He Pou a Rangi
Climate Change Commission

Review of the **2050 emissions target** including whether emissions from international shipping and aviation should be included

November 2024

Haere mai – Welcome

This report is required under sections 5R, 5S, and 5T of the Climate Change Response Act 2002.

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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. The Commission operates under its Interests Policy, which is derived from the Crown Entities Act 2004. 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.

An update has been made to this document to correct a rounding error in the version that was tabled in Parliament: In Chapter 6, Table 6.3 (p. 113) has been updated to correct a rounding error for two figures. This does not affect the overall results.

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Te karere a te Tumu

Me whai rautaki pae tawhiti e Aotearoa New Zealand ki tāna whakawhitinga tukuwaro whakamimititanga, e ārahina ana e tētahi whāinga maunga teitei otiia, me whakatutuki atu.

Ko ngā whāinga he ārahi haere i ngā whakataunga o ngā kāwanatanga o te wā me pēhea rā e whakahaere i ngā parahanga haurehu, ā, he tohu i te ahu whakamuatanga. He tautoko tēnei i ngā pakihi ngā hapori me ētahi atu ki te whakamahere me te whakangao mō te anamata. Ko te whai māramatanga ki te taunga (te whāinga) e tika tonu ana me te whakatikaina tōna ahunga ina tika ana, nā konei he whakaū e pai ana te whakangao me te whakamahere.

Kia whai whakataunga mēnā rānei me panoni te whāinga, me whai taunakitanga tuawhiti, tātaringa tōrongapū kore, he whakamāramatanga i ngā whakaaro kē me te mārama hoki ki ngā hua me ngā whakaaweawenga – koia tēnei tā ēnei kupu tohutohu e whakarato ai. Ko ā mātou tātaringa motuhake, kupu tohutohu hoki kua whai mōhiotanga mai i ngā taunakitanga me ngā whakamōhiotanga mai ka kohikohi i te Kāwanatanga, ngā rāngai me ngā hapori puta noa i te motu.

Ka whakaaturia ēnei tātaringa, kupu tohutohu hoki, hei whenua, e taea ana e tātou te whakatere ake i ngā tukuwaro whakamimititanga i ngā haurehu kati mahana me te whakatipu tonutia te ōhanga, te whakamimiti i ngā utu ngoi, whakawhanake i te toitūtanga o te puna ngoi me te whakapakari tonu i te hauora o te taiao. Kia whai hua nui atu ai i ngā hua-tahitanga, me atamai e tātou he aha tā tātou e whakangao ai, ā, āhea anō hoki. Hei tauira, ko ngā tino wā hei whakangao i ngā mahi tūāhanga, koia anō hoki tēnā ko te wā me whakakapi, kua whakakinohia, kua piki rānei ngā utu whakapaipai.

Me whāinga e taea ai te whakatutuki, ā, me whaiwhakaaro hoki ki ngā utu me ngā pānga ki te ōhanga me ngā hapori. Ngā wāhi e rongo ai ngā pānga kei te āhua o te kaupapa here a te Kāwanatanga, ka mutu, ko ngā whakataunga nā te takiktahi, ngā whare, ngā pakihi me ngā hapori e whakatutukitia ai te whāinga.

Kua tuari te Kāwanatanga i tāna oati kia whakatutukihia te whāinga o te wā nei me ngā hohenga pēnei me te whakarea kia rua i tā Aoteroa New Zealand pūngao whakahou hei ara ōhanga whakamimiti tukuwaro, ā, kia whai hua pai ake ai i tā Aotearoa Kaupapa Tauhokohoko.

Heoi anō, e whakaaturia ana e ngā taunakitanga kāhore te ao e tika ana āna mahi kia pai ai te tapenga o te whakamahanatanga toharite ā- ao ki te 1.5°C. Tā te āhuarangi hurihuri he kōkiri i ngā huarere kino o te wā nei, ko te pikinga waitai me te whakawaikawatanga haeretanga o te moana. E pā wawe mai ana ēnei āhuatanga, ā, he kikino hoki ngā pānga ki tā Aotearoa New Zealand whāinga whakamimititanga tukuwaro i whakarite ai nō te tau 2019. I ia tana tukuwaro e karohia ana, kua tangohia ake rānei i te rangi, he tana whai take.

Nō te tau 2019 ko Aotearoa he whenua e ārahina ana te whakatakoto whāinga pae tawhiti whakamimiti tukuwaro. Heoi anō, he whenua he rite ki tō tātou whenua, he nui atu a rātou mahi, ā, e kawatau nui atu ana anō hoki. He whakarato te tātaringa he angitū mō Aotearoa New Zealand te urutauhia te whāinga me te noho rite ki tā te ao whānui mahi e mahi nei.

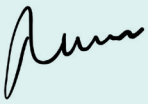
Ko ngā porihanga puta i te ao e whakawhiti ana hei whenua kia waihanga, kia hoko anō hoki i ngā ō tukuwaro e tautoko ana i ngā whakapau kahanga o te ao whānui kia turaki i ngā tukuwaro i ngā kawenga ō ā-poti, ā-rererangi hoki mā te whakatakoto whāinga ā-whenua. He whenua tauhokohoko a Aotearoa. Ko a mātou kiritaki kei te ao whānui e nui haere a rātou kawatau kia whai whāinga tukuwaro whakamimiti ngā kaiwhakarato, nā reira he tūraru kei roto mō te taha ōhanga, mō te Aotearoa whānui hoki mēnā rā whakaaro ai te ao whānui kāore e rahi ana ngā mahi whakamimiti tukuwaro tā Aotearoa nei. Ko te whakamimiti tukuwaro i ngā haurehu katoa rawa atu nei, mā ngā hangarau o te wā nei e tautoko ai i a tātou kia mau tonu ki ngā mākete o te ao whānui.

He panonitanga kei te haere mai, ahakoa he aha otiia, te pātai nui kē, me pēhea tātou e hautū haere ai i tēnei panonitanga.

He whiringa ō te Kāwanatanga, ngā pakihi me ngā hapori ka pēhea rā ngā hohenga e whai ai. Tā ēnei whiringa e whai pānga ai mā wai kē e whai hua, mā wai ngā nama, te rongonuitanga o te whenua, ā, ka pēhea nei te nui o te hiahia ki a tātou nā ō hoko whakawaho, ngā mahi tūruhi ki konei ki ngā kiritaki o te ao whānui.

Ko te whakatakaroa i ngā mahi he whakamimiti nei i ngā whiringa e wātea ana hei te anamata. Waihoki, hei utu anō ko ngā tūraru nui ake me ngā utu, ā, he angitutanga ka mahue mō tātou me a tātou tamariki mokopuna.

E tūtohu ana rā mātou kia whai whāinga kia tautokona te ao kia karo ai i ngā whai pānga kikino o te āhuarangi hurihuri otiia, kia hiranga tahitanga anō hoki, kia whai whāinga e taea ana ā-utu, e taea ana hoki te whakatutuki atu e whai nei i ngā hua mō Aotearoa.



Dr Rod Carr, Te Tumu

Chair's message

Aotearoa New Zealand needs a long-term strategic approach to its low emissions transition, guided by an ambitious – but achievable – target. The target guides successive governments' decisions on how to deal with climate polluting gases, and signals the direction of travel.

This signal helps businesses, communities and others to plan and invest for the future. Sense-checking that our destination (the target) is still appropriate, and course-correcting when necessary, helps ensure that investment and planning is sound.

To make its decision on whether to amend the target, the Government needs robust evidence, apolitical analysis, an understanding of different perspectives, and an understanding of the likely benefits and impacts – that's what this advice provides. Our independent analysis and advice has been informed by evidence and insights gathered from the Government, sectors and communities across the motu.

This analysis and advice shows that, as a country, we can move further and faster to reduce the country's gross emissions of greenhouse gases and still grow the economy, reduce energy costs, upgrade the security of our energy supply, and improve public health and our local environment. To get the most out of any co-benefits, we need to be smart about what we invest in and when. For example, the most cost-effective times to invest in infrastructure include when it is due to be replaced, it has been damaged, or its maintenance costs increase.

The target must also be realistic and take account of costs and impacts on Aotearoa New Zealand's economy and communities. How and where impacts are felt depends on government policy, and on decisions made by individuals, households, businesses and communities, to meet the target.

The Government has shared its commitment to achieving the current target with actions like doubling Aotearoa New Zealand's renewable energy as part of the pathway to a low emissions economy, and making the NZ Emissions Trading Scheme more effective.

However, the evidence shows that the world is not on track to limit average warming to 1.5°C. Climate change is driving more frequent and severe weather events, sea-level rise and ocean acidification. These are happening sooner, and with more intensity, than was expected when Aotearoa New Zealand's emissions reduction target was set in 2019. Every tonne of emissions averted or removed from the atmosphere matters.

In 2019 Aotearoa New Zealand was a frontrunner in setting a long-term emissions reduction target. However, many comparable countries are now doing more, and expecting more. This review provides an opportunity for Aotearoa New Zealand to adjust our goal and keep pace with global efforts.

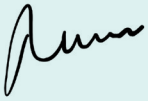
Societies around the world are transitioning to producing, and consuming, low emissions goods, and some countries are now supporting international efforts to tackle emissions from international shipping and aviation by setting domestic targets. Aotearoa New Zealand is a trading nation. Our international customers increasingly require suppliers to have emissions targets, so there are economic and reputational risks if overseas markets think Aotearoa New Zealand is not doing enough. Reducing emissions of all greenhouse gases as much as possible, as soon as possible, using already available technologies will help us retain access to international markets.

Change is coming whatever we do – the question is how much we choose to steer this change.

The Government, business and communities all have choices to make about what climate action to take. These choices affect who benefits, who bears the costs, the country's reputation, and how desirable our exports and tourism are to overseas consumers.

Delaying action will reduce the options available in the future. It will also result in higher risks and costs, and opportunities lost, for us and our children.

We are recommending a target that contributes to global efforts to tackle climate change – but equally importantly, a target that is affordable, achievable and is in Aotearoa New Zealand's best interest.



Dr Rod Carr, Chair

Te kupu a te Pou

Ko te whāinga whakamimiti tukuwaro i whakarite mai nā te Pāremata i te tau 2019 i te tautokotanga mai a ngā pāti ki rō Pāremata, ā, kua whakatokahia tāna oati. Koia hei whetū kōrako e ārahi haere ana a Aotearoa i āna mahi āhuarangi hurihuri. Kua rite te whāinga ki te tohu mai i roto i ngā tau, e rima ka taha, e whakaāheitia ana te Kāwanatanga, ngā pakihi me ngā hapori ki te whakamahere, te whakangao me te mahi.

Heoi anō, me tāwariwari hoki – mea ka panoni ngā āhuatanga, me panoni anō te motu ki hea e haere ana. Koia i whakauruhia atu ai he 'hihira mārama' ki te pūnaha. E here ana te Kōmihana kia tātaringia te whāinga i ia rima tau me te whakarato ki te kāwanatanga te rā o ngā kupu tohutohu motuhake mātanga nei mea rānei ka panonitia kia pai ai te whenua. Koia tēnei tā mātou tātaringa.

Kia tika ai te taurite i waenga i te pūmautanga me te tāwariwaritanga, ko tā ngā taipitopito o te ture he whakatakoto i ngā āhuatanga me whai whakaaro e mātou inā tātaringia ai te whāinga. E taea kautia ana e mātou te whai kupu hei panoni i te whāinga, ki te kore he āhuatanga e whakatutuki mai ai.

Ka kore te Kōmihana e ārahina ana e ngā hua o te ao arumoni, i te ao tōrangapū rānei. Ko tō mātou nā motuhaketanga e whakaū ai ko te kāwanatanga o te rā ka whakawhiwhia ki ngā whai kupu, whai taunakitanga tōkeke e pai ai āna mahi whakatau. Waihoki, he whakatairanga anō i te māramatanga me te haepapatanga. Kua whai ēnei whai kupu i te kohikohinga i ngā taunakitanga, te mahi tātari me te whai wāhitanga atu i roto i ngā tau e whā ka taha, ko tā mātou 'karanga taunakitanga' i te tau 2023, me te uiui i te tūmatanui i te tīmatanga o te tau nei.

Ko tā mātou aroturuki nō tata ake nei e whakaaturia ana he koke whakamuatanga – ko ngā tukuwaro o Aotearoa kua heke haere nei nō te tau 2019. Heoi anō, ko ngā taunakitanga o te wā tata mō te rahi o ngā āhuarangi hurihuri he whitawhita, ā, me nui atu, me tere atu, me whai whāinga kaha atu hoki. I ā mātou nā mahi uiui i rongo ai mātou kia awhero nui atu, ngā māharahara o te rāngai me te hapori, ā, ka kite hoki i ngā taunakitanga he aha rā e taea ana ki ngā rāngai kē atu.

He haurehu kē atu, he mahana anō hoki kei roto i te rerenga o te wā, tēnā ka rerekē anō hoki tā mātou whai whakaarotanga ki ērā. He whakataunga wāriu ka mahia i roto i te kaute rerekē i ngā haurehu rerekē, te wāhi rānei ka tīmata ai te mahi kaute. Waihoki, he whakataunga wāriu hoki kia mahia mō te taha taurite tika i waenga i te tangohanga atu i te parahanga haukino kei te hau kē e rere ana, ā, kia whakakorea nō mua mai i te putanga atu ki te rangi.

Ko ā mātou kupu tohutohu e whai nei kia kitea te pikitia nui mā te whai kupu he whakamimititanga nui kē atu e taea ana e ngā pakihi me te rāngai, waihoki kia noho rite anō ki ngā mahi e mahia ana e tā ngā tauhokohoko nui ki a Aotearoa me ētahi anō whenua i waitohu mai i te Whakaaetanga o Pārihi. E whai whakaaro ana ā mātou whāinga ki ngā utu, ngā whai pānga, ngā hua tahi me ngā angitutanga – otiia, ka whakawhirinaki ēnei ki ngā whakataunga a te Kāwanatanga mō ngā mahi me ngā kaupapa here e whāia ai kia whakatutukihia te whāinga.

Kua tino mārama te Kāwanatanga i āna awhero kia whakawhiti a Aotearoa New Zealand hei anamata tukuwaro whakamimiti me ngā hīkoitanga e whakamahia ana pēnei me te Kaupapa Tauhokohoko Tukuwaro NZ, te whakatairanga i ngā hiko whakahounga me ngā whakangao ki te whakamimiti i te ao ahuwhenua – koia i waihanga mai ai kia whai hua ōhanga nui nei.

Ko te whāinga awhero nui atu e whakaaweawetia ngā whakataunga e whakatinana i ngā mahi ki te āhuarangi hurihuri hei ngā tekau tau te haere ake nei. He whakangao tūāhanga nui kei te motu nei hei mahi hei te wāhanga te haere ake. Māna pea e whakatere ake tō tātou whakawhititanga. He angitutanga tēnei ki te whakangao hei whakamimiti i ngā tukuwaro, whakapiki manawanui, he māmā ake te utu te whakahaere me te whakahou tonutia, he whakaheke ngā utu i ngā hau kino o te wā me ngā utu whai pānga ki te pūnaha hauora.

Ko te whakawhiti kia noho hei whenua tukuwaro iti, hei whenua manawanui hoki he hua o roto, he kino o roto i te pae tata otiia – he hua, he angitutanga hoki kei te pae tawhiti. Ko ētahi whiringa me whai whakangao i te tīmatanga i te ao ikiiki, te whakapikitanga o te hiko me te tukanga o te ahumahi. He nui o ēnei whakangao ka utua ko rātou ake i roto i te rerenga o te wā mā roto mai i ngā hekenga utu.

Ko te whakatakoto whāinga he mahi whakawā. Kāore kau ōna tikanga e taea ai te whakatau he aha rā te 'whāinga tika.' He āhuatanga kē hei whai whakaaro, pēnei me ngā hangarau, ngā rawa hoki e wātea ana hei taua wā rā. He āhuatanga atu anō me whai whakaaro ake. Ko ngā whāinga katoa he kaha kei roto, he ngoikoretanga hoki kei roto, ā, he whakaaro kē o te tangata he aha rā e tika ana.

Me whai whakaaro ai e te Kāwanatanga i ngā taunakitanga ka whakatau ai. Ko tāna whakatau e kōkiri whakamua i te rahi me te tere o tā Aotearoa New Zealand whakawhitinga hei ōhanga tukuwaro iti me te whai tautoko atu ki ngā mahi o te ao whānui kia karo ai i ngā whai pānga kikino kē atu o te mahana haeretanga o te ao.

Jo Hendy, Te Pou

Chief Executive's message

The emissions reduction target was set by Parliament in 2019 with cross-party support, and the current Government has reinforced its commitment to it. It is Aotearoa New Zealand's guiding star for climate action. The current target has provided a consistent signal for five years, enabling the Government, business and communities to plan, invest and act.

However, flexibility is also required – if circumstances change, then the country may need to adjust where it is heading. This is why a regular 'sense check' was built into the system. The Commission is required to review the target every five years, and provide the government of the day with independent, expert advice on whether any changes are required to keep the country on track. This is our first such review.

To ensure a balance between stability and flexibility, the legislation details the factors we have to consider when reviewing the target. We can only recommend a change to the target if certain conditions are met.

The Commission is not driven by commercial interests, by advocacy, or by politics. Our independence ensures that the government of the day gets the impartial, evidence-based advice it needs to inform its decisions. It also promotes public transparency and accountability. This advice has been informed by our evidence-gathering, analysis and engagement over the last four years, our specific 'call for evidence' in 2023, and a public consultation earlier this year.

Our recent monitoring report shows that there has been progress – gross emissions in Aotearoa New Zealand have declined each year since 2019. However, the latest evidence about the scale of climate change and urgency of reducing emissions tells us that there is a need to go further, faster with a more ambitious target. Through our consultation we heard calls for greater ambition, sector and community concerns, and saw evidence for what is practical for different sectors. We adjusted our thinking where new evidence was presented, or the facts have changed.

Different gases cause different amounts of warming over different timeframes, so we considered them separately. There are value judgements that get applied through different ways of counting the different gases, or where you start counting from. There are also value judgements to be made on the appropriate balance between removing carbon pollution already in the air, and stopping it being created in the first place.

Our advice aims to take into account the whole picture, by recommending more ambitious emissions reductions that are realistic for firms and sectors, and consistent with actions being taken by New Zealand's major trading partners and other signatories to the Paris Agreement. Our recommended target takes account of costs, impacts, co-benefits, and opportunities – though ultimately these will all depend on the Government's choices about which actions and policies to use to achieve the target.

The Government has been clear about its ambition for transitioning Aotearoa New Zealand to a low emissions future and the steps it is taking using tools like the NZ Emissions Trading Scheme, promotion of renewable electricity, and investment in agricultural emissions reduction – which are also designed to have significant economic benefits.

A more ambitious target will influence investment decisions that determine action on climate change for decades to come. The country has some big investments in infrastructure to make in the near term. This could accelerate our climate transition. It is an opportunity to invest in infrastructure that will reduce emissions and increase resilience, be lower cost to run and maintain, reduce recovery costs after extreme weather, and reduce flow-on costs to the healthcare system.

Transitioning to low emissions and climate-resilient economy has positive and negative impacts in the near term – but also benefits and opportunities in the long term. Some options for action require up-front investment in transport, electricity generation and industrial processes. Many of these investments would pay for themselves over time through reduced costs.

Target setting is a matter of judgement. There is no formula that can determine what the 'right' target is. There are different factors to consider, such as what is technologically and economically possible. There are also different impacts to consider and weigh up. All targets have strengths and weaknesses, and people have different views on what is fair and appropriate.

The Government needs to weigh the evidence and make a judgement. Its decision will drive the scale and pace of Aotearoa New Zealand's transition to low emissions economy and contribution to global efforts to prevent worst impacts of warming.

Jo Hendy, Chief Executive

Mō He Pou a Rangi
Climate Change Commission

He hinonga Karauna motuhake te Komihana nei a He Pou a Rangi i whakatūria e Te Ture Urupare Āhuarangi 2002 (te Ture) hei:

- whakarite i te kupu-akiaki motuhake, whai taunakitanga hoki mā ngā kāwanatanga hou, mō te whakamauru i te huringa āhuarangi (tae ana ki te whakaheke i te tuku haurehu kati mahana) me te urutau ki ngā whiunga o te āhuarangi
- aromatawai, hei arotake hoki i te anga whakamua o te whakaheke tukuwaro me te whakawhiti ki te rehu tika.

Kua ū ngā kāwanatanga hou ki te whakaheke i ngā haurehu whakapoke-āhuarangi o Aotearoa me te urutau ki ngā pānga o te huringa āhuarangi. Tukua ai e te Kōmihana ngā pārongo tapatahi e pā ana ki ngā kōwhiringa me urupare rā e te kāwanatanga o te rā. Mā tō mātou motuhaketanga e mōhio ai a Aotearoa – me te ao – ki te motuhenga o ngā mahi huringa āhuarangi o Aotearoa.

Ko te hōkaitanga me ngā angawā kua whakaritea mō ngā aroturukitanga me ngā kupu āwhina a te Komihana, kei roto tonu i te Ture. Kei te Minita Āhuarangi te tikanga rā kia tono motuhake ki te Kōmihana mō tētahi kupu akiaki motuhake.

Kei te Ture te mana ki te Komihana kia tō māi i te taunakitanga tika o te wā, te tātaritanga me ngā whiunga a te āhuarangi, ka mutu, ko te pānga ki a Aotearoa ā-tairoa nei, āpiti tonu ki ngā tūhonohono me ngā uiuinga tūmatanui.

Kei te Ture hoki te tohutohu i a mātou kia whai whakaaro ki te hononga a te Karauna ki te Māori, ki te ao Māori me ōna tino pānga ki te iwi Māori, i ā mātou mahi. Tuia rā ko te whakawhanake i ētahi hononga pono ki te iwi Māori, te mahi kia mātau ki ngā whakaaro whānui, ki ngā hiahia me ngā awhero o te iwi Māori, te mōhio ki te mana me ngā tikanga o te iwi Māori, ka mutu, kia tika te rapa o te hononga e tika ai te urunga ki o mātou mahi.

Kāore mātou e whakatakoto kaupapahere, ehara hoki i te mea me whai te Kāwanatanga i ā mātou kōrero āwhina. Heoi anō, e ai ki te ture, me tāpae te Kāwanatanga i ā mātou kupu akiaki ki te Pāremata, me te urupare tūmatanui mai mā te tuhi – āpiti tonu ko te whai whakaaro noa ki te wehenga atu i ā mātou whakahau. Ka āwhina ēnei haepapa ki te whakaū i te āta arohia o ngā kōrero āwhina motuhake e pā ana ki te urupare huringa āhuarangi o te motu e ngā Kāwanatanga hou.

E aro ana te kupu akiaki a te Kōmihana ki ngā hua ka taea mā ngā mahi, ngā kaupapahere hoki a te kāwanatanga, me ngā kōwhiringa e wātea ana ki te hunga whakatau – tae ana ki ngā ara me ngā tūraru ka tāpaetia e ēnā kōwhiringa. Ko te whāinga ko te tautoko i te Kāwanatanga ki te whakatutuki i tana tūranga i raro i te Ture, tae ana ki te whakatutuki i ngā tahua tukuwaro me te whāinga o 2050, me te tuku i a ngā iwi o Aotearoa ki te whakarite, ki te urutau anō hoki ki ngā pānga o te huringa o te āhuarangi.

Ko tēnei te tūāpapa o tā mātou mahere mahi, e tuku ana i te kupu akiaki motuhake, whai taunakitanga anō hoki, ki te Kāwanatanga mō tā Aotearoa whakamauru me te urutau ki ngā whiunga o te āhuarangi me te whakawhiti atu ki tētahi anamata tōnui, āhuarangi-pakari me te tukuwaro iti.

Kei tā mātou pae tukutuku ētahi pārongo anō e pā ana ki te hōtaka mahi a te Kōmihana, kei www.climatecommission.govt.nz.

About He Pou a Rangi Climate Change Commission

He Pou a Rangi Climate Change Commission (the Commission) is an independent Crown entity established by the Climate Change Response Act 2002 (the Act) to:

a. provide independent, evidence-based advice to successive governments on mitigating climate change (including through reducing emissions of greenhouse gases) and adapting to the effects of climate change
b. monitor and review progress towards emissions reduction and adaptation.

Successive governments have committed to reducing Aotearoa New Zealand's emissions of greenhouse gases and adapting to the impacts of climate change. The Commission provides impartial information about the choices the government of the day has to respond to climate change. Our independence provides assurance to New Zealanders – and internationally – about the credibility of Aotearoa New Zealand's action on climate change.

The scope and timeframes for the Commission's advice and monitoring reports are set out in the Act. In addition, the Minister of Climate Change may also make a specific request to the Commission for advice on any topic.

The Act requires the Commission to draw from the best available evidence and analysis, and to consider the impacts of climate change and the implications for Aotearoa New Zealand over time, including through engagement and public consultation.

The Act also directs us to consider the Crown–Māori relationship, te ao Māori, and specific effects on iwi/Māori in our work. This involves building meaningful and respectful relationships with iwi/Māori, working to understand the diverse perspectives, needs and aspirations of iwi/Māori, recognising Māori rights and interests, and enabling active partnership and participation in our work.

We do not set policy, and the Government does not have to take our advice. However, the Act does require the Government to present our advice to Parliament, and to respond publicly in writing – including providing any reasons for departing from our recommendations. These obligations help ensure independent advice on the country's climate change response is given due consideration by successive governments.

The Commission's advice focuses on the outcomes that can result from government action and policy, and the choices that decision-makers have – including the opportunities and risks presented by those different options. The aim is to support the Government to fulfil its role under the Act, including achieving emissions budgets and the 2050 target, and allowing the people of Aotearoa New Zealand to prepare for, and adapt to, the effects of climate change.

This is the foundation of our programme of work providing the Government with independent, evidence-based advice on how Aotearoa New Zealand can mitigate and adapt to the effects of climate change and transition to a thriving, climate-resilient, and low emissions future.

More information on the Commission's work programme can be found on our website, www.climatecommission.govt.nz.

Te whakarākei matua | Executive summary

He Pou a Rangi Climate Change Commission has reviewed Aotearoa New Zealand's 2050 target for reduction in greenhouse gas emissions, and is recommending the target is amended.

As required by the Climate Change Response Act 2002 (the Act), we have reviewed the country's 2050 emissions reduction target, and also considered whether to include emissions from international shipping and aviation in the target.

The 2050 target sets clear, long-term requirements for Aotearoa New Zealand's reductions in greenhouse gas emissions. It guides the Government's climate change policies, decisions and actions. It also provides long-term clarity for households, businesses and communities so they can plan long-term action and investment.

When the target was set, Parliament recognised that circumstances can change. For that reason it required that the target be reviewed every five years. This is our first review.

The Act sets clear conditions for that review. It details the factors we have to consider, and it provides that we can recommend amending the target only if significant changes have occurred, and those changes justify amending the target. This test reflects the importance of keeping Aotearoa New Zealand on a steady course to low emissions, while still allowing the country to adjust when necessary along the way.

Our review of the evidence shows that significant changes have occurred since the target was set by Parliament in 2019. After assessing the evidence, consulting with the public, and revising our analysis based on what we learned, our assessment is that the changes are significant enough to justify amendments to the 2050 target.

On the following pages we summarise our analysis and set out our recommendation for the 2050 target.

