions in biogenic methane that are compatible with the global 1.5°C effort. These are represented by the interquartile range of modelled pathways. The pathways in the top half of this range are the ones with greater reductions in methane and less reliance on unproven carbon removal methods. They have also been estimated to be the most likely to deliver the best overall social, economic and environmental outcomes.

97 Fundamentally, it is our judgement that there is no reason to anticipate that Aotearoa would be expected to contribute less than the middle of the IPCC range for reductions of biogenic methane.

Recommendation 33

Reductions in biogenic methane that might be required of Aotearoa in the future as part of a global 1.5°C effort

We advise that the reductions in emissions of biogenic methane that Aotearoa may eventually need to make as part of a global effort to limit the global average temperature increase to 1.5°C above pre-industrial levels could be between 49% and 60% below 2017 levels by 2100.

98 Our analysis suggests that the successful development of a methane vaccine or inhibitor suitable for pastoral systems would help reduce the country's biogenic methane emissions by more than 50%.

99 There is a role for agricultural products from Aotearoa in a low-emissions future, both for the nutrition it can provide and the valuable natural products such as wool. However, to create and maintain the market for those products, Aotearoa needs to be able to demonstrate their genuine climate, environmental, social and cultural credentials.

Part 4

Supporting information

Glossary of Terms

Te Reo Māori	English translation
hapū	Kinship group, comprised of whānau who share a common ancestry.
haukāinga	Home people, people from the pā.
Iwi	Extended kinship group, often referring to a large group of people descended from a common ancestor and associated with a distinct territory. Also means bone.
He kai kei aku ringa (phrase)	Providing food from my own hands. Crown-Māori Economic Development Strategy – has become a metaphor for the resilience and economic self-determination of Māori.
Ināia tonu nei	The time is now.
kaitiaki (verb)	Guardian/steward. Tangata whenua, whānau, hapū, Iwi exercising responsibilities of kaitiakitanga inherited through whakapapa Māori.
kaitiakitanga (noun)	Guardianship/stewardship, tangata whenua, whānau, hapū, Iwi holding this responsibility.
kotahitanga	Unity, inclusive and collective action.
manaakitanga	Care, respect, hospitality. Enhancing the mana of others.
mana motuhake	Prestige, power, authority. Power, influence. The spiritual power and authority to enhance and restore tapu.
mātauranga Māori	Māori knowledge systems.
mokopuna	Grandchildren.
papakāinga	Home, village, residence, in contemporary terms refers to housing, or housing development constructed on the concept of the kāinga/pā.
rangatira	Chief, leader, representative/s with authority.
rangatiratanga	Chieftainship, right to exercise authority.

Te Reo Māori	English translation
taiao	Natural world.
takiwā	Tribal area, region or territory.
tangata whenua	People of the land.
taonga	Items of value; includes resources/access to resources. In te ao Māori taonga incorporates a range of social, economic and cultural aspects such as te reo (Māori language), wāhi tapu (sacred sites), waterways, fishing grounds, mountains and place names. Children and future generations may also be regarded as taonga.
taonga tuku iho	Heirloom/cultural property handed down.
te ao Māori	Māori world view.
tiaki (verb)	Guardian/steward. To safeguard/protect.
tiakitanga (noun)	Guardianship, caring of, protection.
tikanga	Customary system of values.
tino rangatiratanga	Sovereignty.
tūrangawaewae	Place of standing, place of belonging.
Wai (noun)	Water.
Waiora	Wellbeing.
whānaungatanga	Kinship, sense of family connection – a relationship through shared experiences and working together which provides people with a sense of belonging. It develops as a result of kinship rights and obligations, which also serve to strengthen each member of the kin group.
whenua	Land. Also means placenta.