Summary for decision-makers

Significant changes since 2019

- Many comparable countries have by now set targets that are more ambitious than the current target of Aotearoa New Zealand.
- Also, scientific evidence is increasingly clear that global action is insufficient to limit global warming to 1.5°C outright. This implies that even greater reductions are needed in the near and longer terms to limit as much as possible the amount by which the world exceeds 1.5°C, and then to potentially bring the temperature back down again.
- The impacts of global warming are greater, in both severity and scale, than was understood by the global science community when the target was set.
- The increased risks and impacts of climate change have implications for Aotearoa New Zealand's future. Delaying action transfers costs and risks to future generations.

Summary for decision-makers (continued)

Our 2050 target recommendation

- We are recommending that the target be amended to require:
  - net emissions of all greenhouse gases other than biogenic methane to reach at least net negative 20 $MtCO_2e$ by 2050
  - emissions from international shipping and aviation to be included in this net negative 20 $MtCO_2e$ target
  - gross emissions of biogenic methane to reach at least 35–47% below 2017 levels by 2050
  - there are further reductions and removals of greenhouse gases beyond these levels after 2050.

Why amend the target?

- The significant changes since 2019 all point to Aotearoa New Zealand moving further and faster to reduce emissions than the current 2050 target provides for.
- The recommended target responds to these changes and reflects Aotearoa New Zealand's commitment to global action on climate change.
- The recommended target also takes account of what is realistic and feasible for the economy and communities.

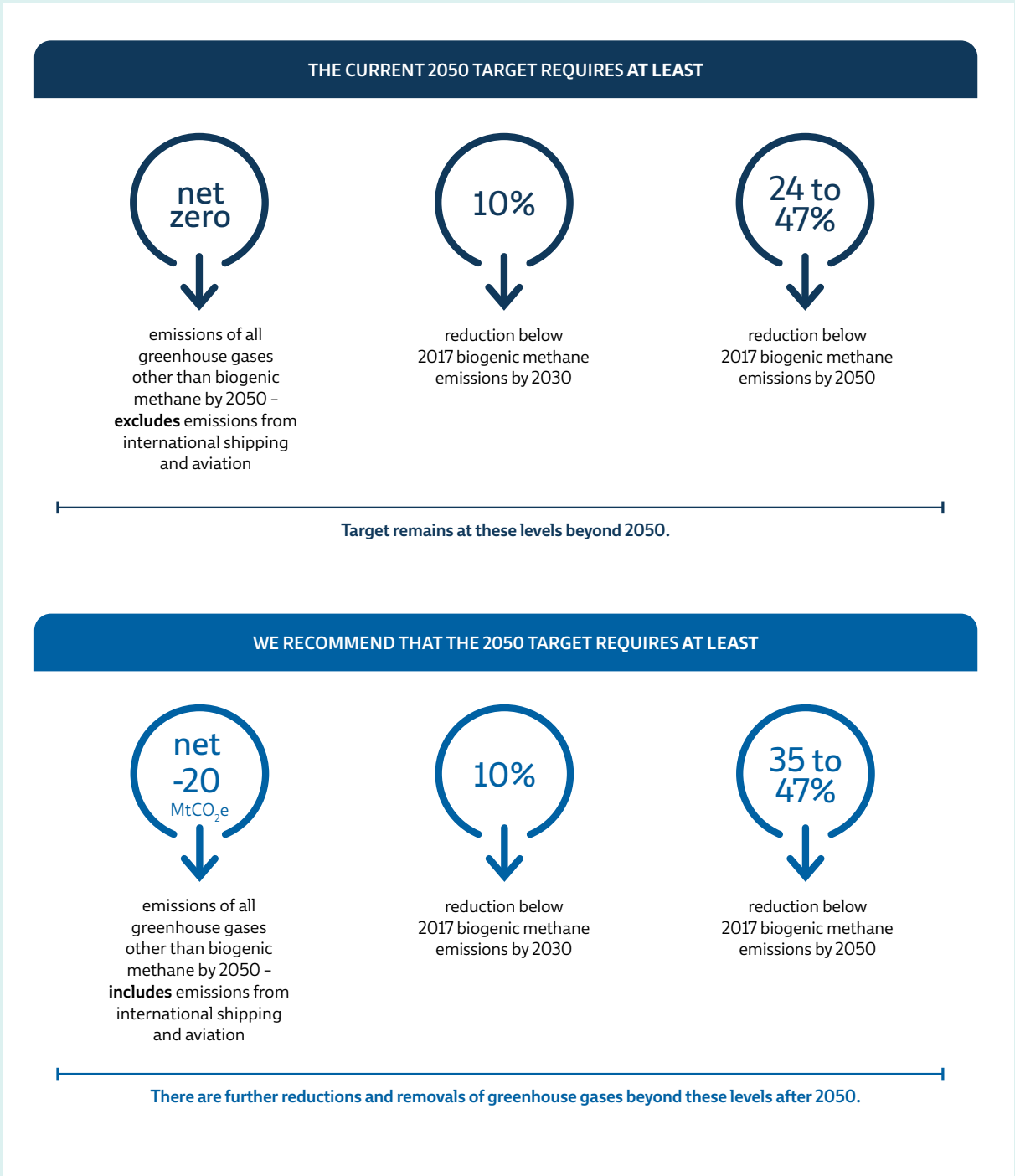
Why include emissions from international shipping and aviation?

- Emissions from Aotearoa New Zealand's international shipping and aviation are equivalent to about 9% of Aotearoa New Zealand's net domestic greenhouse gas emissions.
- Including these emissions in the target is feasible and would mean these sectors become part of Aotearoa New Zealand's emissions reduction planning. This would increase certainty, transparency and accountability in Aotearoa New Zealand's efforts to limit warming.
- Including these emissions in the target would also align Aotearoa New Zealand with trading partners and international industry efforts to reduce these emissions.

Impacts

- The recommended target:
  - is consistent with an emissions pathway in which the country causes one third less warming by 2100
  - is compatible with ongoing economic growth
  - would bring Aotearoa New Zealand's target closer to other countries
  - has potential co-benefits such as improved energy security, better health outcomes and closer alignment with international market preferences
  - would reduce the risk of a harsher and costlier future transition.

Figure ES.1: The current 2050 target and the recommended target



The first review of the 2050 target

This document presents the first independent review of the 2050 target for reduction of greenhouse gas emissions by He Pou a Rangi Climate Change Commission (the Commission), as required in the Act. It also presents a one-off review, also required in the Act, into whether international shipping and aviation emissions should be included within the target, and if so how.

It sets out our approach, the evidence we examined, and our findings and recommendations.

Aotearoa New Zealand's 2050 target

One of the Act's purposes is to provide a framework for Aotearoa New Zealand's contribution to international efforts aimed at limiting global temperature increase to 1.5°C above pre-industrial levels.

To support that purpose, the Act sets a target for reduction in Aotearoa New Zealand's greenhouse gas emissions by 2050. The Act sets the 2050 target for emissions of all greenhouse gases other than biogenic methane to reach at least net zero by 2050 and beyond, and for gross emissions of biogenic methane to reduce to 10% below 2017 levels by 2030, and 24–47% below 2017 levels by 2050 and beyond.[i] This 'split-gas' approach reflects the different impacts of these gases on global warming.

While the current target covers Aotearoa New Zealand's domestic greenhouse gas emissions, it does not include emissions from international shipping and aviation.

The 2050 target guides government decisions about emissions budgets and emissions reduction plans, which in turn influence government policy decisions on matters such as transport, energy, building, land use and much more. Ultimately, those policy decisions affect every individual, household, business and community in Aotearoa New Zealand.

Our approach to these reviews

Both of our reviews reflected the Act's requirements. For the 2050 target review, we considered whether there had been significant changes since 2019 relating to climate change. We then considered whether those changes justified a recommendation to amend the target. We considered the implications of amending the target for Aotearoa New Zealand. We also considered whether and how any amendments to the target would support the Act's purposes.

The Act allows us to recommend amendments to the target only if significant change has occurred since it was last set. This reflects the importance of ensuring stability and clarity for households, businesses, and communities, while still allowing flexibility for the country to respond to significant changes in circumstances.

For our review of emissions from international shipping and aviation, we considered whether to include those emissions in the 2050 target, and if so how.

In all of our work, the Act requires us to consider a range of factors including science, technology, the economy, social and environmental circumstances, intergenerational impacts, te ao Māori, and international responses to climate change.

i **Gross emissions** are the total amount of greenhouse gases produced from the energy, agriculture, industry and waste sectors. **Net emissions** take into account how much carbon dioxide has been emitted and removed from the atmosphere from forests, subtracting that amount from gross emissions calculations. In Aotearoa New Zealand, removals are currently achieved through planting trees, which take in and store carbon dioxide from the atmosphere as they grow.
Biogenic methane is methane emitted in the agriculture and waste sectors, mainly from ruminant animals and decomposing waste.

In June 2024, the Government commissioned an independent panel to review methane science and the 2050 target, in order to determine the level of methane emissions that would be consistent with 'no additional warming' beyond 2017 levels. While we acknowledge that context, our review is separate and is conducted according to the 2050 target and international shipping and aviation review requirements set out in the Act.

Building insight and evidence through consultation

Our reviews of the 2050 target, and on whether to include emissions from international shipping and aviation in the target, were informed by public feedback.

During 2023 we ran an initial call for evidence, in which individuals and organisations provided evidence relevant to both of our reviews. We also drew on existing evidence from previous engagements with iwi/Māori and stakeholders. Between July and December 2023, we met with some of the organisations that had submitted evidence, including representatives from the agriculture, shipping and aviation industries.

In April 2024 we released discussion documents f or both reviews. During April and May we conducted further engagement including regional meetings, online webinars, hui with sector groups and other stakeholders, hui with iwi/Māori, and more. We received 192 submissions about our review of Aotearoa New Zealand's 2050 target, and 158 on our review of whether emissions from international shipping and aviation should be included in the target.

We carefully considered all feedback we received, and investigated any new evidence presented to us. The consultation shaped our analysis and influenced our final recommendations – at times contributing to changes in our analysis as discussed below.

Separate but connected advice: our advice on the fourth emissions budget

In late 2024 the Commission has also provided advice on Aotearoa New Zealand's fourth emissions budget, covering the period 2036–2040 (see https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/preparing-advice-on-emissions-budgets/advice-on-the-fourth-emissions-budget/final-report). That advice is aligned to the *current* 2050 target. It does not take account of this advice about the 2050 target and inclusion of international shipping and aviation emissions in the target.

While each piece of advice has a specific focus, they both deal with Aotearoa New Zealand's journey to becoming and maintaining a thriving, low emissions economy by and beyond 2050.

Together they provide decision-makers and citizens with a clear view of options for Government decision-making that will affect the country's actions, planning and investment for the next 20–30 years.

What we found

Global efforts are not sufficient to limit warming to 1.5°C and other countries are adopting more ambitious targets

Since 2019 many comparable countries have adopted emissions reduction targets that are more ambitious than Aotearoa New Zealand's current 2050 target. Trading partners such as Australia, the United States, the European Union, Japan, Singapore and Ireland have adopted targets aiming for emissions of all greenhouse gases to reach net zero by 2050.

Aotearoa New Zealand's 2050 target aims for net zero for some greenhouse gases, and for reduced gross emissions of biogenic methane, rather than for net zero emissions overall. In 2019 Aotearoa New Zealand was among global leaders in setting a long-term emissions reduction target. That is no longer the case. Many comparable countries' responses to climate change have shifted significantly since the 2050 target was first set.

Since 2019 it has also become increasingly clear that current global action is not sufficient to limit warming to 1.5°C above pre-industrial levels. Average global temperatures are already close to that threshold. It is highly likely that average warming will exceed 1.5°C within the next 10 years, bringing increased risk of severe and widespread climate impacts. This implies that even greater reductions in global emissions are needed in the near and longer terms to limit as much as possible the amount by which the world exceeds 1.5°C, and then to potentially bring the temperature back down again.

The impacts of climate change are greater in both severity and scale than previously anticipated

The impacts of global warming are greater in both severity and scale than was understood in 2019. Research has found that greater impacts are being felt at lower temperature levels than previously expected. Harmful impacts from climate change are becoming more severe and more widespread as the planet warms. Scientific understanding of these impacts has advanced since the 2050 target was first set.

Those impacts include high-profile events such as tropical cyclones, heatwaves and droughts that cause devastating impacts in many parts of the world. Climate change has also disrupted food and water supplies for hundreds of millions of people in recent years. It is causing damage – some irreversible – to land and ocean ecosystems. Recent science suggests that, for every fraction of a degree of warming, people and nature are both more likely to be affected, and more likely to be badly affected.

Aotearoa New Zealand is also affected. The country has, in recent years, already experienced significant harm from cyclones, floods, landslips, droughts and wildfires. Climate change is increasing the frequency and impacts of these events, which cause damage and impose significant costs on Aotearoa New Zealand's communities.

The burden from climate change is being transferred to future generations

The balance of intergenerational equity shifts when Aotearoa New Zealand accelerates or delays action to reduce emissions. That balance has shifted since the 2050 target was set. Because of the decreasing likelihood that the world is on track to limit average warming to 1.5°C above pre-industrial levels, and because the impacts of climate change are more severe and widespread than previously understood, future generations will face a greater burden from climate change. Not only are they likely to face more severe climate impacts, it is likely they will also have to do more to reduce emissions.

The current 2050 target does not reflect these growing risks

The current 2050 target reflects Parliament's judgement of how much Aotearoa New Zealand should reduce emissions in order to contribute to global efforts to limit warming to 1.5°C. That judgement was based on information available when the target was set in 2019. We can recommend amending the target only in response to significant changes since that time.

Our review has found that significant changes have occurred. Those changes all point towards Aotearoa New Zealand moving further and faster to reduce emissions. Other countries have adjusted their targets and emissions reduction plans as it becomes increasingly clear that the world is no longer on track to limit warming to 1.5°C, and as understanding of the risks and impacts of climate change increases.

Aotearoa New Zealand's greenhouse gas emissions are small on a global scale, but high per capita. If every country caused the same warming per capita as Aotearoa New Zealand, global warming would exceed 5°C in coming decades.

The United Nations' 2023 and 2024 emissions gap reports concluded that the world will need to reach net negative emissions of carbon dioxide by 2050 if average global warming is to remain even close to 1.5°C during this century.[ii]

The 2050 target must enable clear and stable policies for Aotearoa New Zealand's economy and communities

Amending the target to require further reductions in emissions would have impacts on Aotearoa New Zealand's economy, society and environment. There would be both costs and benefits.

The mix of impacts would depend on Government policy, and on decisions made by individuals, households, businesses and communities. The target sets a long-term goal for emissions reduction, but does not determine how the goal is reached.

Some options for reducing emissions would require up-front investment to phase out fossil fuels in transport, electricity generation and as many industrial processes as possible. Many of these investments would pay for themselves over time through reduced costs.

Our analysis indicates that Aotearoa New Zealand can reduce emissions further than the level of the current target while the economy continues to grow. Transitioning to a lower emissions economy can bring other benefits. It can strengthen energy security and independence. It can reduce energy costs, improve productivity, increase resilience, and benefit public health.

ii A 'net negative' target means a country is removing more greenhouse emissions from the atmosphere (for example, by planting trees) than it is emitting.

Potential co-benefits from a lower emissions economy

The 2050 target provides long-term guidance on emissions reduction. Amending the target would have impacts across Aotearoa New Zealand's economy and communities. The exact mix of impacts would depend on Government policy, and on decisions made by households, businesses and individuals.

Our analysis has found that many options for reducing emissions also deliver cost savings over time. Options such as electrification of transport, increased use of renewable energy, and greater energy efficiency also bring other potential benefits. Depending on the mix of policy options adopted, some potential co-benefits from emissions reduction include:

- increased productivity – e.g. from energy efficiency, and because renewable electricity is more efficient and cheaper than fossil fuels
- greater energy security and independence – with reduced reliance on imported fossil fuels
- greater innovation – through opportunities to research and develop low emissions solutions, especially in food production
- maintaining global competitiveness – as customers increasingly choose to purchase lower emissions products and services, e.g. in food production and tourism
- healthier people and reduced health costs – from reduced air pollution, more active transport, and warmer homes
- increased resilience – e.g. through land-use changes that reduce erosion, or by designing electricity and urban networks for emissions reduction
- avoiding the costs and risks arising from inaction – including market risks, and the risk that delayed action leads to a harsher, costlier transition in future.

Aotearoa New Zealand's international shipping and aviation sectors can contribute to emissions reduction

Aotearoa New Zealand's emissions from international shipping and aviation are currently excluded from the 2050 target, but cause warming. Emissions from these sectors are equivalent to about 9% of Aotearoa New Zealand's net domestic greenhouse gas emissions. If no action is taken to reduce emissions from these sectors, by 2050 they will likely grow to be equivalent to more than one-third of the country's domestic net emissions.

International shipping and aviation organisations are also coordinating efforts to reduce emissions, and Aotearoa New Zealand has obligations to support that work. Major economies such as the United Kingdom, the European Union, and the United States are already putting policies in place to reduce emissions from international shipping and aviation. Aotearoa New Zealand's economy depends on tourism and trade. How the country manages international shipping and aviation emissions affects access to international markets. Businesses in these sectors are already having to account for their emissions to international customers and trading partners. This trend is likely to continue.

There is potential for the international shipping and aviation sectors to reduce their emissions, especially by adopting alternative fuels. Reducing emissions from these sectors could support Aotearoa New Zealand's contribution to global efforts to limit warming. Reduced emissions could also bring other benefits to the environment, health and international relationships.

We considered public feedback as part of our review

During our public consultation, many submitters referred to the growing impacts of climate change, and called for Aotearoa New Zealand to take more urgent and ambitious action. Some wanted Aotearoa New Zealand to adopt a net zero target covering all greenhouse gases, or a net negative target covering gases other than biogenic methane. Many were concerned about negative impacts for Aotearoa New Zealand if it does not adopt a more ambitious target. Some referred to worsening climate impacts. Others said there would be risks to the country's international reputation.

Some submitters were concerned about impacts on rural communities if farmland is converted to forestry or if the methane target is too ambitious. We took that feedback into account when developing our final recommendations.

Of submitters who considered international shipping and aviation, most supported including those emissions in the target. Many also emphasised the importance of clear Government policy to guide emissions reductions.

Our recommendation

We are recommending the Government amends the 2050 target to require further reductions in greenhouse gases beyond what is required under the current target.

Recommendation

We recommend that the Government:

Amend the emissions reduction target (the 2050 target) to require that:

a. net accounting emissions of greenhouse gases other than biogenic methane, including international shipping and aviation emissions, are at least negative 20 $MtCO_2e$ by the calendar year beginning on 1 January 2050
b. gross emissions of biogenic methane in a calendar year –
   i. are at least 10% less than 2017 emissions by the calendar year beginning on 1 January 2030; and
   ii. are at least 35–47% less than 2017 emissions by the calendar year beginning on 1 January 2050
c. there are further reductions and removals of greenhouse gases beyond these levels after 1 January 2050.

Calculate emissions from international shipping and aviation using the following measures:

- for aviation: refuelling taking place in Aotearoa New Zealand based on bunker fuel use by all international operators
- for shipping: an estimate of 50% of the emissions to/from the next overseas port by all international operators and 100% of their emissions travelling between ports in Aotearoa New Zealand and while docked.

And to:

- reconsider the inclusion of other climate impacts[iii] from international shipping and aviation in the 2050 target in future reviews
- develop measures for meeting the 2050 target that ensure a specific focus occurs on gross emissions reductions for international shipping and aviation.

iii 'Other climate impacts' refers to impacts on climate change that are not caused by emissions of the greenhouse gases included in New Zealand's Greenhouse Gas Inventory.

By meeting the recommended target, Aotearoa New Zealand would increase its contribution to global efforts to limit warming

This recommendation retains the structure of the current target. It responds to significant changes since 2019 in the risks and impacts of climate change. It reflects Aotearoa New Zealand's commitment to global efforts to limit warming to 1.5°C above pre-industrial levels, and it takes account of the potential implications for Aotearoa New Zealand of reducing emissions beyond what is required by the current target.

The recommended target parameters (35%–47% reduction in biogenic methane, and net negative 20 $MtCO_2e$ for all other gases) strengthen the foundation for clear and stable policies that reduce emissions in response to the growing risks and impacts of climate change, while being realistic for Aotearoa New Zealand's economy and communities.

We are not recommending any change to the target's 2030 requirement for biogenic methane, because meaningful emissions reduction in response to a new recommended target (and subsequent budgets and plans) would require immediate changes, with widespread impacts on methane-emitting sectors.

We found no evidence that would support weakening any part of the target.

Our analysis, refined through consultation, has found that there are credible pathways to achieving the recommended target. For both components of the recommended 2050 target, meeting the recommended target requirements would depend on governments providing clear policy direction.

The net negative 20 $MtCO_2e$ component of the recommended target reflects analysis of what is likely to be possible if Aotearoa New Zealand pursues a pathway based on high levels of technology and systems change – for example, through faster electrification of transport networks and growing use of renewable energy. There are significant potential benefits from steering the country along this pathway.

For biogenic methane, the lower end of the recommended target range reflects a pathway that, according to our analysis, is largely possible with current technologies. The higher end reflects what is likely to be possible with significant changes in technology, in particular if methane inhibiting technologies become available in Aotearoa New Zealand.

We are not recommending any change to the target's split-gas structure, which reflects the different warming effects of different greenhouse gases. While carbon dioxide is a long-lived greenhouse gas, other emissions also matter. Biogenic methane accounts for more than half of the warming impact from Aotearoa New Zealand's greenhouse gas emissions. Reducing these emissions would have an immediate impact on Aotearoa's contribution to global efforts to limit warming. The recommended target reflects the importance of every sector contributing to Aotearoa New Zealand's efforts to cause less warming.

The recommended target would mean Aotearoa New Zealand makes a greater contribution towards global efforts to limit warming to 1.5°C than the current target provides for. Our analysis indicates that an emissions scenario that meets the recommended target for domestic emissions would put Aotearoa New Zealand on a path to cause around a third less warming by 2100, than a scenario aligned to the current target. Adding international shipping and aviation emissions to the target is likely to further contribute to reductions in warming.

Our analysis also shows that achieving negative 20 $MtCO_2e$ and a 47% reduction in domestic emissions of biogenic methane would bring Aotearoa New Zealand very close to net zero emissions of all greenhouse gases when using the internationally standard metric GWP_{100}. This is a result of analysis and assumptions rather than a set goal. Since 2019 Australia, the United States, the European Union and several other economies (including some economies with relatively high methane emissions) have adopted net zero all gas targets.

Including emissions from international shipping and aviation in the target would also be consistent with action by other countries and would ensure that emissions from those sectors are included in Aotearoa New Zealand's emissions reduction policy. It would not necessarily mean those sectors are included in the New Zealand Emissions Trading Scheme. That would be a policy decision for the Government. Based on our analysis, the recommended net -20 $MtCO_2e$ target is feasible with international shipping and aviation included.

We considered several options on how to measure emissions from international shipping and aviation. Based on available evidence and feedback about refuelling trends, the recommended options are the most accurate for capturing these emissions. These options provide the best incentives to reduce emissions. They avoid double counting as far as possible. They are also the options submitters preferred during public consultation.

The recommendation to further reduce or remove emissions after 2050 recognises the importance of global efforts to reach net negative emissions after that date.

Meeting the recommended target would require lower emissions at levels that are realistic for Aotearoa New Zealand

Meeting the recommended target would require the country to reduce emissions beyond what is required by the current target. But it also reflects what is realistic and feasible for the country's economy and communities. Through our analysis of significant changes since the target was set, the implications of the recommended target, and how the recommended target meets the purpose the of the Act, the Commission is satisfied that the significant changes justify the change to the target.

The recommended target is compatible with continued growth in GDP, and with higher employment in most regions. Reducing the use of fossil fuels could bring economic and social benefits, including long-term cost savings. Amending the target now could also reduce the risk of Aotearoa New Zealand being forced into a harsher and more costly transition in future.

Moving to a lower emissions economy will have both positive and negative impacts, and those impacts will not be spread evenly across sectors and communities. Clearly signalled transition plans and policies can reduce uncertainty and provide time for sectors and communities to plan and change.

Next steps

The Commission provides independent advice. Whether our recommendation is adopted, and how it is implemented, are matters of Government policy.

The Government is required to respond to the Commission's recommendation within 12 months of receiving it. That response must include reasons for any departure from the recommended target. The Minister of Climate Change is required to inform the public, Parliament and the Commission of the Government's response. Any change to the target would require an amendment to the Act.

The country would then work towards the amended target, and its supporting emissions budgets and emissions reduction plans, as part of its contribution to limiting global warming. The Commission assists with that through ongoing monitoring of progress, and providing advice on budgets and plans. The next review of the target would be in 2029.

Wehenga A:
He whakatakoto i tōna hanga

Part A:
Setting the scene

Wāhanga 1 | Chapter 1

He whakatakinga
Introduction

This chapter provides an overview of He Pou a Rangi Climate Change Commission's 2050 target and international shipping and aviation reviews, and the approaches we have taken to ensure these reviews are fit for purpose.

One of the purposes of the Climate Change Response Act 2002 (the Act) is to set a clear and stable framework for Aotearoa New Zealand to contribute to global efforts to limit the average global temperature increase to 1.5°C above pre-industrial levels.

To support that purpose, the Act sets a target for reduction in Aotearoa New Zealand's greenhouse gas emissions by 2050. Specifically, this 2050 target provides that emissions of greenhouse gases other than biogenic methane should reach net zero by 2050, and emissions of biogenic methane should reduce to 10% below 2017 levels by 2030 and 24–47% below 2017 levels by 2050.

In turn, this 2050 target guides Government decision-making on five-yearly emissions budgets and associated emissions reduction plans. Those decisions, and related Government policies, have impacts throughout Aotearoa New Zealand's society and economy, affecting matters such as energy generation, transport options, air quality, and much more. Ultimately, decisions about emissions reduction affect every household, business and community in Aotearoa New Zealand, not only now but for generations to come. Those decisions also affect Aotearoa New Zealand's international reputation as a country focused on sustainability and protecting the environment, which in turn benefits tourism and export industries.

While the 2050 target sets a clear long-term objective for emissions reduction, Parliament also recognised that circumstances can change, and can materially affect Aotearoa New Zealand's contribution to efforts aimed at limiting global warming. The Act therefore requires the Climate Change Commission, every five years, to review the target. The target was set in 2019, so this is our first review.

The Act also requires us, before the end of 2024, to advise the Minister of Climate Change on whether to include emissions from international shipping and aviation in the target, as the current 2050 target does not include those emissions.

The Act sets out matters we must consider when conducting these reviews. In reviewing the 2050 target, we can recommend changes to the target's timeframe, level, structure and/or rules – but only if significant changes have occurred in nine key areas since the target was previously set in 2019. The significant change requirement does not apply to the review of international shipping and aviation emissions.

In all of our work, section 5M of the Act sets out a range of matters we must consider (see 'How we considered mandatory matters under section 5M of the Act').

This document sets out our analysis, findings and recommendations with respect to the 2050 target and the question of whether emissions from international shipping and aviation should be included in the target. Our analysis reflects the Act's requirements and has been informed by engagement with stakeholders and by open public consultation. In this chapter we explain in more detail our approach to these reviews, and how they were conducted.

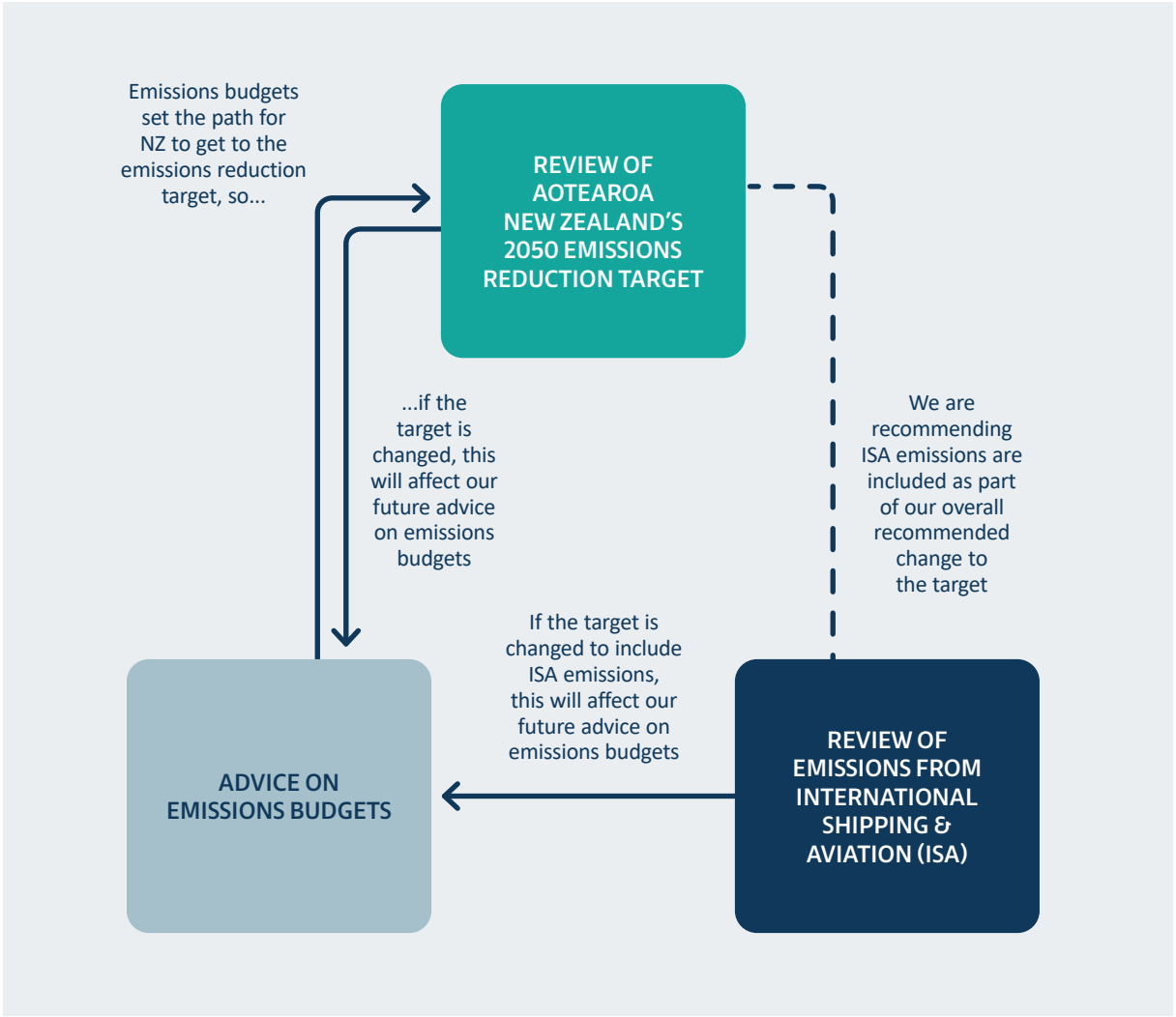
We note that the Government has commissioned a panel to deliver an independent review of methane science and the 2050 target for consistency with no additional warming from agricultural methane emissions. While we acknowledge that context, we are performing our review of the 2050 target due to our obligations under the Act.

The 2050 target guides Aotearoa New Zealand's long-term domestic approach to reducing emissions.

Targets are important tools used to identify and achieve shared, quantifiable and time-bound goals, and support public accountability by providing a means to track and measure progress.

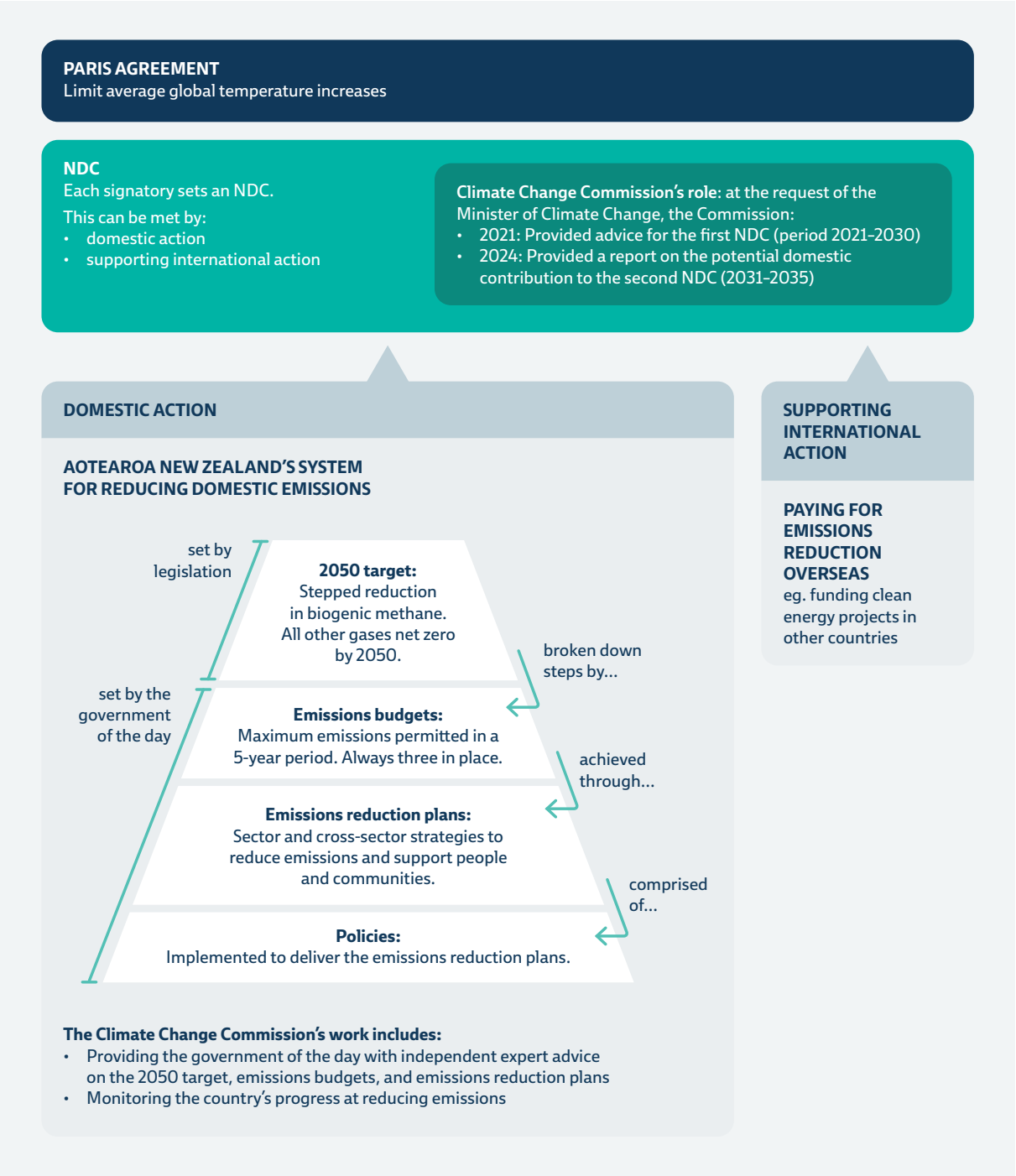
For Aotearoa New Zealand to reduce emissions in an ambitious and achievable manner, the 2050 target needs to drive an equitable and well-managed transition to a thriving, low emissions economy.

Figure 1.1: How the Commission's advice on the 2050 target, international shipping and aviation emissions, and emissions budgets are connected



Many of Aotearoa New Zealand's shorter-term decisions about reducing emissions are directly tied to meeting the 2050 target. Under the Act, governments are required to set emissions budgets that represent the total net volume of emissions the country can emit over a five-year period, with a view to meeting the 2050 target. In this way, emissions budgets act as stepping stones, setting short-term, measurable requirements for reducing domestic emissions on the way to achieving the longer-term 2050 target (see **Figure 1.2**).

Figure 1.2: Emissions reduction commitments and the system for meeting them



To meet emissions budgets, governments develop corresponding emissions reduction plans, which outline the policies, strategies and actions they will put in place to reduce emissions. Each choice made in an emissions reduction plan has different implications for New Zealanders. This includes how change is experienced across different groups in society (for example, what employment opportunities are available in rural communities, or when and where solar and wind farms are built) and what benefits and opportunities related to emissions reductions are realised (for example, when and by how much energy costs are reduced).

The design of the New Zealand Emissions Trading Scheme (NZ ETS) has also been influenced by the 2050 target. The scheme – which puts a price on emissions, changing the relative price of goods and services across the economy – was created with the purpose of assisting Aotearoa New Zealand to meet its climate change goals, including the 2050 target. Each year, the Minister of Climate Change is required to update the NZ ETS settings in accordance with the 2050 target, emissions budgets, and Aotearoa New Zealand's Nationally Determined Contribution (NDC) under the Paris Agreement.

About the current 2050 target

The current 2050 target was established by Parliament in November 2019 to achieve the purposes of the Act. The key clauses in the purpose of the Act for the 2050 target are:

> "provide a framework by which New Zealand 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 target requirements are:[iv]

- Emissions of all greenhouse gases other than biogenic methane to be net zero by 2050 and in each subsequent calendar year. This is often referred to as the net zero component.
- Gross emissions of biogenic methane emissions must be at least 10% below 2017 levels by 2030.
- Gross emissions of biogenic methane must be at least 24–47% below 2017 levels by 2050 and in each subsequent calendar year.

These three components mean the target is often referred to as a 'split-gas' target for domestic emissions, as it considers biogenic methane separately from all other greenhouse gases. This reflects the different impact that methane has compared with other greenhouse gases, such as carbon dioxide. Targeting separate gases in this way accounts for their different warming effects over different timeframes and can provide certainty about where and how much emissions reductions should occur.

iv *Gross emissions* are the total amount of greenhouse gases produced from the energy, industry, agriculture, transport and waste sectors. *Net emissions* take into account how much carbon dioxide has been emitted and removed from the atmosphere from forests, subtracting that amount from gross emissions calculations. In Aotearoa New Zealand, *removals* are currently achieved through planting trees, which take in and store carbon dioxide from the atmosphere as they grow. Emissions are calculated using target accounting methodology.

While some certainty is achieved through the requirements for different types of greenhouse gases, a split-gas target is not as flexible as an all gases target and this may result in a less economically efficient outcome for the entire country.

While the target is known as the '2050 target', it specifies that emissions reductions must be maintained at target levels for each subsequent calendar year.

Emissions from domestic shipping and aviation around Aotearoa New Zealand are captured by the 2050 target; emissions from a trip to or from another country are not included. This means they are also not covered by emissions budgets or emissions reduction plans.

Why international shipping and aviation emissions matter

As an island nation located far from many major economies, Aotearoa New Zealand relies heavily on international shipping and aviation to connect with the rest of the world. These sectors help New Zealanders keep in touch with friends and family living abroad, enable tourism and business engagement around the globe, import and export goods crucial to the economy and daily life, and help keep Aotearoa New Zealand closely connected across the Pacific region.

Globally, greenhouse gas emissions from international shipping and aviation are significant and increasing. This is also the case in Aotearoa New Zealand.

The Commission estimates Aotearoa New Zealand's international shipping and aviation emissions in 2023 are around 6.7 $MtCO_2e$. That is equivalent to around 9% of Aotearoa New Zealand's domestic net emissions for all sectors in 2023.[v]

International shipping and aviation emissions can be reduced or offset through removals or reductions in other sectors to make a greater contribution to limiting warming to 1.5°C by the 2050s.

Action is underway on international shipping and aviation emissions globally

There are efforts underway to reduce shipping and aviation emissions across the world. The International Maritime Organization (IMO) and International Civil Aviation Organization (ICAO) are United Nations agencies tasked with coordinating global action on international shipping and aviation emissions. Both have set targets to reduce these emissions to net zero at a global level by or around 2050.[1]

Aotearoa New Zealand has international legal obligations to support IMO and ICAO efforts to reduce international shipping and aviation emissions.

In support of these targets, IMO and ICAO have asked individual countries to create national action plans to reduce their emissions from international shipping and aviation. Major economies like the European Union, United Kingdom, and United States of America are now setting domestic targets and putting in place policies to achieve them.

v Commission calculations based on:
New Zealand Customs Service. (2024). *Arrivals and Departures - All Craft Types - Actual Date of Arrival / Departure*; Julien Gaffuri and Joonas Korhonen. (2021). *SeaRoute*. www.github.com/eurostat/searoute; QGIS Development Team. (2024). *QGIS*. qgis.org/en/site; Ministry of Transport. (2024). *FIGS: Overseas ship visits*. www.transport.govt.nz/statistics-and-insights/freight-and-logistics/sheet/figs-overseas-ship-visits; International Maritime Organization. (2022). *Report of fuel oil consumption data submitted to the IMO Ship Fuel Oil Consumption Database.* www.imo.org/en/ourwork/environment/pages/data-collection-system.aspx; UNFCCC. (Accessed 2024); *Query results for — Party: New Zealand — Years: All years — Category: International Bunkers — Gas: Aggregate GHGs — Unit: kt CO_2 equivalent*. di.unfccc.int/detailed_data_by_party; Tarr, A., Smith, I., and Rodger, C. (2022). Carbon dioxide emissions from international air transport of people and freight: New Zealand as a case study. *Environmental Research Communications*, 4. doi.org/10.1088/2515-7620/abf15d; Ministry for the Environment. (18 April 2024). Te Rārangi Haurehu Kati Mahana a Aotearoa 1990–2022 New Zealand's Greenhouse Gas Inventory 1990–2022. www.environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2022/

Our approach to the 2050 target and international shipping and aviation reviews

General approach

As an independent Crown entity, we provide expert, evidence-based advice to Government that presents broad thinking about the impacts of climate change and implications for Aotearoa New Zealand over time. This advice is based on research, evidence and modelling, and draws on the expertise of our Board of Commissioners, He Pou Herenga (a Māori advisory body to the Board) and staff. We are informed by evidence and insights gathered through engagements with people on the ground.

Our work is evidence-based, but that does not just mean quantitative data. We value different types of expertise and forms of knowledge. We have analysed the latest data, considered the issues the Act requires us to address, and drawn on insights and evidence from engagement with iwi/Māori and stakeholders.

We consider the Crown–Māori relationship, te ao Māori and specific effects on iwi/Māori. Our analysis and engagement with communities shows this will support faster emissions reduction and help achieve an equitable transition for the benefit of all New Zealanders.

Our analysis and advice take a 'systems view', which means we consider how government policies, economy, industry, society and the environment are all connected. Engaging with people and communities who can provide evidence, analysis and insights from different perspectives is essential to ensure our final advice is relevant, practical and well-informed. This is why we undertook consultation and stakeholder engagements.

Our modelling builds on the approach taken in *Ināia tonu nei*, which was externally reviewed and scrutinised. We model scenarios and pathways to understand the feasibility of different actions and outcomes of our advice, should it be accepted by Government. It is up to the Government to choose which policies it uses, and different policies have different costs and benefits.

Statutory reviews

Section 5S of the Climate Change Response Act 2002 requires the Commission to review the 2050 target every five years. The target was set in 2019, so this is the Commission's first review.

Under section 5T of the Act, the Commission may recommend changes to the time frame, level, greenhouse gases, emissions and removals the target applies to, and how the target may be met. We can recommend amendments to the target only in response to 'significant changes' in nine key areas (as discussed below).

In 2019, when the 2050 target was established by Parliament, international shipping and aviation emissions were not included. Instead, a requirement under section 5R was created for the Commission to:

> "provide written advice to the Minister [of Climate Change] on whether the 2050 target should be amended to include emissions from international shipping and aviation (and, if so, how the target should be amended)."

Both the review of the 2050 target and whether to include emissions from international shipping and aviation are about the target for emissions reductions that informs the rest of the emissions reduction policy system. For this reason, they should be considered as a package and we have combined them into a single report.

What we considered in the 2050 target review

There is no formula for determining or setting the 'right' target. Parliament applied its judgement in legislating the current target, and we have applied judgement in reviewing it and advising on changing it.

In setting the 2050 target, Parliament made a judgement call about benefits and trade-offs. The Act asks us to review whether or not change to the target is justified under section 5T. This means that the current target is the baseline and starting point for our work.

We also have two main considerations for the international shipping and aviation review, per section 5R of the Act. These are:

- whether to include international shipping and aviation emissions in Aotearoa New Zealand's 2050 target
- if these emissions are included, how should they be included. We have considered the most viable way to count these emissions, the structure of the target, if other climate impacts[vi] should be included, and the level of emissions reduction to aim for.

Significant change

For the 2050 target review, the Commission may only recommend a change to the emissions reduction target if significant change has occurred, or is likely to occur, since the current target was set. Specifically, we must consider whether significant change has occurred in the following areas, as set out in section 5T(2)(a) of the Act:

i. global action
ii. scientific understanding of climate change
iii. New Zealand's economic or fiscal circumstances
iv. New Zealand's obligations under relevant international agreements
v. technological developments
vi. distributional impacts
vii. equity implications (including generational equity)
viii. the principal risks and uncertainties associated with emissions reductions and removals
ix. social, cultural, environmental, and ecological circumstances

And to recommend a change to the target, the Commission is satisfied that the significant change justifies the change to the target as per section 5T(2)(b) of the Act.

Feasibility and impacts

The feasibility and impacts of any change to the target are critical factors in determining whether a change is justified. The Commission developed a set of scenarios to demonstrate the range of actions that could be taken to reduce emissions, using dimensions of technology and systems change across sectors of the economy. This scenario analysis focuses on what is possible rather than defining an optimal mix of actions. These scenarios are useful for generating insights about the implications of amending the target.

vi 'Other climate impacts' refers to impacts on climate change that are not caused by emissions of the greenhouse gases included in New Zealand's Greenhouse Gas Inventory.

Checking that changes to the target are consistent with the purpose of the Act

The 2050 target is designed to support the purpose of the Act to *contribute* to global efforts under the Paris Agreement to *limit the global average temperature* increase to 1.5°C above pre-industrial levels. Therefore, the amount of warming Aotearoa New Zealand causes by meeting any particular target is an important consideration. We used the Finite Amplitude Impulse Response simple climate model (FaIR) to look at the temperature impacts of different options and pathways. FaIR is a reduced-complexity climate model useful for scenario assessment.

To provide insight into Aotearoa New Zealand's contribution, we considered different international perspectives. Our analysis reflected a range of considerations including, for example, the country's projected emissions per capita, contribution to warming, and capacity for emissions reductions.

Considerations for international shipping and aviation emissions

Considering Aotearoa New Zealand's domestic and international legal obligations, the framework the Commission identified, for determining in principle whether international shipping and aviation emissions should be included in the 2050 target in line with the purpose of the Act, is to consider the degree to which:

- international shipping and aviation emissions are contributing to global warming
- limiting warming to 1.5°C requires those emissions to be reduced
- Aotearoa New Zealand contributes to and should take steps to help reduce those emissions
- action is best achieved through targets and policy intervention at an international level, state level, or at both levels
- state-level targets positively or negatively impact international action.

To make this decision also requires considering how the emissions could be included in the target and what the impacts of that would be. The evidence and analysis for considering these is set out throughout this advice.

We have sought to present the latest evidence available in support of this advice. However, there are some significant pieces of information that will become public between this advice being finalised and the Government making its decision. These include the outcome of feasibility studies into sustainable aviation fuel production in Aotearoa New Zealand, and IMO decisions around pricing and fuel standards for international shipping.

Considerations for combining our recommendations on the 2050 target review and including international shipping aviation emissions in the target

The recommendations of the 2050 target and international shipping and aviation reviews are closely intertwined. The effect of the findings of both reviews is to increase the overall level of emissions reduction required by the 2050 target. It is important that the recommendations of the two reviews are able to operate together coherently.

We have used the 'feasibility and impacts' and 'purpose of the Act' criteria to assess the effects of combining the recommendations from the 2050 target review and the international shipping and aviation review.

- *Purpose of the Act*: how does the combined recommendation meet the purpose of the Act?
- *Feasibility and impacts*: is the combined recommendation feasible, what are the impacts and does combining them increase the risk of the target not being achievable?

How we considered mandatory matters under section 5M of the Act

In all our work the Commission considers, where relevant, the matters set out in section 5M of the Act. Our reviews considered these matters throughout, including in the ways set out in the table below.

Table 1.1: Examples of how the matters under section 5M were considered

Matter the Commission must consider under section 5M	Examples of how it was considered
current available scientific knowledge	Considered in *Chapter 4: Significant changes since the 2050 target was set*, in the temperature response modelling included in *Chapter 6: Implications of our recommended 2050 target*, in *Chapter 7: How international shipping and aviation emissions could be included* with a particular focus on other climate impacts from international shipping and aviation, and in *Chapter 9: Implications of including international shipping and aviation emissions* to understand the impacts of these emissions and how they need to be addressed to limit warming.
existing technology and anticipated technological developments, including the costs and benefits of early adoption of these in New Zealand	Considered in *Chapter 4: Significant changes since the 2050 target was set*, in the scenario modelling used to examine impacts in *Chapter 6: Implications of our recommended 2050 target*, in *Chapter 7: How international shipping and aviation emissions could be included* and in *Chapter 9: Implications of including international shipping and aviation emissions*, which discuss potential technologies for reducing these emissions and incorporates those technologies into modelling to understand potential emission reductions.

social, cultural, environmental, and ecological circumstances, including differences between sectors and regions	Considered in *Chapter 4: Significant changes since the 2050 target was set*, and in examining impacts in *Chapter 6: Implications of our recommended 2050 target* and *Chapter 9: Implications of including international shipping and aviation emissions*.
the likely economic effects	Considered in *Chapter 4: Significant changes since the 2050 target was set*, and in examining impacts in *Chapter 6: Implications of our recommended 2050 target* and *Chapter 9: Implications of including international shipping and aviation emissions.*
the distribution of benefits, costs, and risks between generations	Considered in *Chapter 4: Significant changes since the 2050 target was set*, and in examining impacts in *Chapter 6: Implications of our recommended 2050 target* and *Chapter 9: Implications of including international shipping and aviation emissions.*
the Crown-Māori relationship, te ao Māori and specific effects on iwi and Māori	Considered in *Chapter 4: Significant changes since the 2050 target was set*, and in examining impacts in *Chapter 6: Implications of our recommended 2050 target* and *Chapter 9: Implications of including international shipping and aviation emissions.*
responses to climate change taken or planned by parties to the Paris Agreement or to the Convention.	Considered in *Chapter 4: Significant changes since the 2050 target was set*, and in understanding the context around international shipping and aviation emissions and examining how the recommended target contributes to the global efforts to limit warming in *Chapter 9: Implications of including international shipping and aviation emissions.*

How we have structured this document

This final advice document has 10 chapters across four parts.

PART A: Setting the scene

Chapter 1: Introduction. This chapter provides important context about our approach to undertaking the 2050 target and international shipping and aviation reviews.

Chapter 2: What we heard. This chapter details how we went about consulting with the public, the key themes of what we heard, and what we did in response.

PART B: Reviewing the 2050 target

Chapter 3: Important context for our review of the 2050 target. This chapter sets out important context about what the current target is and its implications for global warming. It also discusses the choices and consequences associated with taking a 'no additional warming' approach to setting targets.

Chapter 4: Significant changes since the 2050 target was set. This chapter discusses our approach to looking for significant change and how we tested significant changes through four steps. It then considers where we found evidence of significant changes.

Chapter 5: Our recommendation for the 2050 target. This chapter sets out our recommended change to the target.

Chapter 6: Implications of our recommended 2050 target. This chapter discusses potential impacts of the recommended target and how it fulfills the purpose of the Act.

PART C: Reviewing whether to include emissions from international shipping and aviation in the 2050 target – and if so, how

International shipping and aviation emissions at a glance: This section provides contextual information about our review and summarises our advice and recommendations.

Chapter 7: How international shipping and aviation emissions could be included. This chapter considers the how component of our initial question, including our recommendations on how to count these emissions and how they might be included in the structure of the 2050 target.

Chapter 8: Whether to include international shipping and aviation emissions. This chapter considers whether to include international shipping and aviation emissions in the 2050 target. Our consideration of this issue takes account of analysis on how the emissions could be included, and the implications of doing do.

Chapter 9: Implications of including international shipping and aviation emissions. This chapter discusses the likely implications of including emissions from international shipping and aviation in the 2050 target, and our approach to assessing these implications.

PART D: Recommendations on the 2050 target

Chapter 10: Combined recommendation. In this chapter we discuss how the recommendations for the 2050 target and international shipping and aviation reviews combine and why this matters.

Wāhanga 2 | Chapter 2

Tā mātou i rangona
What we heard

For Aotearoa New Zealand to achieve a thriving, low emissions future, the 2050 target needs to guide the country to take ambitious and achievable action on climate change.

That is why it is essential that our advice and recommendations about the 2050 target and international shipping and aviation are informed by people on the ground, who know which actions are practical and what impacts will be felt.

In April and May 2024, we asked the people of Aotearoa New Zealand to provide their feedback on our initial review of the 2050 target and our initial review of whether international shipping and aviation emissions should be included in the target. At the same time, we consulted with the country about our draft advice on the fourth emissions budget, which covers the period 2036–2040.

This final advice incorporates the contribution of over a thousand people from across the motu who participated in our consultation process, testing and strengthening our approach through discussion and written submissions. This included representatives of over 300 organisations and community groups.

This chapter sets out the key themes and insights we heard from consultation, highlighting where our thinking has shifted as a result. The first section covers who we heard from and met with, and outlines our process for incorporating the feedback we received into our work. The second section shares what we heard and then steps through how feedback has influenced specific parts of this advice.

While we have made every endeavour to reflect the range and nature of the feedback we received, it is not possible for this report to represent the full diversity of the views shared with us. Readers can also view the consultation submissions directly via our website at: https://www.climatecommission.govt.nz/consultation/submissions

Pre-consultation engagement

To inform our initial reviews of the 2050 target and international shipping and aviation emissions, we drew from the large body of evidence and insights gathered from engagements with iwi/Māori and stakeholders held over the course of the Commission's existence.

In addition, we ran a call for evidence from 31 March to 31 July 2023. A mix of individuals and organisations answered, with 10 respondents providing evidence or information relevant to our initial review of the 2050 target, and 12 respondents providing evidence or information relevant to our review of whether international shipping and aviation emissions should be included in the 2050 target.

Several respondents to the call for evidence provided evidence of the different warming impacts of different greenhouse gas emissions and emphasised this should be an important factor in our review. This informed our review, which looked carefully at how best to assess the warming effects of different gases. Where possible, we compare the effects of different gases by looking at how they directly affect warming. This feedback also informed our focus on the split-gas structure of the target.

Between July and December 2023, we met with some of the organisations who submitted as part of our call for evidence, including representatives from the agriculture, shipping and aviation industries.

This early engagement showed general support for Aotearoa New Zealand taking further action to address its greenhouse gas emissions, including emissions from international shipping and aviation. It also showed there is uncertainty around the exact path forward, with many respondents emphasising the need for long-term policy certainty and consistency with overseas approaches wherever possible.

These pre-consultation engagements helped us understand more about the opportunities and impacts stakeholders viewed as being important for the Commission to consider in our advice. This informed our work as we conducted our initial review of the 2050 target and our review of international shipping and aviation emissions, and continued to provide us with valuable evidence and insights as we finalised our advice and recommendations.