Technical Glossary

2050 targets	The targets set out in the Climate Change Response Act for Aotearoa to: • reduce emissions of greenhouse gases, other than biogenic methane, to net zero by 2050 and beyond. This relates to emissions of carbon dioxide, nitrous oxide, non-biogenic methane and F-gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride). • reduce biogenic methane emissions by at least 10% by 2030 and 24-47% by 2050 and beyond, compared to 2017 levels.
Adaptation	Actions that can help people or natural systems adjust to the actual or expected impacts of climate change. Actions can be incremental and temporary in their effect or transformational by changing systems and their functions, depending on the scale and pace of change and what is at stake.
Biogenic methane	Methane emissions resulting from biological processes in the agriculture and waste sectors.
Biomass	Material originating from living organisms. Some forms of biomass in the environment store significant amounts of carbon. Solid biomass such as wood chips, wood pellets and briquettes can be used as fuel in residential, commercial and industrial situations.
Climate Change Response Act 2002 (the Act)	The Act that establishes the Climate Change Commission and contains the framework for the 2050 emissions reduction targets and emissions budgets. It also provides a legal framework to enable Aotearoa to meet its international obligations under the United Nations framework Convention on Climate Change and the Kyoto Protocol, and provides for the implementation of the New Zealand Emissions Trading Scheme (NZ ETS) and the synthetic greenhouse gas levy.
Climate resilience	Climate resilience is the ability to anticipate, prepare for, and respond to the impacts of changing climate, including those that we know about and can anticipate and those that occur as extreme events. This includes planning now for sea level rise and more frequent flooding. It is also about being ready to respond to extreme events like forest fires or extreme floods, and to trends in precipitation and temperature that emerge over time like droughts.

CO_2e	Carbon dioxide equivalent. This is a way to describe different greenhouse gases on a common scale that relates the warming effect of emissions of a gas to that of carbon dioxide. It is calculated by multiplying the quantity of a greenhouse gas by the relevant global warming potential.
Deforestation	The conversion of forest land to another use such as grazing. In greenhouse gas emissions accounting and policy relevant to Aotearoa, deforestation is defined as clearing forest and not replanting within four years. It does not include harvesting where a forest replanted.
Dry year	In Aotearoa, hydro lakes only hold enough water for a few weeks of winter energy demand if inflows (rain and snow melt) are very low. When inflows are low for long periods of time, hydro generation is reduced and the system relies on other forms of generation such as natural gas and coal. These periods of time are often colloquially referred to as 'dry years'.
Embodied emissions	The sum of emissions involved in making a product, sometimes termed the "carbon footprint".
Emissions	Greenhouse gases released into the atmosphere. The Climate Change Response Act 2002 covers the following greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride.
Emissions budget	The cumulative amount of greenhouse gases that can be emitted over a certain period. In the Climate Change Response Act 2002, emissions budgets are the total amount of all greenhouse gases (expressed as a net amount of carbon dioxide equivalent) that can be released over a five-year period (or four years in the case of 2022-2025).
Emissions leakage	Emissions leakage would occur if efforts to reduce emissions in one location caused an increase in emissions somewhere else so that global emissions overall do not reduce. Emissions leakage risk is created by the uneven implementation of climate policies around the world.
Emissions reduction plan	A plan setting out the policies and strategies for meeting an emissions budget, as required by the Climate Change Response Act 2002.
Exotic production forests	Forests consisting of non-native species, such as pine, that have been planted for harvesting.
F-gases	Fluorinated gases, such as hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

Free allocation	The distribution of emissions units without cost to specific businesses by the government.
Global Warming Potential (GWP)	A factor relating the warming effect of a tonne of emissions of a particular greenhouse gas to those of a tonne of carbon dioxide emissions.
Greenhouse gases	Atmospheric gases that trap heat and contribute to climate change. The gases covered by the Climate Change Response Act 2002 are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).
Gross emissions	Gross emissions include total greenhouse gas emissions from agriculture, energy, industrial processes and product use (IPPU) and waste. Greenhouse gas emissions and removals from land use, land-use change and forestry (LULUCF) are excluded.
Kyoto Protocol	An international treaty under the UNFCCC that deals with emissions limitation or reduction commitments for ratifying developed (Annex 1) countries.
Long-lived gases	Greenhouse gases that have a long lifetime in the atmosphere, i.e. they persist in the atmosphere without breaking down for multi-decadal, centennial or millennial timeframes. For ease of presentation, this report refers to all greenhouse gases other than biogenic methane collectively as long-lived gases, although this includes small amount of other short-lived gas emissions (non-biogenic methane and certain fluorinated gases).
Methane inhibitors and vaccines	Chemical compounds that reduce the production of methane in animals' rumen (stomachs). They typically do this by targeting enzymes that play a key role in the generation of methane.
Mitigation	Human actions to reduce emissions by sources or enhance removals by sinks of greenhouse gases. Examples of reducing emissions by sources include walking instead of driving or replacing a coal boiler with a renewable electric powered one. Examples of enhancing removals by sinks include growing new trees to absorb carbon, or industrial carbon capture and storage activities.
Mt	Megatonnes (million tonnes)
Nationally Determined Contribution (NDC)	Each country that is party to the Paris Agreement must define its contribution to achieving the long-term temperature goal set out in the Paris Agreement. The first NDC adopted by Aotearoa is a target to reduce greenhouse gas emissions by 30% below 2005 levels by 2030.