Consultation

On 8 April 2024, we released three separate but connected documents for consultation:

- a discussion document on our review of the 2050 emissions reduction target
- a discussion document on our review of whether emissions from international shipping and aviation should be included in the 2050 target, and if so how
- a draft version of our advice on Aotearoa New Zealand's fourth emissions budget.

While each consultation document had a specific focus, they all dealt with Aotearoa New Zealand's journey to becoming and maintaining a thriving, low emissions economy by and beyond 2050. Consulting on this work together gave us the opportunity to engage with Aotearoa New Zealand on both *where* we are heading as a country, and *how* we will get there.

Over the following eight weeks, we engaged (in person and online) with approximately 1,200 people, including representatives of more than 300 different organisations and community groups in 129 events and meetings. We shared our thinking and listened as people told us about the issues, impacts and evidence they wanted the Commission, and eventually the Government, to consider and prioritise.

We sought feedback across multiple channels, including through virtual events, in-person engagements, and an online submission process.

During consultation we:

- held engagements all across the country, including in Northland, Auckland, Waikato, Taranaki, Manawatū-Whanganui, Wairarapa, Wellington, Nelson–Tasman, Canterbury, Otago including Queenstown Lakes, and Southland, and we also met virtually with representatives from Bay of Plenty, Hawke's Bay, Rotorua and Christchurch
- hosted two public webinars with approximately 120 total attendees
- held sector-focused meetings for shipping and aviation (both online), and for agriculture/rural communities in Masterton, Whanganui, Inglewood, Taupō, Te Awamutu, Wellsford, Gore, Oamaru, Nelson (in-person)
- hosted a youth workshop in Wellington, with a hybrid option for those who could not attend in person
- held events in partnership with, or were hosted by, entities like the Sustainable Business Council, Future Farmers, Are Ake, Forest Owners Association, BARNZ and Cool-Safe
- engaged with iwi/Māori in dedicated events, both ā-tinana and online
- held briefings for the media, stakeholders and government agencies.

Incorporating the results of consultation

Consultation closed on 31 May 2024. We received a total of 526 submissions from a mix of individuals (265 submissions) and groups (261 submissions), including submissions from iwi/Māori, businesses, industry organisations, local government, non-government organisations, membership organisations and advocacy groups.

Of these, 192 submissions were on focused on our initial review of Aotearoa New Zealand's 2050 target, 158 were on our review of emissions from international shipping and aviation, and 176 were on our draft advice on Aotearoa New Zealand's fourth emissions budget.

Commission staff considered each piece of consultation feedback we received, whether it was shared in an online submission, at a consultation event, or by email. In line with the Commission's commitment to upholding Māori data sovereignty, all kaupapa Māori submissions, including those related to mātauranga Māori, tikanga, kawa, whakapapa, and/or relationships to whenua, were analysed in accordance with the *Principles of Māori Data Sovereignty* by Te Mana Raraunga.[2]

Where we were presented with new evidence, we investigated it carefully and considered its potential impact on our work, re-evaluating our approach and analysis as appropriate.

What we heard through consultation also shaped the next stages of our analysis and helped lead us to the recommendations in this report. Before confirming these recommendations, our Board of Commissioners tested whether the recommendations appropriately reflected the feedback and evidence shared with us.

Themes that emerged from feedback

This section summarises the themes we heard throughout consultation and outlines how these contributions have shaped our final advice. The themes that emerged are set out under four headings:

- values and priorities in decisions about climate change response
- areas to consider while reducing greenhouse gas emissions
- the role of government in reducing emissions
- practical options for reducing greenhouse gas emissions.

Our consultation included invitations for submitters to share their priorities for the country's climate change response. The feedback we receive about values and priorities informs Commission advice, and is reflected to Government decision-makers, and to people in the community who act in response.

The Government has choices about how to reduce Aotearoa New Zealand's greenhouse gas emissions. Our advice provides a thorough and robust package of information and analysis that can help the Government understand the implications of its choices about emissions reduction and where value judgements need to be made.

As an independent, expert advisor to the Government, the Commission is not driven by commercial interests or by politics. This independence is essential to ensuring the government of the day gets the impartial, evidence-based advice it needs to make informed decisions. In shaping our advice in response to consultation feedback, we have given weight to new evidence and insights.

Values and priorities in decisions about climate change response

The increasing cost of climate change impacts: The growing intensity and scale of the effects of climate change was a thread in many submissions, underlining calls for more urgent and ambitious action. Some submitters pointed out that impacts were felt more keenly in communities and households with fewer resources to adapt.

Submitters highlighted the unique and also disproportionate impacts of climate change on hapori Māori, including effects on traditions and knowledge systems, and vulnerability of taonga and wāhi to severe weather events and sea level rise (for example whenua, marae, urupā). The Māori economy's level of investment in land-based activity also increased iwi/Māori exposure to climate change.

Interconnections with adaptation response: Some submissions, including those with a kaupapa Māori focus, noted the interconnectedness between the health of the economy, people and environment, and the importance of enabling adaptation action for an effective and durable transition. We also heard that many iwi/Māori are already helping lead the response to climate change, as tangata whenua, rangatira and kaitiaki, and about the role places like marae play in community-led responses to severe weather events.

Opportunities available: Respondents also highlighted that transition to a low emissions economy presented opportunities, across multiple sectors.

Paris Agreement goals: Many submissions gave priority to supporting Aotearoa New Zealand's commitment to limit the temperature increase to 1.5°C, as specified in legislation, within the wider framing of the Paris Agreement.[vii]

International alignment and contribution: We also heard that if Aotearoa New Zealand makes changes to the 2050 target, it will be important to align with international action and ensure the country is contributing fairly to global efforts to address climate change. Some submitters were concerned that if Aotearoa New Zealand does not take steps to reduce its emissions, there could be negative impacts to the country's reputation and ability to operate in international markets.

Global responsibility: We heard the view that, as a developed nation, Aotearoa New Zealand could do more to contribute to limiting global warming. Some submitters urged the Commission to more explicitly consider the implications for Aotearoa New Zealand's neighbours in the Pacific, which are more immediately vulnerable to changes in the climate. This argument was based on Aotearoa New Zealand's historic contribution to global temperature rises and its close ties to those countries.

Social justice: We heard about the importance of recognising the opportunities for greater social justice in the transition to a low emissions country, including the need to directly consider people struggling to meet basic needs such as food and shelter.

Areas to consider while reducing greenhouse gas emissions

Consideration of the impacts of action to reduce emissions was a key focus in the consultation feedback. Some submitters agreed with the Commission's assessment of the impacts of emissions reduction action or highlighted particular aspects as important to take into account, while others questioned our assumptions. This section sets out themes that showed through in feedback about impacts, calling for particular aspects to be considered in the advice we provide, and the Government's decision-making.

Relative cost of action and inaction: Submitters emphasised the importance of greater understanding of the economic impacts of climate action, alongside increasing understanding of the costs of inaction.

Effects of land-use change: We heard a lot of concern about the effects of changes in land use from livestock farming to exotic forests – for carbon dioxide removal, and also as potential feedstocks for biofuels. This included impacts on rural communities and regional and local economies, and impacts on natural systems including from forestry operations and large-scale monoculture.

Equity: Many submitters commented on the importance of achieving equitable outcomes for future generations, rural communities, and businesses in this country. Supporting future generations was the basis for some of the calls we heard for amending the 2050 target to increase the contribution Aotearoa New Zealand is making to global efforts to limit warming to 1.5°C.

vii The Paris Agreement goals formally are "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". The Paris Agreement is an international treaty aimed at post-2020 climate change action that was adopted in 2015 by 196 parties to the United Nations Framework Convention on Climate Change.

Some Māori respondents emphasised that a 'just and equitable' transition means engaging locally – with whānau, people on the whenua, and through marae – before engaging with hapū and iwi. We heard about the importance of working on local solutions to local problems with local support and guidance throughout the entire process from planning and strategy to policy.

Crown–Māori relationship: We heard about the need for better, meaningful collaboration and engagement with Māori as Treaty partners.

Some submitters said an effective and equitable relationship between the Crown and iwi/Māori can only be achieved through communication and consultation, and ensuring the principles of Te Tiriti o Waitangi/The Treaty of Waitangi are upheld and honoured in partnership. We heard about the importance of early engagement with mana whenua and the potential for using local mātauranga Māori approaches in the response to climate change.

Emissions leakage: We heard that any increase in ambition of national climate action should consider the risk of emissions leakage and ensure that Aotearoa New Zealand's businesses and industries are not put at a comparative disadvantage in the international marketplace.

The role of government in reducing emissions

Policy to drive transition: We heard support for government use of policy to enable the transition to a low emissions country, including regulation, mandates, tax incentives, incentivising the domestic production of alternative fuels, incentivising the transition to low and zero emissions technologies, and emissions pricing.

This included submissions that called for continued use of complementary policies alongside the New Zealand Emissions Trading Scheme (NZ ETS), to support the required pace and scale of transition at sector level while reducing the social and economic impact of high carbon prices.

Investment: We heard calls for increased government investment in a range of areas to support the transition to a lower emissions economy. This included investment in facilities, infrastructure and workforce training. Māori submitters emphasised the need to invest in better education at all levels (including for whānau, hapū, iwi, tamariki, rangatahi and pakeke) around climate change, emissions reduction, and adaptation – to better equip Māori for the effects of climate change.

Resourcing for iwi/Māori initiatives: Almost all Māori submitters noted their communities' existing climate strategies or initiatives to reduce emissions and manage the effects of climate change. The intergenerational taiao strategies, grounded in tikanga and mātauranga Māori, reflected the localised nature of climate change impacts, as well as community priorities. There was a call for local and central government to resource these plans and initiatives to support faster emissions reduction, to the benefit of the community, and ultimately all of Aotearoa New Zealand.

Manage negative impacts of emissions reduction action: Some submissions argued it is part of the role of government to monitor and reduce potential negative impacts from the transition to low emissions, including the potential environmental impacts of switching to alternative energy sources.

Practical options for reducing emissions

Agriculture and methane: We received many submissions that saw agriculture as having a vital role to play in Aotearoa New Zealand's economy. We heard that action in this area will impact rural communities but also that methane emissions can be an opportunity for immediate reductions. Some submitters believe methane-reducing technologies will have a significant role in Aotearoa New Zealand's future and others said they are not feasible and should not be relied upon.

Alternative fuels: We heard a range of views on the role of alternative fuels in Aotearoa New Zealand. Some suggested the Commission has been overly optimistic about the role alternative fuels will play, due to where they are in the development cycle and the scale they can be employed at, while other submitters saw alternative fuels as a domestic production and investment opportunity.

Gross emissions reduction: We heard from a variety of respondents that more emphasis should be given to reduction of emissions at source, rather than relying on removal of greenhouse gases – which in Aotearoa New Zealand is currently achieved through forests. We heard from submitters on the international shipping and aviation review that emissions reductions should occur at source in the international transport sectors, and this should be prioritised over removals to support effective action to meet domestic and global targets. Submitters on the review of the 2050 target raised concerns over the permanence and durability of removals; there was support for amending the target to include a gross reductions component. Other submitters said that higher levels of carbon dioxide removals are required than current settings, and also that using offshore mitigation (when Aotearoa New Zealand pays for emissions reductions or removals that occur overseas) was questionable.

Wider range of strategies: We also heard submissions to include a wider range of emission reduction and removal strategies. This included options focused on increasing energy efficiency and optimising resource use to support a circular economy, and consideration of diverse carbon capture and storage (CCS) technologies.

How we responded

This section is focused on our response to themes that emerged in feedback across the three documents we published for consultation. The following sections report the detail of our response to specific areas of feedback on our initial review of the 2050 target, and on our initial review of whether international shipping and aviation emissions should be included in the target.

We carefully considered these themes, and the insights provided about priorities and values that people expressed through the consultation process. The new evidence and information highlighted here was investigated, at the same time as we processed updated data and information from other sources.

Our final advice presents the results of our review of judgements, conclusions and recommendations in this light.

Relevant changes to our advice, reflecting the themes that emerged in consultation, include:

- We considered the views of submitters on the need for more urgent and ambitious action as part of our decision-making about the 2050 target. The consideration we gave to what was feasible for the country to achieve was informed by other areas that emerged as themes in feedback, including emphasis on greater understanding of the economic impacts of climate action, as well as the costs of inaction.
- In our review of the 2050 target, we re-evaluated our initial view of significant changes that would justify a change in the target. We revised our judgement in three areas, finding that there is significant change in scientific understanding and global action that will place a greater burden on future generations; that there has not been significant change in technological developments including methane inhibitors; and there has not been significant change in the social impacts of extensive land-use change to forestry.
- In our review of whether international shipping and aviation emissions should be included in the 2050 target, we recommend that the Government should develop measures for meeting the target that ensure there is a specific focus on gross emissions reduction for international shipping and aviation.
- We analysed international approaches to counting international shipping and aviation emissions and noted the Government may need to revise the measure over time for this.
- We adjusted key assumptions for our modelling, to lower the level of afforestation in the demonstration path for the fourth emissions budget, which means a lower level of land-use change from livestock farming to new forestry between 2025 and 2050. This informs the recommended level of the fourth emissions budget, and is reflected in our assessment of the impacts of achieving that budget, and of our separate recommendations for changes to the 2050 target.
- We have updated how we describe our understanding of specific effects for iwi/Māori, including potential negative impacts for hapori, as well as opportunities presented in the transition to a low emissions economy.

Responses to our initial review of the 2050 target

Our discussion document on our *Review of the 2050 emissions reduction target* shared our initial answers to three questions:

- Has significant change occurred, or is it likely to occur, since the 2050 target was set by Parliament in 2019?
- Under the current 2050 target, what is Aotearoa New Zealand's contribution to global efforts to limit warming to 1.5°C?
- What are the potential impacts of changing the 2050 target?

Through consultation, we tested our early thinking on these questions before we completed our analysis and determined whether changes to the target are justified. We wanted to hear whether New Zealanders agreed with our overall approach, and our initial findings, and whether we had missed any important information or evidence in our initial work.

Respondents generally agreed with our approach to reviewing the 2050 target, and many supported our initial findings. Many submitters expressed strong support for increasing the overall ambition of the 2050 target, and many expressed concern about potential negative impacts – for example on intergenerational equity – if the target is not amended.

From agricultural-focused engagement, we heard feedback that our review of the 2050 target should consider Aotearoa New Zealand's role in food production and relative emissions efficiency. Some submitters expressed concern that a more ambitious target might lead to changes in rural land use, undermining food production and affecting rural communities.

Many submitters wanted lower emissions from all gases, including methane. We received many submissions that had views on the biogenic methane component of the split-gas target. Some stakeholders voiced support for a 'no additional warming' approach (that is, continue to cause warming at a particular level, for example, 2017 or current levels) as a principle for setting targets. Some also expressed concerns around the unavailability of methane-reducing technologies. We also heard concerns that amendments to the 2050 target could lead to higher costs for the agricultural sector, as a result of policy interventions such as emissions charges.

Have significant changes occurred since 2019?

As part of our initial review of the 2050 target, we did an early assessment to check whether there had been, or were likely to be, significant changes in circumstances since the target was first set in 2019.

With any long-term target, circumstances will change over time. Parliament recognised that some changes in circumstance could affect the 2050 target's ability to serve its intended purpose. To address this possibility, it required the Commission to consider whether significant changes had occurred since the target was set in 2019 in any of nine topics relating to climate change.

Respondents were generally supportive of our approach to checking for significant change. While submitters held a diversity of views across the nine topics we looked at, many agreed with our initial findings.

Global action: We received strong overall support for our initial assessment that there has been significant change in the area of global action.

Some submitters thought that in comparing Aotearoa New Zealand to other countries, the Commission should look at the measurable progress those countries were making towards achieving their respective targets, rather than the targets themselves. We also heard some calls to consider the rise in net zero targets being set in the private sector.

Scientific understanding of climate change: We received general support for our initial assessment that there has been significant change in the area of scientific understanding of climate change.

Supporters pointed to the pace of climate change being faster than scientists predicted when the 2050 target was set, and highlighted concerns about the impact of severe weather and climate change on Aotearoa New Zealand and its people.

Some submitters urged the Commission to consider new science on the impacts of methane, arguing that it shows that methane has less of an impact on global warming than previously understood.

Aotearoa New Zealand's economic or fiscal circumstances: Submitters generally agreed with our initial assessment that there has not been significant change in the area of Aotearoa New Zealand's economic or fiscal circumstances.

We heard some calls for the Commission to consider additional indicators of change, including inflation, insurance rates, and the trade balance.

Aotearoa New Zealand's obligations under relevant international agreements: As noted earlier, submitters were generally supportive of Aotearoa New Zealand contributing to global efforts to limit warming, consistent with Paris Agreement objectives. Many submitters wanted Aotearoa New Zealand to be more ambitious in its own emissions reductions, in order to contribute to these international efforts.

Some submitters referred to a May 2024 opinion from the International Tribunal for the Law of the Sea, which found that states are obliged under the United Nations Convention on the Law of the Sea to reduce greenhouse gas emissions. While this opinion is non-binding, some submitters suggested that Aotearoa New Zealand would face reputational damage if it did not meet its obligations under the convention.

Some submitters also questioned whether the New Zealand-European Union Free Trade Agreement (NZ-EU FTA) may have created new obligations.

Technological developments: Our initial assessment that there has been significant change in the area of technological developments received a mixed response.

Some respondents agreed that the availability of methane inhibitors overseas represents a significant change. Many submissions, however, highlighted that methane inhibitors are not currently usable within Aotearoa New Zealand, and that there is uncertainty about whether and when this technology would be applicable domestically.

We also received feedback about our initial finding that changes to the price of renewable energy did not signify significant change. Respondents pointed out that there has been an electrification tipping point which has provided rapid decarbonisation with existing technology at a scale and pace that was not foreseeable in 2019. We also heard that falls in the cost of battery and solar-powered electricity are greater than the Commission's previous assumptions.

Distributional impacts: Our initial assessment that there has not been significant change in the area of distributional impacts did not attract a large response from submissions.

Some submitters highlighted that the impacts of climate change are not evenly distributed across communities in Aotearoa New Zealand, and suggested that increases in child poverty should be regarded as a 'significant change'.

We also heard a suggestion that food security could be added as an indicator for this assessment.

Equity implications (including generational equity): Our initial assessment that there has not been significant change in the area of equity implications received a mixed response.

Many submissions argued that our initial findings of significant change in the areas of global action and scientific understanding necessitated a finding of significant change related to intergenerational equity. Supporters of this finding pointed to the increasing likelihood of inequitable outcomes for future generations due to the impacts of climate change being more severe and occurring at lower temperatures than previously anticipated, and the decreasing likelihood of the world being on track to limit warming to 1.5°C. We also heard that a newly improved understanding of the financial costs of climate change indicates an increased burden on future peoples.

The principal risks and uncertainties associated with emissions reductions and removals: Our initial analysis included the social acceptability of forests for carbon storage. Our assessment was that there has been significant change in this area. That assessment received a mixed response. In particular, submitters differed on whether there had been changes to the acceptability of forests. Some submitters noted that forestry has an important role to play in meeting the 2050 target, and that forests can benefit rural communities, as well as increasing resiliency to severe weather events.

We also heard from stakeholders opposed to growing use of permanent and production pine forestry due to its effect on communities, the economy and the environment in rural areas. We also heard about rural preferences for native forestry over exotic plantations, and support for mosaic-like landscape patterns of well-integrated land uses.

Social, cultural, environmental, and ecological circumstances: Our initial assessment that there has not been significant change in this area received a mixed response.

We also received feedback that submitters wanted the Commission to conduct further analysis on environmental and ecological circumstances. Respondents suggested that biodiversity and extinction rates could be added as indicators for this assessment.

How we responded

In most respects the feedback supported our initial analysis on whether significant changes had occurred since 2019. In three areas we revised our analysis. In response to feedback, we determined that there have been significant changes in intergenerational equity since 2019. That is, because the impacts of global warming are greater than previously understood, and because it is increasingly clear that the world is not on track to limit warming to 1.5°C above pre-industrial levels, future generations will face a greater burden – they will face more severe impacts, and will have to do more to reduce or even reverse emissions.

In two other areas – technological change, and the risks and uncertainties associated with emissions reductions and removals – our initial assessment was that significant changes had occurred. However, partly in response to feedback, we have revised those assessments and determined that there is not sufficient evidence of significant change.

For our analysis, see *Chapter 4: Significant changes since the 2050 target was set.*

What is the current 2050 target's contribution to limiting global warming?

Our initial review of the 2050 target also included looking at the target's role in fulfilling one of the purposes of the Act, to "contribute to global efforts under the Paris Agreement to limit warming to 1.5°C above pre-industrial levels."

Submitters who commented on our early assessment widely agreed with our approach and findings.

Equitable contribution and Aotearoa New Zealand's unique national characteristics: We heard widespread support for using the Intergovernmental Panel on Climate Change's (IPCC) equitable burden sharing approaches to inform our understanding Aotearoa New Zealand's contribution to global efforts to limit warming. Those burden sharing approaches assess countries' contributions to emissions reduction based on their per capita emissions, responsibility for warming, capacity or ability to pay for reductions, and right to sustainable development. We heard from some submitters who characterised Aotearoa New Zealand as relatively 'wealthy', 'first-world' and 'developed'. Some respondents noted the country's historic emissions and international responsibility, and referred to the importance of considering the more 'climate vulnerable Pacific'.

Some organisations argued that Aotearoa New Zealand's national characteristics (referred to as 'national circumstances' in the discussion document) may be a reason to depart from the IPCC's burden sharing perspectives. Others disagreed, arguing that these national characteristics would not justify such a departure. The most common reason given by these submitters was that Aotearoa New Zealand, as a developed and relatively wealthy nation, should not do less than an equitable share of the global task of reducing emissions and limiting global temperature increases.

Aotearoa New Zealand's efforts to help limit warming: Many submitters agreed that the evidence did not support consideration of a weaker 2050 target. Many expressed support for a more ambitious target.

We heard a range of suggestions for how the current 2050 target could be amended, including changing it to require:

- net zero emissions of greenhouse gases other than biogenic methane before 2050
- net negative emissions of greenhouse gases other than biogenic methane
- net zero emissions of all greenhouse gases
- specific levels of gross emissions reductions
- additional emissions reductions and removals for the post-2050 period.

Many submitters proposed increasing the ambition of the current 2050 target's requirements for biogenic methane reductions, with a 'net zero all gases' target offered most frequently as a target structure to enable this.

Other submissions voiced support for retaining the current target, stressing the importance of stability in enabling investment and long-term decision-making. We also heard specific support for retaining the split-gas structure of the current target from several organisations.

Some submissions supported amending the current 2050 target to reduce Aotearoa New Zealand's overall contribution to global efforts to limit warming. Others suggested a general reduction to the ambition of the target's requirements for biogenic methane, including some respondents who called for the biogenic methane components of target to be amended to be in line with the principle of 'no additional warming'.

How we responded

We carefully considered feedback about Aotearoa New Zealand's contribution to global efforts to limit warming, and on unique national characteristics influencing the country's capacity to reduce emissions. Many submitters supported a more ambitious 2050 target for all gases including methane. Our conclusion is that the 2050 target can be strengthened without changing the current split-gas structure. For our full analysis, see *Chapter 5: Our recommendation for the 2050 target* and *Chapter 6: Implications of our recommended 2050 target.*

What are the potential impacts of changing the 2050 target

Many of the submissions we received contributed to our understanding of the potential impacts of a change to the 2050 target. We heard concerns about the impacts of strengthening the target, such as concerns about potential economic hardship, emissions leakage, and land-use changes.

We also heard from many submitters who were concerned about potential impacts – such as worsening climate impacts and impacts on intergenerational equity – if a more ambitious 2050 target is not adopted. The impacts raised by these respondents included 'reputational risk' and other potential implications for Aotearoa New Zealand businesses operating in international markets, and the costs of inaction on future generations and less developed countries – specifically neighbouring Pacific nations – with reduced capacity to reduce emissions or adapt to climate change.

Many submitters noted that the impacts of changing the 2050 target would likely not be equally distributed across society, but that in most circumstances this would be best addressed through policy measures rather than through our review of the target.

Some submissions from respondents who self-identified as iwi/Māori shared their support for increasing the ambition of the target. These submissions highlighted that the cost of action to reduce emissions now would be less than the future costs resulting from current inaction. We have also heard in other engagement about the responsibility to nurture kaitiaki relationships and support a thriving taiao on behalf of past and future generations.[3]

We also heard from respondents who were concerned about an equitable transition. Because hauora o te taiao and hauora o te tangata are linked within te ao Māori, having a target that enables an equitable transition is important for many iwi/Māori.[4] This is especially relevant when considering the proportion of the Māori economy involved in agriculture and forestry, as any changes to the biogenic methane components of the 2050 target would have direct implications for both of these industries.

How we responded

As noted earlier, in response to feedback, we determined that there have been significant changes in intergenerational equity since 2019. Those changes influenced our final recommendation for the 2050 target, as did submissions on the potential impacts from either amending or retaining the current target. We also incorporated feedback on impacts as relevant in our modelling assumptions.

Responses to our initial review of whether emissions from international shipping and aviation should be included in the 2050 target

The discussion document on our *Review of whether emissions from international shipping and aviation should be included in the 2050 target, and if so how* provided an early view of the options the country has and what Government will need to consider as it makes decisions.

We consulted part way through the process of developing our advice to gain as broad a view as possible of the issues, opportunities and impacts we needed to consider in our work. We sought the public's feedback on the options the Government has, and in particular what should be taken into account when weighing these options up.

We sought feedback on what the impacts and opportunities of transition are for the shipping and aviation sectors, exporters and importers, and the tourism sector, and on the opportunities for job creation and economic growth from domestic alternative fuels production particularly in regional areas.

Through consultation, we heard reiterations of the importance of engagement with iwi/Māori, and calls for Aotearoa New Zealand to use a holistic approach to reducing international shipping and aviation emissions, such as through application of mātauranga Māori.

Whether to include international shipping and aviation emissions

Submitters generally considered that Aotearoa New Zealand should take responsibility for emissions from international shipping and aviation. Of submitters who addressed this issue, most supported including international shipping and aviation within the 2050 target. This included most industry, individual, and non-government organisation submitters. Two of the largest international transport operators for Aotearoa New Zealand, Air New Zealand and Maersk, supported the inclusion of international shipping and aviation emissions, albeit with some caveats around the importance of policy direction for the transition.

A small number of submitters opposed including international shipping and aviation in the 2050 target. Some said the Commission should reconsider emissions from international shipping and aviation at a later date, during future reviews of the 2050 target. Some submitters did not express a view on whether to include these emissions in the 2050 target.

While most submitters supported including international shipping and aviation in the 2050 target, some said their support was 'in principle', and that they wanted greater certainty around the policy direction and impacts. In particular, some wanted government policies to support emissions reductions, and did not favour an approach that would rely solely on the New Zealand Emissions Trading Scheme (NZ ETS).

Many submitters also emphasised that including international shipping and aviation in Aotearoa New Zealand's 2050 target should not come at the expense of cohesive global action. Submitters considered that Aotearoa New Zealand should be aligned with the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO), as well as other countries that Aotearoa New Zealand relies on for trade and tourism. We heard that it is inconsistent with Aotearoa New Zealand's signing of the Paris Agreement to exclude these sectors from domestic targets.

Pricing was an area of significant feedback. Industry submitters tended not to support inclusion if it meant doing so through the NZ ETS. These respondents were of the view that regulation and/or incentives would be more effective to reduce emissions, and that pricing could cause disproportionately negative impacts for Aotearoa New Zealand. We heard that it is important to consider the effects of overseas action, including accounting rules, levies and taxes, and the use of carbon border adjustment mechanisms.

Many submissions raised the role of Government in managing the transition and any associated impacts, including through domestic policy. Some submissions from industry representatives indicated they wanted greater certainty about the policy direction for international shipping and aviation emissions, in order to inform the Government's decision on whether to include these emissions in the 2050 target.

We heard from some submitters that if these emissions are added to the 2050 target, alternative fuels, feedstocks, and domestic production should be discussed further in our advice, including the role they play in decarbonising the international shipping and aviation sectors. These submitters were also interested in hearing more about the plausibility of the domestic production of alternative fuels in Aotearoa New Zealand.

How we responded

In response to these submissions, we have confirmed our position from our initial analysis and recommended that international shipping and aviation be included in the 2050 target. Most submitters supported this position. We have updated our analysis and modelling of the potential impacts (in particular economic impacts) from including these emissions in the target to reflect the evidence received. We have also clarified that including these emissions in the 2050 target should not come at the expense of coordinated global action, and would not necessarily require international shipping and aviation to be included in the NZ ETS (that is a policy decision for the Government to consider). Our consideration of whether to include emissions from international shipping and aviation is set out in *Chapter 8: Whether to include international shipping and aviation emissions* and analysis of the impacts is set out in *Chapter 9: Implications of including international shipping and aviation emissions*.

How to measure international shipping and aviation emissions

Measurement

In order to reach a decision on whether to include international shipping and aviation emissions in the 2050 target, it is necessary to consider how these emissions might be counted. That makes it possible to estimate Aotearoa New Zealand's current emissions and to set five-yearly budgets to reduce these emissions. Through our discussion document, we consulted on six options. Submitters favoured refuelling and to/from next port options. Aviation and tourism organisations tended to prefer refuelling, whereas shipping/exporters preferred to/from next port.

Fairness was a key theme in submissions about measuring international shipping and aviation emissions. We heard that refuelling may be the best measure for aviation, while fuel to/from next or final port would best suit shipping, as these sectors have different emissions profiles and different methods of fuelling. Some submissions called for distinct measures to be used between the two sectors to ensure the most accurate accounting for each.

We heard that alignment with other countries is required to ensure accounting is fair and simple, and that double counting is avoided. We also heard that whichever measurement approach is chosen, it may need revising over time to ensure ongoing alignment with other countries, IMO and ICAO.

Other climate impacts

In addition to the greenhouse gases covered by the 2050 target, international shipping and aviation has other impacts that contribute to climate change. A decision will be needed about including these 'other climate impacts'. Through our discussion document, we consulted on three options.

Most submitters did not provide a preference on these options. Of those who did, most supported including these other climate impacts in emissions accounting. However, no industry submitters preferred this option, instead preferring to exclude or reconsider these impacts. Some non-government organisations preferred to reconsider this issue at a later date, voicing concerns that including these other impacts before the science is more certain could make it harder to transition with the support of industry. None of the submissions on this issue raised new evidence additional to what we had already considered prior to consultation.

How we responded

In response to submissions about how to measure international shipping and aviation emissions, we have followed the approaches favoured by most submitters. Our final advice is to adopt separate measures for shipping and aviation. Shipping emissions should be measured using fuel use to and from the next port, and aviation emissions based on refuelling. We have adopted these measures in part because (of available options) they have the lowest risk of double counting. Our final advice also notes that the measures might have to be reassessed over time. *Chapter 7: How international shipping and aviation emissions could be included* discusses our recommended approach to measuring these emissions.

How international shipping and aviation emissions could be included in the 2050 target

Structure of a target

If international shipping and aviation emissions are added to the 2050 target, a decision will be needed about where they are added: to the net zero component of the target, or as separate components. Through our discussion document, we consulted on four options.

Most submissions preferred to add international shipping and aviation into the net zero component of the 2050 target. We saw a clear preference by industry and individual submitters for adding these emissions to the net zero component of the target, with non-government organisations split between preferring the net zero component, or adding new separate components. Overseas airlines indicated support for "models that allow for a dedicated focus on aviation."

Some submitters who expressed a preference for adding international shipping and aviation emissions into the net zero component still wanted some form of separate accountability and focus on gross emissions. Some recommended separate emissions budgets for these sectors, and several stakeholders recommended they be included within emission reduction plans, reported as separate sectors.

We heard that as an exporting nation, specific considerations for exports should be made, including that market access and signals should be considered in Aotearoa New Zealand's approach to adding these emissions into the 2050 target.

Level of reduction

If international shipping and aviation emissions are added to the 2050 target, decisions will be needed about the level of emissions reduction for international shipping and aviation to aim for, and whether the ambition level of the target as a whole should change.

Nearly all respondents who expressed an opinion on the level of emissions reductions preferred high ambition, and there were no submissions that supported low ambition. Most industry submitters and some individuals had no formal position. Industry submitters indicated the Commission should use global models, including those from IMO and ICAO, but adapted for Aotearoa New Zealand. We also heard technology will change significantly between now and 2050, so ambition levels may need to be adjusted over time.

In response to our question about changing the target's level of emissions reductions to match residual international shipping and aviation emissions, the position of submitters was unclear. Some opposed the target level being lowered.

How we responded

We have recommended that emissions from international shipping and aviation be included in the net zero component of the target and that its level not be lowered. Most preferred this approach, as distinct from establishing separate targets for international aviation and shipping. In response to feedback, we have considered potential impacts on industry from including emissions in the target, and have updated our analysis accordingly. Also in response to feedback, we have suggested that the Government develop specific measures that focus on gross emissions reductions in international shipping and aviation.
See Chapter 7: How international shipping and aviation emissions could be included for our analysis.

Te reo Māori glossary

Kupu/rerenga kupu Māori
English contextual translation

ā-tinana in person

hapori Māori Māori communities

hapū kinship group comprised of whānau who share a common ancestry

hauora wellbeing

iwi extended kinship group of whānau and hapū who share a common ancestry and are associated with a distinct territory

kaitiaki guardians, stewards, trustees

kaupapa Māori issues and topics that have a specific focus on the Māori world

kawa protocols, practices

mana whenua authority over land or a specific territory

marae the open area in front of the wharenui, where formal greetings and discussions take place; often used to include the complex of buildings around the marae

mātauranga Māori Māori knowledge, the body of knowledge originating from Māori ancestors, including the Māori world view and perspectives, Māori creativity, and cultural practices

pakeke adults

rangatahi youth

rangatira chief, chiefly, noble

tamariki children

tangata whenua people born of the whenua – people of the land where their ancestors have lived

taonga treasure, anything prized: applied to anything considered to be of value including socially or culturally valuable objects, resource, phenomena, ideas, and techniques – children and future generations may also be regarded as taonga

te taiao the natural world, the environment

tikanga correct procedure, custom, habit, lore

urupā burial ground

wāhi, wāhi tapu place, sacred place

whakaaro thought, opinion, idea, understanding

whakapapa genealogy of how someone or something has come into being

whānau family

whenua land

Wehenga B: Te tātari i te whāinga 2050

Part B: Reviewing the 2050 target

Wāhanga 3 | Chapter 3

He horopaki hiranga i tā mātou tātaringa o te whāinga 2050
Important context for our review of the 2050 target

In this chapter we discuss important matters that provide the context for our review of the 2050 target.

One of the purposes of the Climate Change Response Act 2002 (the Act) is to provide a framework for policies that contribute to global action aimed at limiting global warming to 1.5°C above pre-industrial levels. In turn, the 2050 target is an integral part of that policy framework, guiding Government decisions on emissions reduction policies.

In this chapter we consider important context for the review of the 2050 target. This includes:

- global efforts to limit climate change
- Aotearoa New Zealand's domestic commitments to reduce emissions
- warming effects from different greenhouse gases, and
- the concept of 'no additional warming' as a principle for setting emissions targets.

Global efforts to limit climate change

Aotearoa New Zealand's 2050 target is a part of global action to limit global warming, which we define as meaning the amount by which Earth will be warmer with, compared to without, the greenhouse gases emitted by human activity.

Assessing the current target requires understanding how warming works, global efforts to limit warming and Aotearoa New Zealand's contribution to those efforts. Reducing warming as soon as possible matters because several impacts of global warming are irreversible, such as sea level rise, ocean acidification and loss of biodiversity.

The Paris Agreement sets a goal of limiting the increase in the global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit warming to 1.5°C. One of the purposes of the Act is to enable Aotearoa New Zealand to contribute to global efforts under the Paris Agreement to limit warming to 1.5°C.

The world is currently heading for warming above the 1.5°C goal of the Act and the Paris Agreement, even if all climate targets and domestic net-zero pledges are met. Countries will need to deliver more than they have currently promised both before and after 2050, as highlighted by the UN *Emissions Gap Report 2023*.[5]

As the world warms beyond 1.5°C, returning to the 1.5°C goal will require at least achieving net negative emissions of long-lived greenhouse gases and increased reductions of short-lived greenhouse gas emissions. This would mean more carbon dioxide being removed from the atmosphere than is emitted. This situation, where the 1.5°C goal is exceeded for a time and then met by actions to lower temperatures, is known as 'overshoot'.

Future emissions, past emissions and current temperatures combine for future warming

The first step to estimating future warming is identifying the causes of global warming. Factors that influence how much and when global temperatures will rise and whether the world meets the temperature goals under the Paris Agreement include:

- the warming that has already occurred due to human activity
- the warming that will occur in the future due to past emissions (carbon dioxide emissions that have already been emitted into the atmosphere have the main impact here – the relationship between cumulative carbon dioxide emissions and global warming is close to linear)[6]
- future emissions of carbon dioxide
- future non-carbon dioxide greenhouse gases emitted, including both long-lived and short-lived greenhouse gases
- the amount and durability of future removals of greenhouse gases from the atmosphere (for example, carbon dioxide removal through planting trees).

Natural factors that can affect warming are unpredictable and small in relation to warming caused by human activities. Changes in solar radiation or volcanic activity are estimated to have contributed less than plus or minus 0.1°C to total warming between 1890 and 2010.[7]

Future warming is likely to exceed 1.5°C

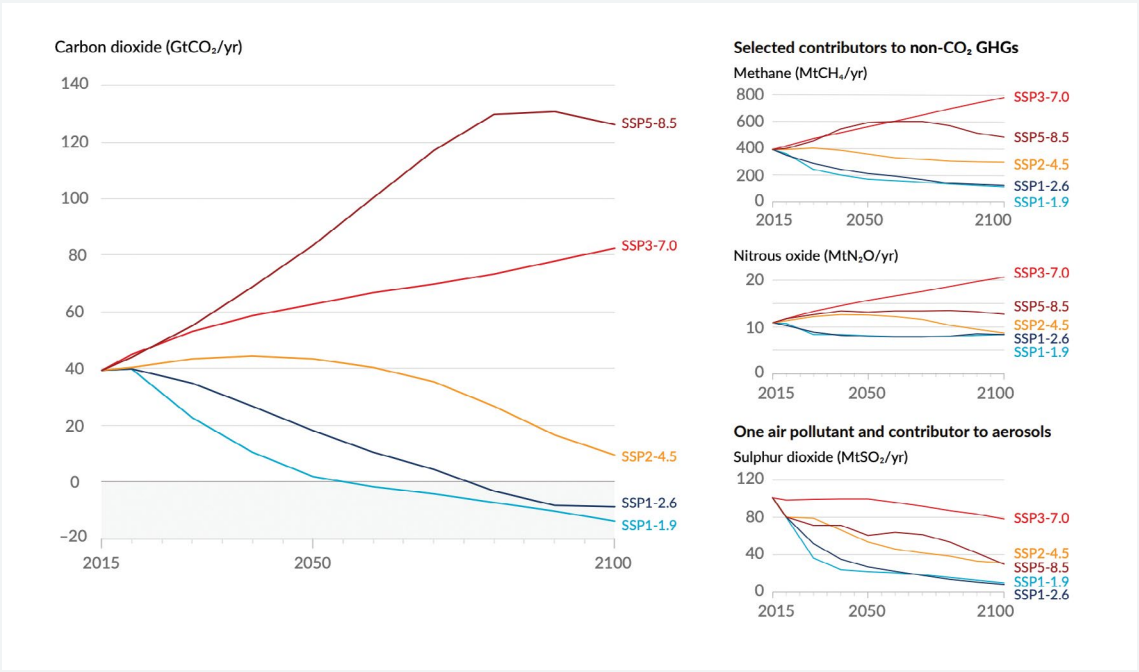
This section sets out what projections of future emissions can tell us about future temperatures.

The IPCC have used scenarios of future emissions based on broad socioeconomic trends that could shape future society. They are useful because while future global emissions are unknown, they largely depend on what people around the world do now and in the future.

One set of scenarios is called 'Shared Socioeconomic Pathways' (SSPs) based on five narratives describing broad socioeconomic trends that could shape future society. These are intended to span the range of plausible futures. The main differences between SSPs come from their assumptions on global population growth, access to education, urbanisation, economic growth, resources availability, technology developments and drivers of demand, such as lifestyle changes.[8]

In its Sixth Assessment Report (AR6), the IPCC looked at five global emissions pathways, one from each narrative, to illustrate what temperatures would result from different levels and combinations of global emissions, including temperature increases already locked in by past emissions. There are many different possible scenarios developed by institutions around the world, including others by the IPCC. We have used the SSPs as useful scenarios to gain insight. The emissions reductions of different greenhouse gases in those pathways are shown in **Figure 3.1**.

Figure 3.1: Future annual emissions of greenhouse gases across five illustrative scenarios



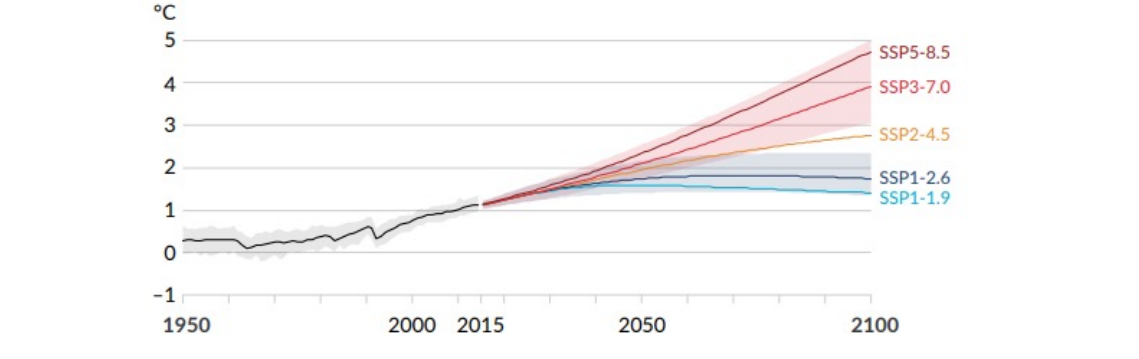
Source: IPCC, Climate Change 2021: The Physical Science Basis[9]

Only one scenario, the SSP1-1.9, shows an outcome close to limiting warming to 1.5°C. However, even under the SSP1-1.9 scenario, 1.5°C is exceeded and requires the world to achieve net negative emissions of carbon dioxide shortly after 2050 to bring warming back down below 1.5°C. This 'overshoot' scenario also requires significant global reductions in the rate of methane emissions, and reductions in nitrous oxide emissions. Although these gases are not reduced to zero, warming from the residual emissions of these gases is counteracted by the net-negative emissions of carbon dioxide.

The temperature outcomes of these scenarios are shown in **Figure 3.2**.

The SSP1-1.9 gives us a good baseline for a global emissions pathway that comes close to limiting warming to 1.5°C, although it requires sustained net negative emissions of carbon dioxide after 2050 to achieve this.

Figure 3.2: Global surface temperature change relative to 1850–1900 across five illustrative scenarios



Source: IPCC, Climate Change 2021: The Physical Science Basis[10]

Aotearoa New Zealand's domestic emissions reduction commitments

The current 2050 target in the Act sets requirements for how much Aotearoa New Zealand's emissions must reduce, and by when. It encompasses all domestic sources of greenhouse gases reported in New Zealand's Greenhouse Gas Inventory (GHG Inventory) and has three distinct components that require different levels of emissions reductions across different timelines and gases:

- net zero emissions of all greenhouse gases other than biogenic methane by and beyond 2050
- a reduction of gross emissions of biogenic methane[viii] to:
  - 10% below 2017 levels by 2030
  - 24–47% below 2017 levels by and beyond 2050.

The structure of the current target has specific requirements for biogenic methane emissions, reflecting the different impact on warming they have to emissions of long-lived gases, as well as uncertainties around the availability and affordability of options to reduce them. The target is often referred to a 'split-gas target' for this reason. Targeting separate gases in this way accounts for their different warming effects over different timeframes and can provide certainty about who needs to reduce emissions and by how much. On the other hand, splitting gases in the target is not as flexible as a target that encompasses all gases and allows trade-offs in policy and emissions reductions as time progresses.

This target serves one of the broader purposes of the Act, which is to:

> "provide a framework by which New Zealand 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".

Targets are important tools used to identify and achieve shared, quantifiable, and time-bound goals. They help galvanise and focus collective action by converting a vision for the future into tangible and attainable outcomes.

The 2050 target is the guiding star for Aotearoa New Zealand's climate change policies – the emissions reductions achieved through the policies need to add up to meet the target. These climate change policies affect energy costs, global market opportunities, the cost and availability of electric vehicles and other low emissions transport, the degree of burden on future generations, and many other aspects of Aotearoa New Zealand's society, economy and environment. The 2050 target also matters for Aotearoa New Zealand's international reputation as a country focused on sustainability and protecting the environment, which in turn benefits tourism and export industries.

viii *Biogenic methane* is methane emitted in the agriculture and waste sectors, mainly from ruminant animals and decomposing waste.

Aotearoa New Zealand's emissions are relatively large for the country's population

This section sets out how much warming has been caused by emissions from Aotearoa New Zealand in the past and warming expected in the future. The warming in a given year is the result of emissions from that year and previous years. The future projections we present are based on the low technology low systems change (LTLS) emissions scenario developed for our advice on Aotearoa New Zealand's fourth emissions budget. This is one possible path that meets the current target and can be used to draw insight about how much warming Aotearoa New Zealand would cause if we achieved the current target. For the period of 2050 to 2075 we assume continued technological and system changes, and constant emissions from 2076 to 2100.

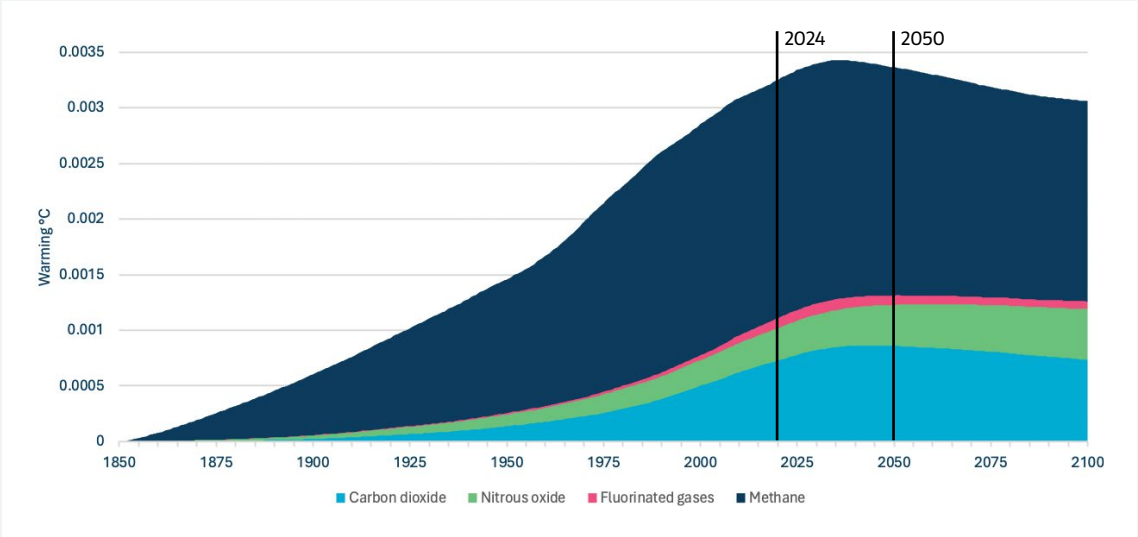
The results show that:

- warming is mainly from methane, carbon dioxide and nitrous oxide
- most warming comes from methane emissions
- global warming caused by emissions from Aotearoa New Zealand peaks in the 2030s–2050s at over 0.003°C
- Aotearoa New Zealand contribution to global warming remains over 0.003°C by 2100.

Looking at warming in this way allows us to understand total warming from different greenhouse gases without the use of metrics that equate other greenhouse gases to carbon dioxide. While this amount of warming is a small part of the total warming the world has seen to date, it is relatively large given the country's population. If every country in the world caused the same level of warming per capita as Aotearoa New Zealand, total warming would peak at around 5°C and decline to around 4.3°C by 2100.

Note this analysis excludes warming caused by the release of carbon dioxide through historical deforestation. Warming from historical deforestation is significantly higher than warming caused by emissions. If we assume that half of the total deforestation occurred since 1850, then warming due to deforestation since then would be around 0.007°C[11] in addition to that caused by emissions as stated above.

Figure 3.3: Warming from emissions in Aotearoa New Zealand 1850–2100 under a scenario that meets the current target

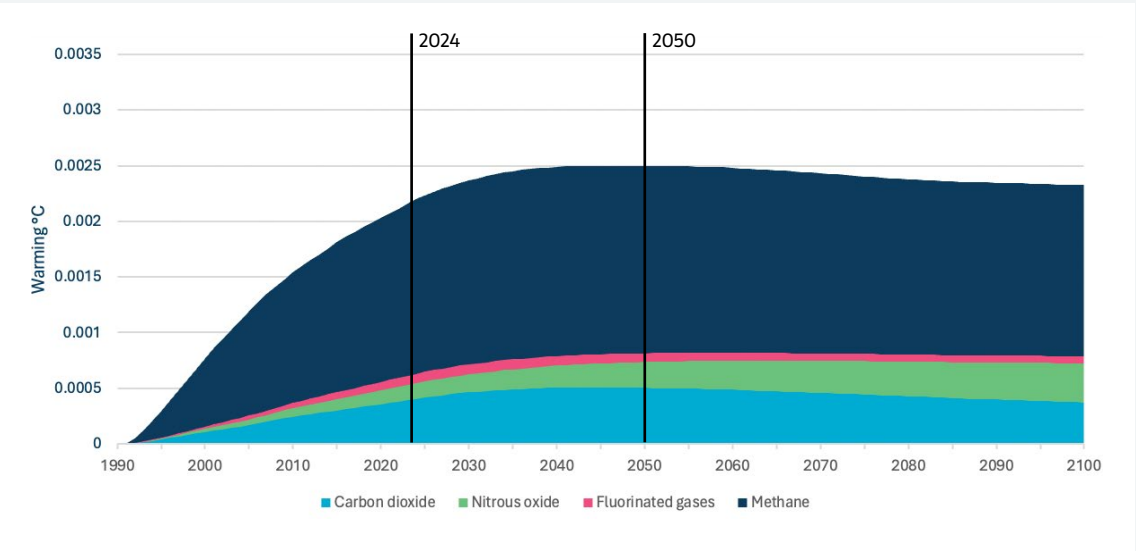


Source: Commission analysis[ix]

ix To produce the analysis we used the Finite Amplitude Impulse Response simple climate model (FaIR). FaIR is a reduced-complexity climate model useful for scenario assessment. Note this figure shows warming from net target accounting emissions only and does not include deforestation, which has contributed even more warming.

Aotearoa New Zealand's share of warming from post-1990 emissions would peak at around 0.0025°C in 2050 and drop to 0.0023°C in 2100, with biogenic methane causing two thirds of this warming.

Figure 3.4: Warming from post-1990 emissions from Aotearoa New Zealand 1990–2100 under a scenario that meets the current 2050 target



Source: Commission analysis

The 2050 target's timeframe and level primarily determine how much warming is caused

How much (the level) and how fast (the timeframe) we reduce emissions will make the biggest difference to limiting global warming.

Emissions of long-lived greenhouse gases like carbon dioxide stay in the atmosphere for hundreds to thousands of years after they are emitted. For these emissions, the total warming from Aotearoa New Zealand will depend on how quickly they are brought down to net zero or lower. Biogenic methane, on the other hand, is a shorter-lived greenhouse gas. Over decades, the warming biogenic methane causes will decrease if emissions decrease. This means how much warming is caused by Aotearoa New Zealand's biogenic methane emissions depends primarily on the recent rate of those emissions.

The current target does not require further emissions reductions after 2050. Sustained net negative carbon dioxide emissions and further reductions of methane are required even in the best-case scenarios assessed by the IPCC.

While the current target requires Aotearoa New Zealand to achieve net zero emissions of most greenhouse gases by 2050, it does not require emissions of biogenic methane to reach net zero. There is no requirement for the remaining emissions of biogenic methane to be offset by deeper reductions of other greenhouse gases before or after 2050. This means that it is possible to achieve the 2050 target and still have net positive emissions of 700–1,000 $KtCH_4$[x] and associated contribution to global warming in 2051 and every year after.

x 19–28 $MtCO_2e$

Warming effects from different greenhouse gases

Different greenhouse gases cause warming differently

The main three greenhouse gas emissions from Aotearoa New Zealand are carbon dioxide, methane and nitrous oxide. While each causes warming, their impacts differ.

Methane has a strong warming effect that lasts several decades, with a smaller amount of warming lingering up to hundreds of years. Nitrous oxide also has a strong warming effect that lasts over a hundred years. By contrast, carbon dioxide has a weaker warming effect on a tonne-for-tonne basis, but lasts much longer in the atmosphere – its impacts can remain over hundreds to thousands of years.

Under IPCC pathways in which warming is limited to 1.5°C or thereabouts, reducing global carbon dioxide to net zero and beyond is essential, and significant reductions in other gases such as methane and nitrous oxide are also essential. In order to contribute to global efforts to limit warming, any emissions target has to address the warming effects from all of these gases.

Warming from carbon dioxide can be reduced

Warming from carbon dioxide is currently the dominant contributor to global warming from emissions of greenhouse gases. Carbon dioxide caused 23% of the warming from Aotearoa New Zealand's emissions in 2022.

While there are different combinations of global greenhouse gas reductions that could limit warming to 1.5°C, they all fundamentally require the warming caused by carbon dioxide to stop increasing and then start to reduce (through removals of carbon dioxide). In other words, carbon dioxide emissions need to become net negative. Net negative carbon dioxide emissions can compensate for warming caused by continued emissions of methane and nitrous oxide, and for the ongoing warming effects of historic carbon dioxide emissions.

There are available and affordable options to reduce and remove carbon dioxide emissions

Net carbon dioxide emissions have been falling since 2006 in Aotearoa New Zealand. Further reducing net carbon dioxide is essential if Aotearoa New Zealand is to meet its national and international targets. The main source of carbon dioxide emissions is burning fossil fuels. Emitting sectors include electricity generation, industry, transport, agriculture and waste. There are many ways to reduce carbon dioxide emissions both now and on the horizon (see *Advice on Aotearoa New Zealand's fourth emissions budget*):

- increasing renewable electricity generation and geothermal carbon capture and reinjection
- electrification of transport, including light passenger vehicles, light commercial vehicles, buses and medium trucks
- improved demand management for renewable electricity, including energy efficiency
- shifts away from fossil fuels including in industry, such as electrification of machinery and shifting away from coal in cement and steel production.