Net emissions	Net emissions differ from gross emissions in that they also include emissions from the land use, land-use change and forestry (LULUCF) sector as well as removals of carbon dioxide from the atmosphere, for example due to the growth of trees.
NZ ETS	New Zealand Emissions Trading Scheme.
Organic waste	Waste containing organic matter that decays to create methane emissions.
Paris Agreement	An international treaty under the UNFCCC to address climate change after 2020.
Post-1989 forests	New forest established after 31 December 1989 on land that was not forest at that date.
Pre-1990 forests	Forest or shrub land established before 1 January 1990.
UNFCCC	United Nations Framework Convention on Climate Change. This is the major foundation global treaty focused on climate change that was signed in 1992 at the Earth Summit in Rio de Janeiro.

He Mihi: Acknowledgements

A big thank you to everyone who took the time to make a submission during our consultation. Your input and participation meant we were able to consider and incorporate the views of New Zealanders across Aotearoa into our first advice to government.

To everyone who took the time to answer the 100 Coastie Voices survey, who were interviewed as case studies for our mahi, and to all the people we spoke to as we travelled around Aotearoa, or connected with online – thank you for your insight, feedback and involvement in preparing this important piece of work.

We wish to express our gratitude to all those who participated in our Technical Reference Groups, and to government officials who shared their knowledge and expertise. We would also like to thank those who provided information, data, and knowledge during meetings, workshops, and through other contributions. This proved essential in shaping our advice from the early stages – this insight and expertise has been invaluable.

We would also like to thank all the staff at the Commission, past and present, who put in a tremendous amount of effort to deliver this advice. The list below reflects all staff employed by the Commission as we deliver this first advice to Government. We acknowledge their excellent contributions, and their dedication and commitment to producing our advice. Thank you also to the consultants who provided specialist expertise and research.

To get to this point saw a phenomenal team effort, and we couldn’t have done it without any one of you. With your help, we are one step closer to our goal of transitioning to a thriving, climate-resilient, low emissions future for Aotearoa.

Thank you to all the staff at the Commission:

Alastair Johnstone
Alexandra Aimer Seton
Anita King
Anne Jonathan
Antonia Burbidge
Ariel Fitterman
Ashleigh Grenfell
Astrid Nunns
Benjamin Abraham
Bhanu Soma
Briana Yee
Carly Soo
Charli Keeling
Chris Holland
Eva Murray
Fran Lovell
Francisco Bagkus Hernandez
Grant Blackwell
Harriet Palmer
Havana Wellbelove
Jo Hendy
Karen Lavin
Kennie Tsui
Kerryn Davey
Laura Stevens
Matthew Smith
Melissa Idiens
Mere Takoko
Olivia Prior
Paul Young
Phil Wiles
Rachel Cooper
Rebecca Alberts
Sally Garden
Sam Prime
Sandra Judith Velarde Pajares
Sean Buchanan
Sharon Kerry
Stephen Walter
Tal Yochay
Tania Loughlin
Tia Greenaway

Graduate Analysts:
Corinna Goepfert
Edward Lewis
Frances Barnett
Isabella Seton
Kyla van Heerden
Sarah Bassett
Selina Reichert

From the Commissioners:

Chair Dr Rod Carr, Deputy Chair Ms Lisa Tumahai, Dr Harry Clark, Dr Judy Lawrence, Ms Catherine Leining, Professor James Renwick, and Professor Nicola Shadbolt.

Errata

The Climate Change Commission (the Commission) has made every effort to ensure the material and analysis underpinning and contained in our advice is accurate and correct. However, the Commission makes no warranty, representation or guarantee that the material is error-free.

Potential errors that come to our attention will be assessed by the Commission, and any necessary corrections to our advice will be notified via an erratum published on our website.

If an error is identified that the Commission considers materially affects any part of our advice, the Commission will notify the Minister of Climate Change in writing as soon as possible.

He Pou a Rangi –
Climate Change Commission

Level 21, 1 Willis Street
Wellington 6011
PO Box 24448
Wellington 6142

www.climatecommission.govt.nz

ISBN 978-0-473-57799-5