Land-based carbon dioxide removals like forests contribute to emissions reductions when they remove CO_2 from the atmosphere. Novel carbon dioxide removal techniques are also on the horizon, such as bioenergy with carbon capture and storage, and direct air capture.

Warming from biogenic methane emissions can be reduced

Biogenic methane caused 65% of the warming from Aotearoa New Zealand's emissions in 2022.

Aotearoa New Zealand's biogenic methane emissions have caused more warming since 1850 than carbon dioxide and nitrous oxide emissions combined (excluding deforestation). This is also true for the period since 1990.

Global pathways for limiting warming below or close to 1.5°C require reduced emissions of and warming from methane, as well as net negative carbon dioxide emissions. Changing how much methane Aotearoa New Zealand emits in future would make a major difference to how much warming the country causes.

There are available and affordable options to reduce biogenic methane emissions

Biogenic methane emissions have been reducing since 2005 in Aotearoa New Zealand showing reductions are not only possible, but are already happening. Further reductions are essential if Aotearoa New Zealand is to meet its national and international targets. The main sector sources of biogenic methane in 2022 were agriculture, with 91% of the total and waste, with 9%. There are many ways to reduce biogenic methane emissions both now and on the horizon:[12]

- Waste – increased use of composting facilities and anaerobic digestion.
- Methane inhibitors – while not yet usable in Aotearoa New Zealand, a feed additive methane inhibitor capable of reducing methane emissions from animals like cows and sheep by around 30% is legal for use in more than 55 countries worldwide, including the United States, Brazil, Chile, European Union, Canada and Australia.[13]
- Next generation methane technologies – one or more of a set of promising developments such as methane vaccines or other alternatives to inhibitor delivery such as a bolus have a good chance of becoming available soon.
- Low emission feeds – some supplementary feeds reduce methane emissions per unit of feed intake because they ferment differently in the rumen. Two supplementary feeds already in use in New Zealand have been shown to reduce the amount of methane produced per unit of feed consumed: forage rape and fodder beet.
- Stocking rate and individual animal performance – methods are available to drop the stocking rate (the number of animals per hectare on a farm) such that output and profit are maintained or even increased. This may be via the use of better genetics, re-examining supplementary feeding and re-visiting fertiliser practices.
- Land-use change – land-use change reduces emissions if the new land use produces fewer emissions than the previous land use. In general, this is done by reducing the number of ruminant animals and producing a non-animal product such as an arable or horticultural crop, timber, or carbon in the form of trees on part or the whole of the farm.

Warming from nitrous oxide emissions can be reduced

Warming from nitrous oxide contributes to global warming. Global emissions of nitrous oxide have increased by about 30% over the past four decades.[14] Nitrous oxide caused 9% of the warming in 2022 from Aotearoa New Zealand's emissions.

The global pathways that require net negative emissions of carbon dioxide and reduced methane emissions also require nitrous oxide emissions levels to stabilise or fall.

The primary source of nitrous oxide is agriculture, particularly the use of nitrogen fertilisers. The IPCC notes that there are measures available to reduce nitrous oxide globally.[15] For Aotearoa New Zealand, our analysis (which informed emissions scenarios) is that reducing nitrous oxide emissions could be more challenging under current and expected practices and technologies than reducing emissions of other greenhouse gases.

Options to reduce nitrous oxide emissions include improving fertiliser use efficiency, adopting precision agriculture techniques, and exploring microbial solutions to enhance natural nitrogen fixation in soils.

No additional warming as a principle for setting targets

The term 'no additional warming' is sometimes used to describe an approach in which the warming caused by methane emissions should be stabilised at current or recent levels.

Through our call for evidence and during consultation, many submitters suggested we should adopt 'no additional warming' as a principle for our recommendation on the biogenic methane component of the 2050 target. Most of the content we received with regard to 'no additional warming' was centred around assessing the impacts of applying no additional warming with respect to the warming from recent levels of biogenic methane. However, we were not provided with evidence that would support a conclusion that taking a 'no additional warming' approach for a major short-lived greenhouse gas such as biogenic methane would be consistent with contributing to global efforts to limit warming to 1.5°C above pre-industrial levels, as required under the purpose of the Act.

In a global commons problem like climate change, what matters is the amount of warming that any individual emitter and gas contributes to global warming, not whether that amount is increasing or decreasing relative to a recent reference year. Because methane is short-lived, historical methane emissions have only a limited effect on future warming, and the contribution of Aotearoa New Zealand's methane emissions to future global warming depends largely on our future emissions. Every tonne of methane that we still emit in future will make the Earth warmer than it would have been without that emission; equally, every tonne avoided would avoid further climate-related damages.

Globally, significant reductions in methane emissions are necessary to help limit global warming to anywhere near 1.5°C (or well below 2°C).[16] A 'no additional warming' approach for biogenic methane would mean Aotearoa New Zealand would claim an entitlement to ongoing methane emissions, at a level determined only by our past level of emissions, rather than looking for effective and efficient opportunities to avoid future methane emissions.

Based on the evidence available to the Commission, we are unable to conclude that a 'no additional warming' approach for biogenic methane would constitute an adequate contribution to global efforts to limiting warming to 1.5°C.

This section sets out some important further context about why using 'no additional warming' as a principle for setting targets with respect to biogenic methane presents challenges, and the consequences if this were adopted as way to set a target.

In June 2024 the Government appointed a panel to review methane science and targets for consistency with no additional warming relative to 2017 as a reference year. We understand the panel will submit their findings to Government so that they may be considered alongside this advice, as the Government decides whether, and/or how, to amend the current 2050 target. Our review is separate from the panel's work, and is conducted according to the Act's 2050 target review requirements.

How 'no additional warming' is applied requires value judgements

In consultation we heard that setting a target for biogenic methane based on no additional warming would be consistent with taking a science-based approach. While science can inform decision-makers of the consequences related to different choices, any target setting exercise also involves making judgments about what we as a country value.

Turning 'no additional warming' into a prescribed target would require judgements about:

- the reference year (when 'no additional warming' is measured from)
- levels of observed and expected background (global) methane emissions
- risk tolerance for the possibility that the methane emissions target does not limit the warming it causes as much as intended.

The required methane emissions level consistent with a 'no additional warming' approach can vary widely depending on choices about the reference year and background emissions scenarios. Science cannot tell us what reference year to chose to contribute to global efforts to limit warming to 1.5°C. One study that varies the reference year (from 1984 to 2017) and background emission scenarios suggests Aotearoa New Zealand's biogenic methane emissions would need to reduce by 14–58% from 2017 levels to achieve 'no additional warming' by 2050.[17]

The choice of reference year is inherently subjective. In addition, the warming caused by our methane emissions depends on global background emissions, i.e. how much methane will be in the atmosphere already in future. Global methane emissions are hard to predict (with many defensible options). As a result, an emissions target set on the basis of 'no additional warming' may not deliver the intended outcome. These subjective calls and scientific uncertainties mean that a 'no additional warming' principle does not give a clear answer to target setting based on science, even if it were considered to be a relevant target-setting principle. Setting a target based on this principle would not avoid further policy choices based on a feasibility and impacts assessment.

Setting targets according to no additional warming from biogenic methane would require trade-offs and create consequences

If applying the principle of 'no additional warming' resulted in a less ambitious target for biogenic methane reductions than the current target, Aotearoa New Zealand would face choices.

It would have to:

- set a new target that allows more warming than the current 2050 target, or
- try to maintain the expected warming impacts of the current target and require faster and further reductions of other greenhouse gases.

As set out in *Chapter 4: Significant changes since the 2050 target was set*, the Commission has found no reasons to relax Aotearoa New Zealand's contribution to global efforts and no significant change that would justify causing even more warming than under the current target.

If Aotearoa New Zealand does not wish to cause even more warming than under the present target, a 'no additional warming' target for biogenic methane would need to be balanced by even faster reductions of long-lived gases. However, such a re-balancing of the two components of the 2050 target would be unlikely to achieve cost-effective mitigation across the economy. Further feasible and cost-effective reductions of biogenic methane beyond those resulting in no additional warming could be foregone, while more costly additional reductions of other gases are required, to achieve the same warming outcome.

Every tonne of biogenic methane avoided provides a benefit to the climate since it avoids climate-related damages, just as every tonne of carbon dioxide avoided provides a benefit. As described earlier, there are technologies and approaches that can be used to reduce biogenic methane emissions. Setting a 'no additional warming' biogenic methane target is likely to exclude meaningful and cost-effective opportunities to reduce biogenic methane emissions from such considerations. In the end it is the amount of warming from all emissions that matters to avoid the worst effects of climate change.

To illustrate the potential implications of re-balancing from the current target to one based on a principle of no additional warming from biogenic methane, we used one of the metrics assessed in the most recent IPCC report[18] to illustrate the consequences, if the methane reduction target is changed by just one percentage point. The example is based on achieving the same warming outcome in 50 or 100 years after the hypothetical target adjustment, based on a sustained change in biogenic methane levels being similar to a corresponding one-off reduction or removal of carbon dioxide. This metric recognises explicitly that methane is short-lived and therefore the warming from sustained emissions do not accumulate in the same way as warming from carbon dioxide.

For every sustained increase in methane emissions by one percentage point (i.e. if emissions were reduced by only 23% rather than 24% in 2050), the Government would need to achieve a further one-off reduction in other greenhouse gases by between 36 and 44 $MtCO_2e$[xi] to maintain the same overall contribution to global warming over the following 50 to 100 years.

Such further reductions could be achieved by one of the following:

- Purchasing 36 $MtCO_2e$ worth of international credits per one percentage point target change, which would cost between $1.5 billion and $8.3 billion depending on how they are acquired, or
- Incentivising 36 $MtCO_2e$ worth of additional afforestation, which is around 50,000 ha[xii] of afforestation per one percentage point target change. This would require managing additional economic social and cultural impacts associated with increased afforestation, or
- Having a one-off reduction of 36 $MtCO_2e$ of other gases per one percentage point change. As context, 36 $MtCO_2e$ is equivalent to all gross emissions in Aotearoa New Zealand from energy, transport, industry and waste for all of 2022.

If a 'no additional warming' approach were used to reduce the biogenic methane component of the target from the midpoint (35%~) of the current range (24–47%) to a level suggested would deliver no additional warming, around 15%, then the numbers in this examples should be multiplied by the change of 20 (35%-15%=20). The Parliamentary Commissioner for the Environment estimated that offsetting the actual warming from a 20% change in biogenic methane emissions would require approximately 1.5 million hectares of additional pine afforestation,[19] over and above those needed already to meet the current target.

xi We use the combined global temperature-change potential metric (CGTP) values from the IPCC (IPCC AR6 WG1 Chapter 7, Table 7.15) for the calculation. Using the value for CGTP-50 (years) 13.6 $ktCH_4$ (non-fossil) multiplied by 2,675 results in 36,398 $ktCO_2$. Using the value for CGTP-100 (years) 13.6 $ktCH_4$ (non-fossil) multiplied by 3,228 results in 43,923 $ktCO_2$

xii At a long-term average carbon yield for production pine of 196.2 tC/ha, drawn from the Energy and Emissions in New Zealand (ENZ) model.

Wāhanga 4 | Chapter 4

He panonitanga nui nō te whāinga 2050
Significant changes since the 2050 target was set

As part of our review the 2050 target, we must determine whether significant climate-related changes have occurred since the target was first set.

In establishing the 2050 target as Aotearoa New Zealand's domestic contribution to global efforts under the Paris Agreement to limit global warming to 1.5°C, Parliament set the country on a long-term course for reducing its greenhouse gas emissions.

With any long-term target, circumstances will change over time. While change is constant and to be expected, Parliament recognised in setting the 2050 target that some changes could impact the target's ability to serve its intended purpose.

For that reason the Climate Change Response Act 2002 (the Act) requires us to review the target every five years. We can recommend changes to the target, but only under certain conditions. We must first consider whether significant changes have occurred since the target was previously set, and then determine whether those changes justify amendments to the target.

This sets a high bar for change. It recognises the importance of having a stable, long-term target for emissions reduction, but balances that against responsiveness to changing circumstances.

Almost no aspect of the climate, economic or societal landscape has remained unchanged since 2019, when the target was set. The challenge is to determine which changes are significant and may merit a change to the 2050 target.

In this chapter, we share our analysis and findings of significant change across the nine topics the Act requires us to consider when determining whether significant change has occurred.

Our approach to checking for significant change

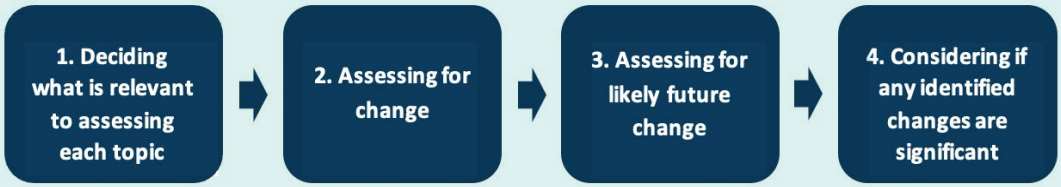
The Act specifies the areas in which we are tasked with looking for significant change.[20] These are:

- global action on climate change
- scientific understanding of climate change
- Aotearoa New Zealand's economic or fiscal circumstances
- Aotearoa New Zealand's obligations under relevant international agreements
- technological developments
- distributional impacts
- equity implications (including generational equity)
- the principal risks and uncertainties associated with emissions reductions and removals
- social, cultural, environmental, and ecological circumstances.

Our approach to checking for significant change involved four steps

While the Act directs us on where to look for significant change, it does not provide specific guidance on how to tell if it has occurred or is likely to occur. For this review, we developed a four-step process (**Figure 4.1**), which enables us to consider each area methodically, looking at a wide range of factors.

Figure 4.1: Significant change assessment process



Step 1: Deciding what is relevant to assessing each topic

In each area, we looked for climate-related change, that could impact the 2050 target's ability to serve its intended purpose. To do this, we identified indicators that would help us understand how each topic from the Act connects to the purposes of the Act to:

- develop and implement clear and stable climate change policies
- contribute to global efforts under the Paris Agreement to limit warming to 1.5°C.

Step 2: Assessing for change

In this step, we looked at what the circumstances were in 2019, when the 2050 target was first set, and compared them to the current day. We expected to find some level of change across all of the specified areas, as a natural course of events over time. As part of this step, we assessed which identified changes could impact the 2050 target's ability to serve its intended purpose.

Step 3: Assessing for likely future change

In this step, we used projections, and in some cases modelling, to look at whether circumstances were likely to undergo significant change in the future. We then assessed whether likely future change could impact the 2050 target's intended purpose. This included considering when the likely change might occur. As we will review the 2050 target every five years, change that is likely to happen sooner is more relevant and more likely to be significant.

Step 4: Considering if any identified changes are significant

In this step, we analysed the changes identified in steps 2 and 3 for their significance by considering their importance, consequence and notability.

To assess if a change was 'important', we looked at the change's relevance to the 2050 target, and whether it could impact the ability of government and society to take action to achieve it.

To assess if a change was 'consequential', we looked at whether the change could impact the 2050 target's ability to achieve its intended purpose.

To assess if a change was 'notable', we looked at whether it was reasonably foreseeable in 2019, when the 2050 target was first set.

Under this process, we only considered a change to be 'significant' if we found evidence that it had, or was likely to have, important, consequential and notable impacts on the 2050 target.

What we heard

Respondents were generally supportive of our approach to checking for significant change. While submitters held a diversity of views across the nine topics we looked at, many agreed with our initial findings. We received strong overall support for our initial assessment that there has been significant change in the area of global action, and received general support for our initial assessment that there has been significant change in the area of scientific understanding of climate change. Many submitters wanted Aotearoa New Zealand to be more ambitious in its emissions reductions in order to contribute to international efforts.

Many submissions argued that our initial findings of significant change in the areas of global action and scientific understanding necessitated a finding of significant change related to intergenerational equity. Supporters of this finding pointed to the increasing likelihood of inequitable outcomes for future generations due to the impacts of climate change being more severe and occurring at lower temperatures than previously anticipated, and the decreasing likelihood of the world being on track to limit warming to 1.5°C. We agreed with that point of view and have amended our finding so that intergenerational equity is now a significant change.

Our initial assessment that there has been significant change in the availability and use of methane inhibitors received many submissions from agricultural stakeholders who highlighted that they are not currently useable in Aotearoa New Zealand, and there is uncertainty about whether and when they would be applicable domestically. We agreed with that feedback and amended our initial finding to now find that there has not been a significant change in technological developments.

Submissions on our initial assessment that there was a significant change in the principal risks and uncertainties associated with emissions reductions and removals noted that forestry has an important role to play in meeting the 2050 target and the risks associated with forestry have not materially changed since 2019. We agreed with that feedback and amended our initial finding to now find that there has not been a significant change in the principal risks and uncertainties associated with emissions reductions or removals.

After considering what we heard and carrying out further analysis, we think three topics have changed significantly

After reviewing all of the feedback we received through consultation, we determined that our initial approach to looking for significant change was fit for purpose and confirmed that we would follow this same approach to confirm our findings.

We then re-evaluated each of our initial significant change findings, taking into consideration the perspectives and new evidence shared with us through consultation.

As a result, we have found evidence of significant change in three of the nine areas of focus specified by the Act. These areas are:

- global action
- scientific understanding of climate change
- intergenerational equity implications.

Global action

Step 1: Deciding what is relevant to assessing each topic

To assess global action as it relates to climate change, we considered several indicators:

- the long-term emissions reductions committed to by comparable countries and economies through self-determined targets
- the adequacy of those targets to contribute to global efforts under the Paris Agreement to limit warming to 1.5°C
- the progress being made by countries and economies to achieve their targets through actual emissions reductions.

For this analysis, we used information about countries and economies with some similarities to Aotearoa New Zealand, including:

- countries that are often compared to Aotearoa New Zealand and included by the Ministry for the Environment in its reporting, such as Australia, Japan, United States of America (USA), Canada, the European Union and the United Kingdom[21]
- members of the Small Advanced Economies Initiative (SAEI), which are countries with a similar population size and economic framework to Aotearoa New Zealand, including Singapore, Switzerland, Denmark, Finland, Ireland and Israel[22]
- developed countries or those in transition according to the United Nations Framework Convention on Climate Change Annex 1 countries that emitted methane at a similar or higher rate in 2021 compared to Aotearoa New Zealand in 2021, including the United States, Russia, Canada, Ukraine, Turkey, France, Kazakhstan, the United Kingdom, Germany, Italy, Poland, Spain, Romania, Netherlands, Ireland and Japan[23]
- countries that emit relatively large amounts of biogenic methane emissions compared to their overall emissions, including Uruguay, Costa Rica, Bulgaria, Albania, Belarus, Brazil, Ireland, Argentina, and Latvia. For this group, we have excluded countries with relatively low incomes (with per capita Gross Domestic Product below US$6,000) or population sizes (below one million people).

In response to feedback, we considered whether our focus for assessing global action should shift from looking at the emissions reduction targets being set by other countries to the actual progress those countries are making towards achieving their targets. We determined that the targets set by other countries, and the intentions those targets signal, remain relevant to our review of Aotearoa New Zealand's national target. Our approach does also consider measurable progress in reducing emissions as part of our assessment of whether the world is on track to meet the 1.5°C goal.

Steps 2 and 3: Assessing for change or likely future change

The time available for global action to prevent exceeding 1.5°C has decreased

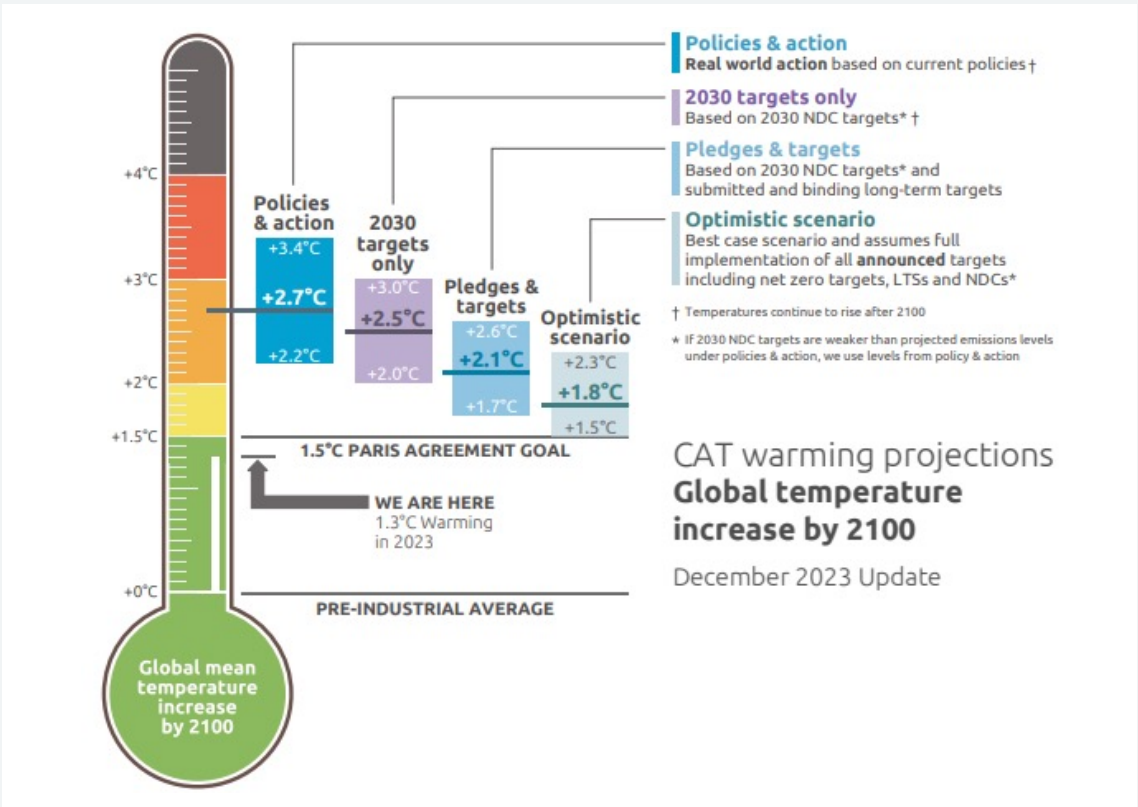
Since 2019, the likelihood that global warming will exceed 1.5°C, requiring action to reduce temperatures to bring warming back below that threshold, has increased, while the time available for the world to act has decreased.

The UN *Emissions Gap Report 2023* shows:[24]

- as a result of commitments under the Paris Agreement, global greenhouse gas emissions are now expected to be lower in 2030 than previous projections
- in the most optimistic scenario – with all commitments and pledges implemented – the world has a 66% chance of limiting warming to 2.0°C (range: 1.8°C to 2.5°C)
- with only current policies continuing, the world has a 66% chance of limiting 21st century warming to 3.0°C (range: 1.9°C to 3.8°C)
- limiting warming to 2°C will require implementing current targets and increasing the ambition of targets.

Figure 4.2 shows that, globally, current policies and actions are not enough to limit warming to 1.5°C, nor are the world's 2030 nationally determined contributions (NDCs) under the Paris Agreement or long-term targets (generally 2050 targets). This accords with the findings of the *Emissions Gap Report 2024*.[25]

Figure 4.2: Climate Action Tracker (CAT) warming projections for global temperature increase by 2100



Source: Climatetracker.org

Aotearoa New Zealand's targets in comparison to peers

When the 2050 target was first set in 2019, Aotearoa New Zealand was a relative global leader along with the United Kingdom,[26] Switzerland,[27] and Denmark[28] in setting or announcing long-term emissions reduction targets.

Our analysis suggests that position has changed, and that the 2050 target is now less ambitious than many of the targets set by comparable countries and economies. Net zero all gas targets include biogenic methane in their net zero requirements, which is a lower level of emission than Aotearoa New Zealand.

- Finland, which in 2019 had a target to achieve net zero emissions of all greenhouse gases by 2050, brought its target's timeline forward in 2022. It now requires net zero of all greenhouse gases by 2035, and net negative emissions in the years following.[29]
- The past few years have seen a small number of countries commit to becoming net negative on a variety of different timescales. Most recently in February 2024, Germany announced that it intends to introduce a target to reach net negative greenhouse gas emissions by 2060.[30]
- Australia,[31] Japan,[32] USA,[33] Canada,[34] European Union,[35] Singapore[36] and Ireland[37] moved to targets requiring net zero emissions of all greenhouse gases in 2021.
- Norway[38] and Israel[39] do not require net zero emissions of all greenhouse gases, but our analysis shows their targets still exceed the ambition level of Aotearoa New Zealand's 2050 target.
- Among the comparison group of countries identified as emitting relatively high levels of biogenic methane, the number of targets requiring net zero emissions of all greenhouse gases has increased since 2019. Argentina, Ireland, and Brazil have now joined Latvia,[40] Costa Rica[41] and Denmark, which already had targets requiring net zero emissions of all greenhouse gases in 2019.

Step 4: Considering if any identified changes are significant

Our analysis indicates the change in the relative ambition of Aotearoa New Zealand's international peers and competitors means the 2050 target is now less ambitious than targets set by comparable countries and economies. This finding has important, consequential and notable impacts on the 2050 target, and is therefore significant.

The UN *Emissions Gap Report 2023* shows a change in the likelihood that global temperatures will rise beyond 1.5°C above pre-industrial levels, and that the time available to act is decreasing. This finding has important, consequential and notable impacts on the 2050 target's ability to achieve its purpose and is therefore significant.

Scientific understanding of climate change

Step 1: Deciding what is relevant to assessing each topic

Research and scientific understanding begin with questions, then information and observations are collected and tested, forming preliminary understandings. Models are developed based on preliminary understandings and then tested with additional data and observations. Results are systematically scrutinised by peers and then published if they meet scientific quality standards in scientific journals. These journal articles build the basis for improving understanding of components of the climate system and factors that influence it.

To provide the world with a clear consensus of the scientific understanding of climate change, the Intergovernmental Panel on Climate Change (IPCC) provides governments at all levels with scientific information they can use to develop climate policies and responses. To help governments achieve this objective, the IPCC provides regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

The IPCC's reports are comprehensive and balanced assessments of the state of knowledge on topics related to climate change. Reports from other professional organisations, similarly based upon foundations of peer reviewed science, also feed into the collective understanding of climate change.

The Commission draws upon the consensus view of the scientific understanding of climate change that is based upon recognised peer-review processes.

For this review we looked across the spectrum of climate change science:

- how the climate system functions – advancements in modelling and observations
- the detection and attribution of climate change – assessing whether the climate is changing and if it is, identification of the cause
- how greenhouse gases behave in the Earth system – the accumulation and behaviour of greenhouse gases in the atmosphere controlled by biogeochemical cycles
- climate change mitigation – emissions sources, levels of gases, and mitigation options
- the quantification of emissions – considering changes in how the emissions from individual sources (or groups of sources) are reported on using internationally agreed-upon methods
- how to compare the warming impacts of greenhouse gases in the atmosphere – models and metrics
- the impacts of warming – the negative and positive consequences of climate change and options for adapting to it
- the risks and implications of warming impacts – the vulnerability of socioeconomic and natural systems to climate change.

Steps 2 and 3: Assessing for change or likely future change

The IPCC Fifth Assessment Report[42] and the following special reports were the most up to date at the time the target was set: *Global Warming of 1.5°C,*[43] *Climate Change and Land*,[44] and *The Ocean and Cryosphere in a Changing Climate.*[45] These reports were commissioned in response to a request of the Conference of Parties following the adoption of the Paris Agreement in 2015, to identify the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emissions pathways.

The most recent report from the IPCC is the *AR6 Synthesis Report: Climate Change 2023*, released in March 2023, and the three working group Assessment Reports upon which it is based.[46] We also considered a number of other relevant reports including: the *Global Methane Assessment* (2021),[47] the *UN's Emissions Gap Report* (2023),[48] *United in Science 2022 Report* (2022),[49] the *State of Climate 2022* report (2023),[50] the Food and Agriculture Organization (FAO) of the UN's *Methane emissions in livestock and rice systems report* (2023),[51] and the *Global Stocktake Report* (2023).[52]

From analysing these reports, our findings are:

- Since 2019, there have been advances in the scientific understanding of climate change across topic areas 1 through 6 (listed above). However, these have largely added nuance and precision to the existing state of knowledge and, for the purposes of this target review, are not consequential or notable.
- Understanding of the physical science of greenhouse gases is improving all the time. However, there has not been an important or notable change in the understanding of the physical science of methane and how it warms the atmosphere. We carefully examined the information shared by some submitters about the science of methane but did not find evidence supporting a conclusion that methane has a significantly different impact on global warming than previously understood.
- There has been a change in scientific understanding identified in topic areas seven and eight that could be significant, relating to the impacts of warming and the risks and implications of warming impacts. Risks are increasing with every increment of warming and high risks are now assessed to occur at lower levels of global warming.

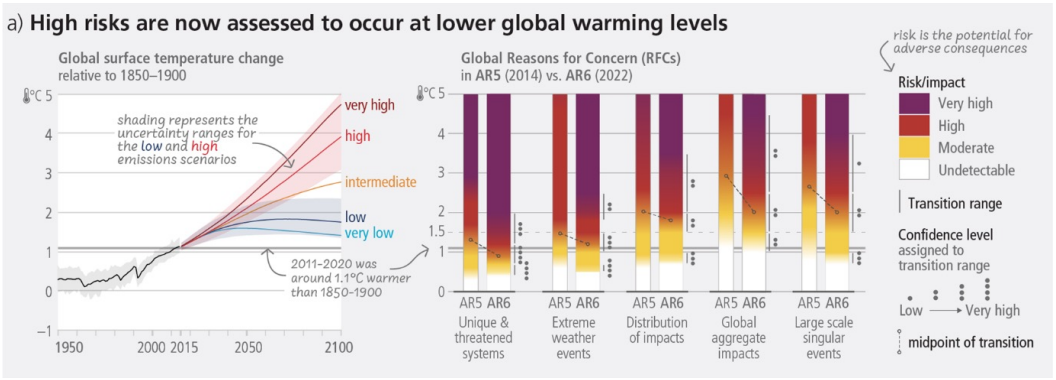
Understanding the impacts of warming

The impacts of warming will be widespread, affecting the way we live, work and play. The IPCC has been assessing the vulnerability of socio-economic and natural systems to climate change.[53] To understand these impacts the IPCC has used a set of five key "reasons for concern" to summarise risks from climate change at a global level. The methodology has become more formalised for the past two assessments to enable a systematic comparison of the level of risk identified over time. This methodology covers more than 120 key risks[54] aggregated into five reasons for concern:

- unique and threatened systems
- extreme weather events
- distribution of impacts
- global aggregate impacts
- large scale singular events.

As shown in **Figure 4.3**, the very high and high risks (the darker colours on the bars) now occur at lower temperatures than was previously understood. This means climate risks are appearing sooner and with more severity than was previously understood.[55]

Figure 4.3: Change in risks between Fifth Assessment Report (AR5) and Sixth Assessment Report (AR6)



Source: Intergovernmental Panel on Climate Change

The main change in scientific understanding is new knowledge of the *impacts* of events. There is a greater understanding of the vulnerability of human and natural systems, meaning for any given change in the climate, those systems are both more likely to be affected and more likely to be more badly affected. The country has, in recent years, already experienced significant harm from climate-related events including cyclones, floods, landslips, droughts and wildfires. Climate change is increasing the frequency and impacts of these events, which cause damage and impose significant costs on Aotearoa New Zealand's communities.[56]

Step 4: Considering if any identified changes are significant

Most of the physical science underpinning Aotearoa New Zealand's emissions target has not significantly changed. The understanding of the impacts of climate change however is important, consequential and notable given the potential scale of those impacts on Aotearoa New Zealand and around the globe.

Our analysis indicates that a significant change has occured in the scientific understanding of climate change, but only as it relates to the impacts, risks and implications of warming. Risks are increasing with every increment of warming and high risks are now assessed to occur at lower levels of global warming.

Equity implications (including intergenerational equity)

Step 1: Deciding what is relevant to assessing each topic

Equity is about how society treats different people and groups. We recognise that this can be incredibly impactful, and we do not seek to dismiss or minimise these personal experiences. Our task was to look at what has changed significantly enough at a national level to warrant considering a change in the climate target.

To determine the dimensions of equity most relevant to transitioning to a low emissions future we looked to the IPCC's Fifth Assessment Report,[57] from which we identified the following types of equity: equity between genders, equity between low- and high-income people, regional equity, international equity, intergenerational equity, and equity for iwi/Māori. The first three we considered under 'distributional impacts' below. Here we look whether there has been a significant change in intergenerational equity, international equity, and equity for iwi/Māori.

Intergenerational equity – we considered qualitatively how the impacts of climate change and of climate policies affect current and future generations.

International equity – we identified trends in international equity in addressing climate change and analysed Aotearoa New Zealand's 2050 target against four metrics of international equity: equal per capita emissions, capacity/ability to pay, historic responsibility for warming, and the right to sustainable development. This analysis is set out in *Chapter 6: Implications of our recommended 2050 target.*

Equity for iwi/Māori – we assessed where Māori have been affected differently by climate policy, and considered policies introduced since 2019.

Steps 2 and 3: Assessing for change or likely future change

Intergenerational equity

In response to feedback about the equity implications of worsening climate change, we have revised our analysis. Our initial assessment was that there had been no significant changes since 2019 in terms of intergenerational equity. However, submitters argued, and we have accepted, that our findings of significant changes in scientific understanding and global action since 2019 have implications for intergenerational equity. There is an increasing likelihood of inequitable outcomes for future generations due to the impacts of climate change being more severe and occurring at lower temperatures than previously anticipated, and the decreasing likelihood of the world being on track to limit warming to 1.5°C. We also heard through consultation that a newly improved understanding of the financial costs of climate change indicates an increased burden on future generations.

As a result, we consider that issues of intergenerational equity have changed since 2019 and that they are important, notable and consequential.

International equity

In *Chapter 6: Implications of our recommended 2050 target* we assess Aotearoa New Zealand's 2050 target against four metrics of international equity. While the results of these different equity approaches differ between them, their results have not changed significantly since the target was set in 2019. We consider that there is no evidence that issues of international equity have changed notably or consequentially since the target was set.

Equity for iwi/Māori

Although emissions targets do not disproportionately affect Māori directly, the implementation of policy occurs against a historical context of policies that have resulted in poor outcomes for iwi/ Māori.[58,59,60,61,62,63]

Examples of climate change targets driving policy that affects iwi/ Māori include:[64]

- Some iwi/Māori have significant interests in the forestry and/or agriculture sectors, and may be negatively impacted by any increasing costs or other changes in these sectors.[65]
- land-use characteristics of Māori freehold land mean that these landowners may have more limited options and face challenges in terms of land-use change
- a large proportion of forested Māori freehold land was planted before 1990, rendering this land ineligible for earning emissions trading units – but still liable to pay carbon credits if deforested
- Māori enterprises with the highest number of employees are in the agriculture, forestry and fishing sectors, which are more exposed to shocks in the economy and the effects of climate change.

While we do not seek to dismiss or minimise the impacts of historical policy on iwi/ Māori our task is to look at what has changed significantly enough at a national level to warrant considering a change in the climate target. We have not found evidence that these issues have changed since 2019.

Step 4: Considering if any identified changes are significant

We do not consider that there have been significant changes since 2019 to international equity or equity for iwi/ Māori that would warrant considering a change in the climate target.

However, we find that there has been a significant change in intergenerational equity implications of climate change due to our findings of significant changes in scientific understanding and global action since 2019.

After considering what we heard and carrying out further analysis we find that six topics have not changed significantly

After reviewing all of the feedback we received through consultation, we re-evaluated each of our initial significant change findings, taking into consideration the perspectives and new evidence shared with us through consultation.

The feedback and our analysis, shows significant change has not occurred, and is not likely to occur, in the other six topics identified in the Act:

- Aotearoa New Zealand's economic or fiscal circumstances
- Aotearoa New Zealand's obligations under relevant international agreements
- technological developments
- distributional impacts
- the principal risks and uncertainties associated with emissions reductions and removals
- social, cultural, environmental, and ecological circumstances.

Economic or fiscal circumstances

Step 1: Deciding what is relevant to assessing each topic

For this analysis, we looked specifically for changes that are likely to shift Aotearoa New Zealand's economic or fiscal circumstances over the long term, to 2050. If there are large, persistent changes in short-term indicators that add up to a more fundamental change in circumstances, these will be reflected in long-term indicators. This is an important aspect of our analysis, as many economic and fiscal indicators fluctuate over months or years.

For economic circumstances, we used the forecast Gross Domestic Product (GDP) per capita, which reflects the value of final goods and services produced in the country in a year, divided by its total population. For fiscal circumstances, we used the projected net core Crown debt-to-GDP ratio, which reflects the actual debt burden that needs to be repaid, considering the Government's financial assets.

These indicators combine information from multiple sources to show any change in the resources available to transition the economy to low emissions while maintaining wellbeing, and align with domestic and international reporting metrics. Significant changes in other economic indicators, such as inflation or interest rates, are likely to affect these indicators.

Following consultation feedback, we looked at inflation, insurance rates and the trade balance, and considered whether these should be added to our approach for looking for significant change. However, our investigation found that significant change in any of these proposed indicators would be reflected in the chosen indicator of gross domestic product per capita.

Steps 2 and 3: Assessing for change or likely future change

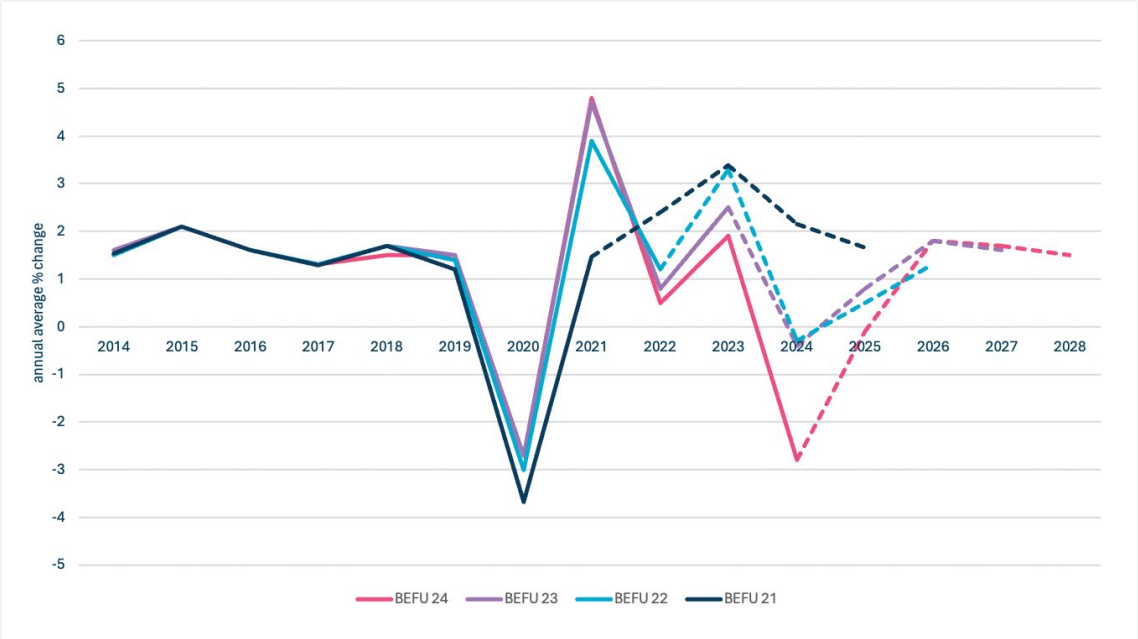
Forecast GDP per capita

Since 2019, Aotearoa New Zealand, along with the rest of the world, experienced the COVID-19 pandemic. The pandemic was incredibly difficult for many people in many ways, including impacts on health and livelihoods. From an economic lens, the pandemic caused significant economic disruption and a contraction of GDP per capita in 2020.[66] However, as the economy has recovered, the economic forecast has moved back in line with long-term trends.[67]

Recently, increases in inflation have raised the cost of living in Aotearoa New Zealand, impacting daily life for many people across the motu. While high inflation is impactful, it has historically not been persistent largely in part due to the actions taken by governments and the Reserve Bank. Current inflation rates are not anticipated to continue over the long term or to change the country's expected economic circumstances out to 2050. The annual inflation rate in Aotearoa New Zealand slowed to 2.2% in the third quarter of 2024, down from 3.3% in the June 2024 quarter.[68]

Aotearoa New Zealand's Treasury provides GDP per capita and forecasts the next four years as part of the Budget Economic and Fiscal Update (BEFU). From 2014 to 2019, GDP per capita growth rates were between 1–2%. This is also true for the latest forecast from 2026 in BEFU 2024. Real GDP per capita has been lower than previously expected from 2022 to 2024, with a strongly negative result in 2024. While the resulting smaller per capita economy is real, if the expected recovery is realised it will not represent a long-term step change.[69]

Figure 4.4: Change in Budget Economic and Fiscal Update (BEFU) forecasts of GDP per capita 2021–2024

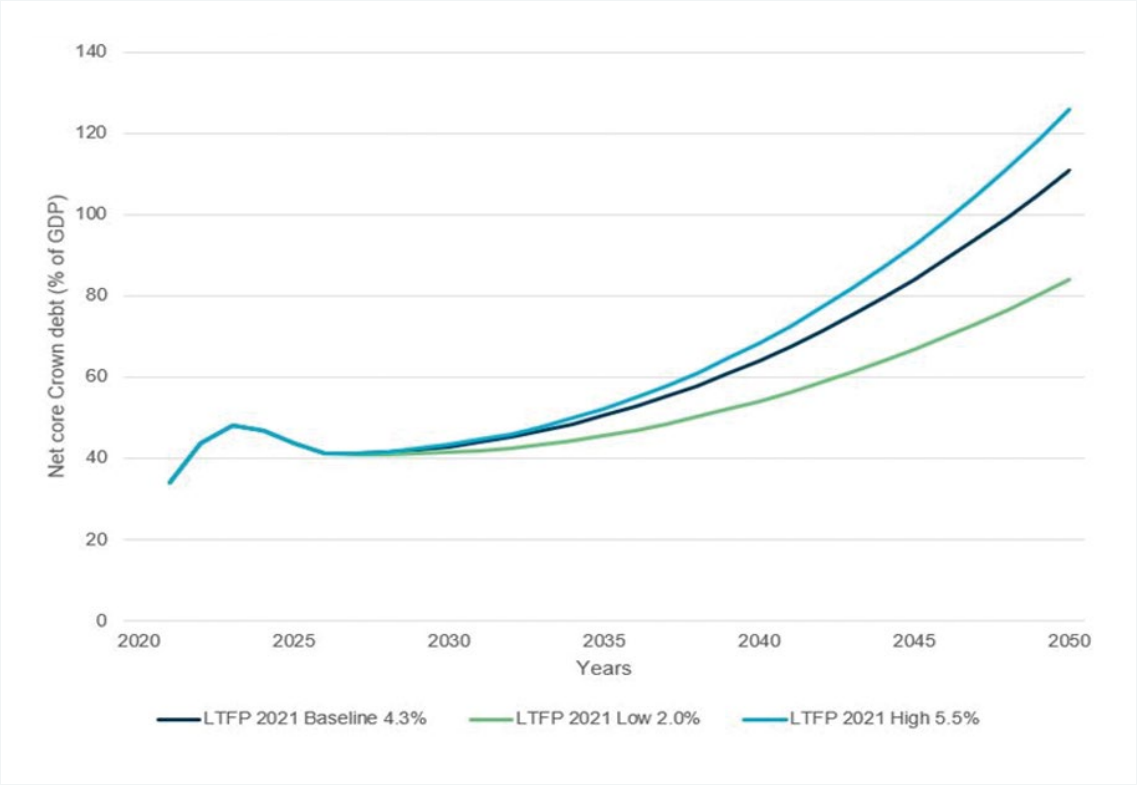


Source: Commission graph, adapted from BEFUs 2021,[70] 2022,[71] 2023[72] and 2024.[73]
Note BEFU forecasts show a 5-year outlook only.

Projected net core Crown debt-to-GDP ratio

Net core Crown debt to GDP shows government debt relative to the size of the economy. Since 2019, the net core Crown debt-to-GDP ratio has increased (as shown in **Figure 4.5** below). If unaddressed, the higher debt-to-GDP ratio may limit government ability to allocate funds towards emissions reduction efforts and the transition to a thriving, low emissions economy. Our initial analysis, based on data from the Treasury, shows this increase is expected to decline in the short term, and then to remain somewhat consistent through to around 2030 before increasing again in the long term. The Treasury has stated that it is possible to manage net core Crown debt within 'prudent levels'.[74]

Figure 4.5: Projected net core Crown debt as % of GDP using the Treasury's Long-term Fiscal Position (LTFP), testing for different interest rates



Source: Commission analysis adapted from He Tirohanga Mokopuna 2021.[75]
Note the different lines in the graph above represent the sensitivity testing of different interest rates (2.0–5.5%).

Step 4: Considering if any identified changes are significant

Our analysis indicates there has not been significant change to Aotearoa New Zealand's economic or fiscal circumstances as they relate to climate change. The changes to GDP per capita since 2019, largely caused by the COVID-19 pandemic, were temporary and will not affect the long term, and are therefore not consequential for the 2050 target.

We consider the projected changes to fiscal circumstance (**Figure 4.5**) are consequential but were foreseen in 2019 and can be adapted to over time, and are therefore not notable for the purposes of this review.

Aotearoa New Zealand's obligations under relevant international agreements

Step 1: Deciding what is relevant to assessing each topic

To investigate this topic the Commission defined international agreements, and then looked at what would constitute an 'international obligation'.

Relevant international agreements

The United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement (the climate treaties) are referenced in the purpose of the Act multiple times. Relevant international agreements extend beyond the climate treaties to all agreements that both create obligations and have a bearing on Aotearoa New Zealand's response to climate change.

International obligations

Obligations under relevant international agreements will include all actions Aotearoa New Zealand commits to making under those agreements. However, there is a distinction between formal international agreements, and high-level political commitments. International agreements can impose obligations on us and go through a ratification process by Parliament. This includes multilateral treaties and bilateral agreements.

Political commitments can be agreed to by the government of the day but are not binding commitments and do not impose obligations. These are voluntary initiatives such as the Global Methane Pledge and the Beyond Oil and Gas Alliance. The Ministry of Foreign Affairs and Trade's (MFAT) guidance on International Treaty Making notes that, since such arrangements are not intended to embody international legal obligations, they are not agreements in the legal sense at all.[76]

Aotearoa New Zealand has also entered into numerous non-binding political arrangements since the emissions target was set, whereby Aotearoa New Zealand has committed to taking certain steps (individually or collectively with other countries) in relation to climate change. We consider that these are likely outside the scope of Aotearoa New Zealand's obligations under relevant international agreements.

Steps 2 and 3: Assessing for change or likely future change

Agreements that potentially create obligations fall into three categories:

- multilateral agreements that impose obligations on Aotearoa New Zealand in relation to climate change or related topics
- COP[xiii] decisions under the UNFCCC, Kyoto Protocol, and Paris Agreement
- free trade agreements, both multilateral and bilateral.

The following analysis looks at changes in these categories since 2019.

Changes to nationally determined contributions

Aotearoa New Zealand submitted its original Nationally Determined Contribution (NDC) when it signed up to the Paris Agreement in 2016. In October 2021, before the United Nations conference in Glasgow, Aotearoa New Zealand updated its NDC.[77] By February 2025, Aotearoa New Zealand will need to set its second NDC for the period 2031–2035. The Paris Agreement imposes a binding obligation on countries to *have* an NDC in force at all times but does not impose an obligation to meet that NDC. NDCs themselves are non-binding. This means changes in the level of Aotearoa New Zealand's NDC are not a change in international obligations, rather it is a change in Aotearoa New Zealand's public commitment.

New COP decisions

There have been three COP meetings since the Act was passed. These concluded the Glasgow climate pact (COP25), the Paris Rulebook (COP26), and the Sharm el-Sheikh implementation plan. The Paris Rulebook includes guidance on a transparency process and implementation of article 6. While some aspects of the Paris Rulebook are binding, it does not impose any additional obligations on parties to reduce emissions, and the same is true for the Glasgow climate pact and the Sharm el-Sheikh implementation plan.

xiii The UNFCCC Conference of the Parties (COP) is an annual international climate change meeting held by the United Nations.

Free trade agreements

Aotearoa New Zealand concluded two new free trade agreements (FTAs) since 2019 – one with the United Kingdom and one with the European Union. The two new FTAs create legally binding obligations on Aotearoa New Zealand, including "in respect of climate change".

New Zealand-United Kingdom FTA

The environment chapter of this FTA includes environmental obligations, such as ending unabated coal-fired electricity generation in their territories as part of a clean energy transition aligned with the goals of the Paris Agreement. MFAT's National Interest Analysis confirms that these commitments are consistent with Aotearoa New Zealand's environmental legislation and current policy settings.[78]

New Zealand-European Union FTA

Article 19.6 is the most relevant and requires the parties to:

- effectively implement the UNFCCC and the Paris Agreement, including commitments regarding NDCs; and
- refrain from any action or omission that materially defeats the object and purpose of the Paris Agreement.

The Paris Agreement imposes a binding obligation on countries to have an NDC in force at all times but does not impose an obligation to meet that NDC. NDCs themselves are non-binding. The FTA provides an enforcement mechanism for existing obligations but does not establish any new obligations.[79]

We consider that the obligations in the FTA are consistent with Aotearoa New Zealand's existing legal obligations under the climate treaties.

While we received questions from some submitters about whether the New Zealand-European Union Free Trade Agreement may have created new obligations, we did not receive new evidence that would justify changing our initial assessment.

United Nations Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea is a multilateral treaty that includes obligations to address pollution occurring in or affecting the marine environment. As a ratified party, Aotearoa New Zealand must protect and preserve the marine environment including taking all measures consistent with the Convention to prevent, reduce and control pollution of the marine environment.[80]

Feedback from consultation suggested that the May 2024 advisory opinion from the International Tribunal for the Law of the Sea (ITLOS) represents a significant change in Aotearoa New Zealand's international obligations. The opinion from the tribunal was that the obligation to address pollution includes an obligation to reduce greenhouse gases. However, the ITLOS advisory opinion was non-binding, which means Aotearoa New Zealand's obligations have not changed.

We also noted that some submissions considered there may be reputational damage from not meeting non-binding commitments.

Step 4: Considering if any identified changes are significant

The three climate treaties (the UNFCCC, the Kyoto Protocol and the Paris Agreement) are the most important international agreements under section 5T(2)(a)(iv) of the Act. We consider that Aotearoa New Zealand's obligations under the three climate treaties have not changed since the emissions target was set, including because of subsequent COP decisions. FTAs have not changed the nature of New Zealand's obligations under the Paris Agreement.

Therefore, we consider that there has not been a significant change to New Zealand's obligations under international agreements relating to climate change, and we have seen no evidence that there is likely to be a significant change to them in the future.

Technological developments

Step 1: Deciding what is relevant to assessing each topic

We researched how technologies that reduce emissions have changed since the 2050 target was set and whether a significant change is likely. We considered the availability and relative cost of low or zero emissions technologies across:

- renewable energy, process heat and buildings
- industrial processes
- engineered removals
- transport
- agriculture
- waste.

For more information about the cost and availability of technologies, see the *Technical Annex – Modelling and analysis* to support the draft advice on Aotearoa New Zealand's fourth emissions budget.

Steps 2 and 3: Assessing for change or likely future change

Renewable energy, process heat and buildings

Since 2019 a number of renewable power technologies have become cheaper than the lower range of the fossil generation price.[81] Anticipated technologies and fuels, and their price and availability across renewable energy and process heat, were reasonably foreseeable in 2019. Feedback from consultation highlighted the notability and consequentiality of increases in renewable energy since 2019. As a result, we looked at whether there was evidence that the current and future price of renewable energy has, or is likely to, reduce beyond previous expectations. We determined that, given the context of more than a decade of falling costs and that the rate of cost reductions is slowing, the cost reductions observed since 2019 were predictable, and therefore this does not signify significant change.

Industrial processes

Mitigation technologies available for heavy industries (aluminium, cement and lime, iron and steel, ammonia and methanol) have not changed notably since 2019. While there has been increased adoption of technology – an electric arc furnace in steelmaking – this technology is not new. Aotearoa New Zealand has made steel using this particular technology in the past.[82]

Engineered removals

The costs of technologies for carbon dioxide removal (carbon capture and storage, bioenergy with carbon capture and storage, direct air carbon capture and storage) have remained persistently high since 2019.[83] There are emerging technologies that we have noted and are tracking, but there has been no uptake in Aotearoa New Zealand to date. We expect incremental changes that are in line with changes over previous years, but do not anticipate anything notable.

Transport

Anticipated technologies and fuels for transport have not changed notably since 2019. Electric vehicle technologies have been more widely deployed through a wider range of makes and models available in the Aotearoa New Zealand market, but the underlying technology has not changed. The changes in availability were reasonably foreseeable in 2019.

Agriculture

Since 2019, a methane inhibitor for sheep and cattle has changed from a promising possibility to a widely available method for reducing methane emissions in over 40 countries, including Australia, Canada, and across Europe.[xiv] Current methane inhibitor technology can reduce methane emissions from animals like cows and sheep by around 30%.[84]

In response to feedback about methane inhibitors, we have revised our analysis. Our initial assessment had been that the availability of methane inhibitors is a significant change. Following further analysis, we agree with the feedback we heard that the methane inhibitors currently available overseas are by and large unsuitable for Aotearoa New Zealand contexts and are not expected to significantly impact this country's emissions. We also agreed with the submissions that argued that, when the 2050 target was set, methane inhibitors were understood to be close to commercialisation, and so would likely contribute to achieving the target.

We have not observed any other notable changes to technologies for reducing agricultural emissions. A large number of technologies are under development and there is significant research and development investment. However, it is too early to say whether any of these are likely to become commercially available at scale.

Waste

Mitigation technologies for emissions from waste have not significantly changed since 2019. In mid-2022 the Ecogas Reporoa Organics Processing Facility opened. This facility is the first major anaerobic digestion plant in New Zealand. However, the technology was well known prior to 2019.

Step 4: Considering if any identified changes are significant

We consider that the changes in technology for process heat and buildings, industrial processes, engineered removals, transport and waste have not changed in a way that is notable or consequential.

For renewable energy the trend from 2010 to 2019 made further improvements reasonably foreseeable, making the change less notable. On this basis our finding is that this change does not meet the bar of being significant.

We consider that the development of a methane inhibitor for use in agriculture, while important, is not a notable or consequential change as it is still too uncertain when this kind of technology will become available and practically implemented in Aotearoa New Zealand. This may change for the next review in five years if methane inhibitors or similar technologies have a route to adoption in Aotearoa New Zealand.

xiv A compound that directly reduces the amount of methane produced, which can currently be applied via a feed additive, but similar technology is under development to apply it via a vaccine or slow-release capsule called a bolus.

Distributional impacts

Step 1: Deciding what is relevant to assessing each topic

Distributional impacts are about the effects on people and their lives, homes and employment. We recognise that any changes to people in these areas are often incredibly impactful. While we do not seek to dismiss or minimise these personal experiences, our task is to look at what has changed significantly at a national level enough to warrant considering a change in the climate target.

We investigated distributional impacts as they relate to climate change. We found research on this topic was generally focused on either the impacts on production and employment, or the impacts on households.[85]

We investigated climate policy impacts on employment between regions and between industries, and household living costs, in addition to selecting three indicators that draw on data gathered by Stats New Zealand. The indicators reflect how income (Gini coefficient), material wellbeing (Material Wellbeing Index (MWI)), and child poverty (the proportion of children who are materially disadvantaged) are currently distributed in Aotearoa New Zealand, and how this distribution has changed over time.

As a result of feedback from consultation we considered whether to include food security as an indicator of significant change, but determined that this concern is covered by our existing indicators of income, hardship and poverty.

Steps 2 and 3: Assessing for change or likely future change

Net employment impact likely minimal

Climate policy will have distributional impacts on employment between industries and regions, however analysis by Riggs and Mitchell shows the net impact of climate policies on total employment is likely to be relatively small in Aotearoa New Zealand,[86] while international research has shown the impacts of climate policy on employment are mostly reallocation between industries rather than any net losses or gains in jobs.[87]

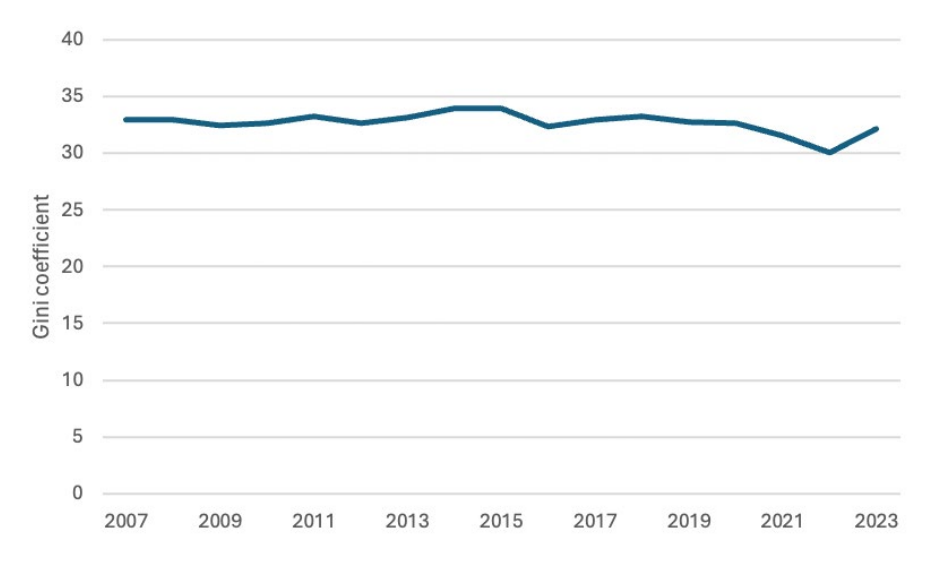
Short-term costs but long-term benefits for households

In the short term, emissions prices will be passed on to households via costs for emissions-intensive goods like transport, fuel, and energy, which will likely have a disproportionate impact on lower-income households. As households transition away from fossil fuels however, they will experience longer-term benefits such as warmer, healthier homes. For the poorest in Aotearoa New Zealand, increases in the cost of living have been counterbalanced to a degree by boosts to benefits, income tax cuts, working for families tax credits, and increases in the minimum wage.[88]

The Gini coefficient shows reduced income inequality

The Gini coefficient is a common method of measuring income equality in a population, where a higher number represents increased inequality. Stats NZ finds that the Gini coefficient for Aotearoa New Zealand has fallen between 2019 and 2022, from 33.9 to 30.0 before increasing to 32.1 in 2023.[89] Aotearoa New Zealand falls slightly above the median Gini coefficient for OECD countries.[90]

Figure 4.6: Time series of Gini coefficient for Aotearoa New Zealand 2007 to 2023

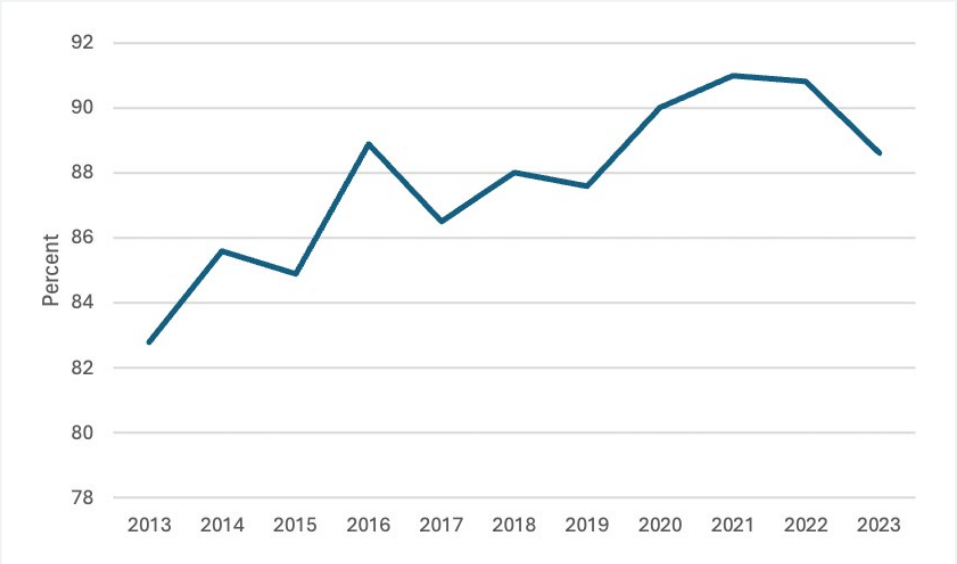


Source: Stats NZ Household income and housing cost statistics, 2023,[91] 2020,[92] and 2019[93]

Material wellbeing increases

Material wellbeing can be measured using the Material Wellbeing Index. The index is a score based on answers to 24 questions about households' standard of living, access to necessities for a basic standard of living, non-essential things that could be expected in a typical household, and the ability to cope with any unexpected demands on the household budget.[94] Between 2019 and 2022, the percentage of households reporting good material wellbeing increased from 87.5% to 90.8% before falling back to 88.6% in 2023.[95] This continues a longer-term trend (see **Figure 4.7**) of increasing wellbeing since 2013, when 82.8% of households reported good material wellbeing.

Figure 4.7: Proportion of survey respondents who report good material wellbeing (MWI>15) 2013–2023

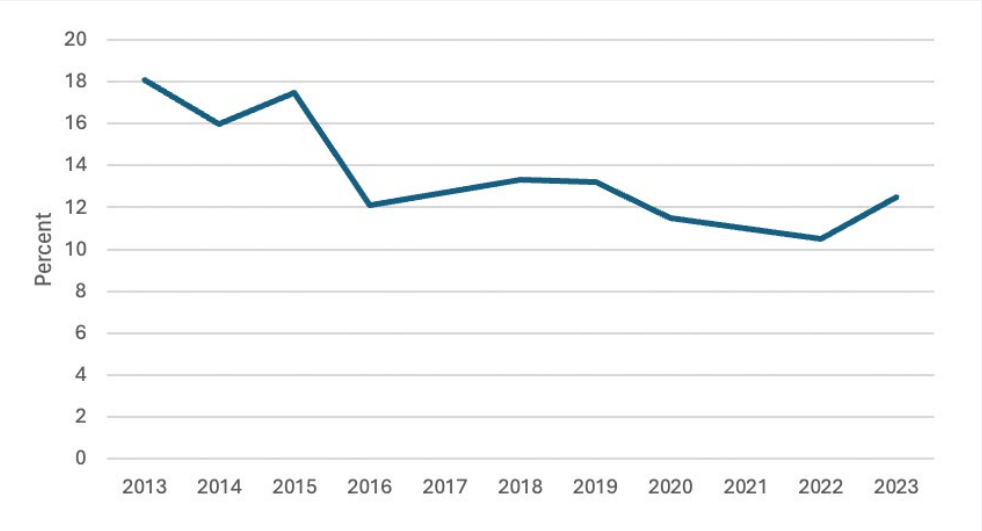


Source: Stats NZ Household income and housing cost statistics, 2023[96] 2022,[97] 2020,[98] and 2019[99]

Child poverty decreases

To measure child poverty, the Ministry for Social Development developed the DEP-17 index. The index includes 17 deprivation measures, such as 'enforced lack of essentials', and 'economised, cut back or delayed purchases a lot' with a higher score representing greater material hardship. Between 2019 and 2023, the percentage of children living in households in material hardship decreased from 13.2% in 2019 to 12.5% in 2023, a trend of decreasing child poverty since 2013.[100]

Figure 4.8: Proportion of children living in material hardship 2013–2023



Source: Stats NZ Child Poverty Statistics Year ended June 2023[101]

Step 4: Considering if any identified changes are significant

We do not consider the changes since 2019 to distributional impacts as they relate to climate change targets are important, consequential or notable.

We consider that there has not been a significant change to distributional impacts, and we have seen no evidence that there is likely to be a significant change to them in the future.

The principal risks and uncertainties associated with emissions reductions and removals

Step 1: Deciding what is relevant to assessing each topic

We considered the principal risks and uncertainties associated with emissions reductions throughout our assessments of each criterion in this chapter. For the risks and uncertainties of removals, engineered removals are not currently occurring in Aotearoa New Zealand. Forests are currently the only carbon dioxide removal activity recognised in New Zealand's Greenhouse Gas Inventory. There are specific risks and uncertainties associated with forests that are not covered elsewhere, so we focused on possible changes in these risks and uncertainties.

Forests, which remove carbon dioxide and store carbon from the atmosphere, are critical to the pathway to achieving the net zero component of the 2050 target. They also provide us with an option for reaching and maintaining net negative emissions, which *Chapter 3: Important context for our review of the 2050 target* suggests the world will need.

We consider there are two key risks and uncertainties associated with forests as a climate change solution:

- **permanence** – the expected duration of the carbon storage
- **acceptability** – the balance of benefits and harms.

Steps 2 and 3: Assessing for change or likely future change

Permanence

Storing carbon in forests is less durable than not emitting fossil carbon in the first place. The durability of forests as carbon storage can be affected by several factors including fires, extreme weather events, pests and human actions.

- In recent years wildfires have increased in number and area, along with lengthened fire seasons at some sites, surpassing expectations set in 2019.[102]
- Since 2019 extreme weather events have become more frequent and intense, and although this was anticipated, vulnerability has been shown through events such as Cyclone Gabrielle.
- Climate change creates favourable conditions for the introduction and establishment of new pest species, and the northern districts of the North Island are projected to become more suitable for sub-tropical pest species, including those that pose a threat to forests.[103]

Acceptability

Forests provide many useful services and benefits in Aotearoa New Zealand. There is a strong connection between forestry and iwi/Māori land ownership, and the relationship iwi/Māori have as tangata whenua to te taiao. Forestry waste can provide a sustainable energy resource to decarbonise other parts of the economy such as in process heat. Forests currently remove, and are projected to continue to remove, significant amounts of carbon dioxide. These removals provide more options in how climate targets are met, with other non-forestry forms of carbon dioxide removal such as direct air capture currently expensive and uncertain. Afforestation is likely to be an important part of global efforts to respond to temperature overshoots. Forests can allow Aotearoa New Zealand to realise significant long-term carbon dioxide removals, while providing co-benefits.

Since 2019 communities have expressed concern regarding the land-use change to forests, usually from sheep and beef pasture.[104] Many agricultural and rural communities worry about the consequences of the transition for their communities and livelihoods.[105]

The operation of plantation forestry carries environmental risks if forestry slash (wastes at harvest) is not well managed. In particular, extreme weather events such as Cyclone Gabrielle in 2023 resulted in devastating damage connected to some harvested forest land which flooded woody debris and sedimentation into land, waterways and infrastructure.[106,107] The Ministerial inquiry into land use since Cyclone Gabrielle found that the forest industry has lost its social licence in Tairāwhiti, and recommended an immediate halt to large-scale clear-fell harvesting in the region.[108]

Step 4: Considering if any identified changes are significant

Afforestation has a role as part of a mix of options for Aotearoa New Zealand to meet the 2050 target. The impacts of climate change on the permanence of carbon dioxide stored in forests were recognised before 2019. Although, the risk may be becoming more significant, there is in our judgement, currently not enough certainty that the level of change is sufficiently notable to draw a significant change finding.[109] In future reviews it will be important to assess as more information becomes available.

We have revised our initial assessment that the principal risks and uncertainties associated with emissions reductions and removals have significantly changed due to a deterioration in the social acceptability of forestry. This reassessment is partly in response to feedback as well as considering the bar for a significant change finding.

Social, cultural, environmental, and ecological circumstances

Step 1: Deciding what is relevant to assessing each topic

To enable us to identify any changes that might have occurred in these areas since the emissions target was set in 2019, we compiled five indicators to provide insight into social, cultural, environmental, and ecological circumstances within Aotearoa New Zealand as they relate to climate change. We chose democratic participation, public concern about climate change, and education as areas relevant to social and cultural circumstances, and water quality and air quality as areas relevant to environmental and ecological circumstances.

General election turnout rates were chosen as a measure demonstrating the willingness of the public to participate in collective processes.

Climate mitigation and adaptation will not succeed without the support of the public, so to understand the level of that support and whether that had changed since 2019, we investigated public attitudes towards climate change.

An educated workforce is required to transition Aotearoa New Zealand to a thriving, low emissions economy. For education we assessed the proportion of school leavers with NCEA level 2 or above.

To assess water quality, we used as an indicator the macroinvertebrate community index (MCI). The MCI is a measure of the abundance and diversity of macroinvertebrates and is an indicator of overall river health.

For air quality indicators we used commonly accepted measures of particulate matter in the air (concentrations of PM_{10} and PM_{25}).

As a result of consultation feedback, we considered using biodiversity and extinction rates as additional indicators, but found there is currently not enough data associated with these measures for them to be appropriate tools for looking for significant change. In the future, when more data is available to support the use of these indicators, we will re-evaluate their inclusion in our analytical approach.

Steps 2 and 3: Assessing for change or likely future change

Social and cultural indicators

Democratic participation

Aotearoa New Zealand shows generally high levels of engagement in general elections and turnout has been steadily increasing between 2011 and 2020, reaching 82% in 2020.[110] There was a slight decline in estimated turnout at the 2023 election to 78%.[111]

Public concern about climate change

Evidence for a significant change in public concern about climate change is mixed. In 2018 just 19% of the Aotearoa New Zealand public surveyed rated climate change as an important challenge.[112] By March 2023, 71% of respondents said that climate change was an important or very important issue for New Zealand.[113] While these surveys asked slightly different questions, they nonetheless show an increase in public concern about climate change between 2018 and 2023.[xv] However, following consultation, we strengthened our analysis with additional data on public concerns about climate change, which showed that climate change was ranked the most important issue by 22% of New Zealanders in November 2019 and 19% of New Zealanders in February 2024.[114] Over the five year period, public concern about climate change did not indicate any significant change to social, cultural, environmental, and ecological circumstances as they relate to climate change, which supports our initial finding.

xv The 2018 survey asked, "What would you say are the most important challenges facing New Zealand in the next 20 years?" And "Which of these would you say best describes your view of climate change?" with options ranging from "Entirely natural process" to "Entirely human driven". The 2023 survey was part of EECA's ongoing monitoring of public attitudes and asked, "How important do you consider each of the following issues to New Zealand?"

Education level of school leavers

The proportion of school leavers with NCEA level 2 or above dropped from 79.9% in 2019 to 74% in 2023.[115] This is likely due to the impacts of the COVID-19 pandemic – both on school students' ability to learn through disruption, and on low-income households' need for financial support.

Environmental and ecological indicators

Water quality

Freshwater quality requires measurement on very long timescales to account for the strong influence of natural variation from year to year.[116] While water quality has been decreasing in Aotearoa New Zealand since 2001, it is too early to assess whether it has changed since 2019. In the future, increases in horticulture due to land-use changes could increase freshwater demand and put pressure on freshwater ecosystems, but it is too early to tell what the actual effect might be.[117]

Air quality

Vehicle exhaust is a significant source of air pollution, and as vehicles have become more emissions- and fuel-efficient over time in Aotearoa New Zealand, air pollutant concentrations have decreased.[118] Looking to the future, we can expect that as internal combustion engine use reduces in favour of increased use of electric vehicles and public and active transport, transport emissions will continue to contribute less to air pollution.

Step 4: Considering if any identified changes are significant

Of the indicators chosen, general election turnout rates, water (MCI), and air quality have not changed in an important, notable, or consequential way since 2019. The other two indicators have changed, but evidence for a change in public concern about climate change since 2019 is mixed and we consider the proportion of school leavers with NCEA level 2 or above is unlikely to continue to decline due to the temporary nature of COVID-19 lockdowns and other restrictions.

We consider that there has not been a significant change to social, cultural, environmental, and ecological circumstances and we have seen no evidence that there is likely to be a significant change to them in the future.

Wāhanga 5 | Chapter 5

A mātou tūtohu ki te whāinga 2050
Our recommendation for the 2050 target

He Pou a Rangi Climate Change Commission is recommending that the 2050 target be amended to require lower emissions of greenhouse gases other than biogenic methane, and to tighten the target range for emissions of biogenic methane.

As discussed in *Chapter 4: Significant changes since the 2050 target was set*, there have been significant changes relating to climate change since the target was set. Those changes have influenced the target's effectiveness as a guiding star for Aotearoa New Zealand's contribution to global efforts to limit warming. We are recommending amendments to the target.

This chapter sets out our recommendation. We considered whether amendments to the target were justified in response to the significant changes that have occurred since 2019. We also considered the potential impacts of an amended target on Aotearoa New Zealand. More on the potential impacts can be found in *Chapter 6: Implications of our recommended 2050 target*.

The growing risks and impacts from climate change point to Aotearoa New Zealand taking further steps to reduce the warming it causes. But it's also important that the target is also set in a way that allows for clear and stable climate change policies for the country's economy and communities. Our recommended target takes both of these factors into account.

Our recommendation for the 2050 target

He Pou a Rangi Climate Change Commission recommends that:

a. net accounting emissions of greenhouse gases other than biogenic methane are at least negative 20 $MtCO_2e$ by the calendar year beginning on 1 January 2050

b. emissions of biogenic methane in a calendar year are:
   i. at least 10% less than 2017 emissions by the calendar year beginning on 1 January 2030, and
   ii. at least 35–47% less than 2017 emissions by the calendar year beginning on 1 January 2050

c. there are further reductions and removals of greenhouse gases after 1 January 2050.

Box 5.1: What does it mean to have negative emissions?

A net greenhouse gas level is the emissions less removals. Net negative is when the amount of removals is larger than the amount of emissions.

Past emissions continue to warm the planet now and in the future. If global warming exceeds 1.5°C, net negative emissions will be necessary to bring temperatures back down to 1.5°C.

In Aotearoa New Zealand, achieving net negative emissions is likely to look like an afforestation rate similar to 2020–2024 combined with low residual emissions. Getting to low residual emissions will require applying system changes and adopting existing and new technologies. The only currently recognised method under the Act of removing carbon dioxide from the atmosphere is by growing trees. In the future there may be other ways of removing emissions; some are technological and engineering focused, and some are more nature-based.

What we heard

In our April 2024 discussion document *Review of Aotearoa New Zealand's 2050 emissions reduction target* we sought feedback on what to consider and prioritise in making judgements about whether and how the 2050 target should change. We heard from submitters that:

- The growing intensity and scale of the effects of climate change was important in setting targets – this is considered in the 'scientific understanding' aspect of significant changes since the target was set. See *Chapter 4: Significant changes since the 2050 target was set.*
- Opportunities are available to reduce emissions; this is part of feasibility, and many opportunities are included in the emission pathways we use. See *Chapter 6: Implications of our recommended 2050 target.*
- Priority should be given to supporting Aotearoa New Zealand's commitment to limit the temperature increase to 1.5°C. See *Chapter 6: Implications of our recommended 2050 target* for how this analysis is considered.
- What they saw as a fair contribution for Aotearoa New Zealand to global efforts to limit global warming is important, and many said that Aotearoa New Zealand needs to be aligned with comparator countries. See the 'global action' aspect of significant change in *Chapter 4: Significant changes since the 2050 target was set*, where this is a consideration and also see *Chapter 6: Implications of our recommended 2050 target.*
- The importance of recognising opportunities for greater social justice in the transition to a low emissions country should be emphasised. Part of feasibility is looking at impacts across sectors and ensuring that nationally, resources are available to support a transition. See *Chapter 6: Implications of our recommended 2050 target.*
- There are concerns about the impacts of strengthening the target, including concerns about potential economic hardship, emissions leakage, land-use changes, and reduced rural employment and other impacts on rural communities. See *Chapter 6: Implications of our recommended 2050 target*.
- There are concerns about the flow-on effects of land-use change for rural communities. In response to these concerns, we changed our assumptions in the modelling that informs this advice. See *Chapter 6: Implications of our recommended 2050 target.*
- That any increase in ambition of national climate action should consider the risk of emissions leakage. We consider this issue in *Chapter 6: Implications of our recommended 2050 target.*

The recommended target responds to the significant changes in circumstances since the 2050 target was set

Our review has found that three significant changes in circumstances have occurred since the target was set. Those changes all point towards Aotearoa New Zealand moving further and faster to reduce emissions. The recommended target responds to these significant changes by targeting lower and ultimately negative emissions of long-lived gases, raising the minimum amount of biogenic methane reductions needed compared to the current target, and signalling further emissions removals and reductions after 2050.

The significant changes in circumstance and how the target responds to them are set out below.

There has been a shift in global action on climate change

Since 2019 the likelihood that warming will exceed 1.5°C in coming decades has increased. Average global temperatures are already close to that threshold. It is highly likely that warming will exceed 1.5°C in coming decades, bringing increased risk of severe and widespread climate impacts. Many countries are taking additional action to reduce greenhouse gas emissions. Comparable countries are aiming for their emissions of all greenhouse gases to reach net zero by 2050.[xvi]

Achieving the recommended target would mean Aotearoa New Zealand causes less warming than achieving the current target, and this is the direction of action that collectively the world needs to take to meet the goals set in the Paris Agreement, and the Act. Adopting the recommended target would put Aotearoa New Zealand more in line with comparator countries' targets; achieving negative 20 $MtCO_2e$ for all gases other than biogenic methane, and a 47% reduction in biogenic methane by 2050 is very close to net zero all gases when calculated using the internationally standard metric, GWP_{100}.

There is a greater scientific understanding of the impacts of climate change

The impacts of global warming are greater in both severity and scale than was understood in 2019. Research for the IPCC has found that greater impacts are being felt at lower temperature levels than previously expected. Harmful impacts from climate change are becoming more severe and more widespread as the planet warms. Scientific understanding of these impacts has advanced since the 2050 target was first set.

Achieving the recommended target would mean Aotearoa New Zealand causes less warming than achieving the current target. This lowers overall global warming, lowering the impacts of climate change. The signal to achieve further reductions and removals after 2050 also puts Aotearoa New Zealand on a track to continue to reduce the warming it causes. Many of the scenarios limiting global warming to 1.5°C rely on global net negative greenhouse gas emissions after 2050.[119]

xvi Including Canada, United Kingdom, the EU, USA, Japan and South Korea.

The balance of intergenerational equity has shifted

The balance of intergenerational equity has shifted since the 2050 target was set. Because the chances of exceeding 1.5°C above pre-industrial levels have gone up, and because the impacts of climate change are greater than previously understood, future generations will face a greater burden in adapting to and mitigating climate change. Not only are they likely to face more severe climate impacts, it is likely they will also have to do more to reduce and remove emissions.

The recommended target responds to the significant change in the scientific understanding of climate change. Achieving the recommended target would mean Aotearoa New Zealand causes less warming than achieving the current target. This lowers overall global warming, lowering the impacts of climate change. The signal to achieve further reductions and removals after 2050 also put Aotearoa New Zealand on a track to continue to reduce the warming it causes. Many of the scenarios limiting global warming to 1.5°C rely on global net negative greenhouse gas emissions after 2050.[120]

The recommended target responds to the significant change in intergenerational equity by requiring current generations to do more than the current target.

The recommended target retains the structure of the current target

The structure of the current target has specific requirements for biogenic methane emissions, reflecting the different impact on warming they have to emissions of long-lived gases, as well as uncertainties around the availability and affordability of options to reduce them.

We find no reason to recommend a change to the split-gas structure of the target. Having separate target components for biogenic methane and other gases allows Aotearoa New Zealand to take actions tailored to those different effects.

The recommended target responds to the significant changes in circumstances, while considering the potential impacts of the change

When setting the target in 2019 Parliament applied judgement, and after significant engagement and consultation, analysis and research, we have applied judgement in recommending an amendment to the target. The recommended target goes further on emissions reductions in response to the significant changes we found. Our judgement on how much further we recommend Aotearoa New Zealand go on emissions reductions is informed by our analysis using different scenarios to understand what emissions levels might be possible to achieve across different parts of the economy under varying scenarios of assumptions, and by assessing the implications of scenario outcomes that align to the recommended target as discussed in *Chapter 6: Implications of the recommended target*. This analysis, combined with what we learned through consultation, led us to conclude that the recommended target parameters of 35%–47% reductions in biogenic methane, and net negative 20 $MtCO_2e$ for all other gases, strengthen the foundation for clear and stable policies while also increasing Aotearoa New Zealand's contribution to limiting warming to 1.5°C above pre-industrial levels.

Targets set a level of emissions to reach over a timeframe, and therefore how much change is needed. Targets do not dictate the pathway and policies to meet them; that is the role of emissions budgets and the policies that make up emissions reduction plans. If the target is to be achieved, then the policies will need to result in outcomes that add up. The extent and mix of future impacts will heavily depend on government policy and on the actions of businesses and the wider community.

Wāhanga 6 | Chapter 6

Ngā pānga o tā mātou tūtohu i te whāinga 2050
Implications of our recommended 2050 target

The target needs to be effective in guiding Aotearoa New Zealand's contribution to global efforts to limit global warming. It is also important that the target is realistic and feasible when taking account of the possible impacts across the economy and society.

In *Chapter 5: Our recommendation for the 2050 target* we set out our recommendation for an amended 2050 target:

a. net accounting emissions of greenhouse gases other than biogenic methane are at least negative 20 $MtCO_2e$ by the calendar year beginning on 1 January 2050
b. emissions of biogenic methane in a calendar year are:
    i. at least 10% less than 2017 emissions by the calendar year beginning on 1 January 2030, and
    ii. at least 35–47% less than 2017 emissions by the calendar year beginning on 1 January 2050
c. there are further reductions and removals of greenhouse gases after 1 January 2050.

The recommendation is a response to the significant changes that have occurred since 2019 in relation to climate change. It also reflects consideration of the potential impacts of an amended target. Checking that the recommended target is feasible aligns with the Act's purpose of providing a framework for Aotearoa New Zealand to develop and implement clear and stable climate change policies. The Commission is satisfied that the significant changes justify the change to the target. In this chapter we discuss those impacts.

While emissions reductions matter, it is also important that the targeted reductions are realistic and feasible for Aotearoa New Zealand. We used economic modelling to assess the likely impacts of various scenarios. Those scenarios provide insight into the possible impacts of an amended target, but they are not forecasts. The exact mix of impacts would depend on Government policy and on the actions of businesses and the wider community. Any transition to a lower emissions economy will bring a mix of costs and benefits. These are uncertain and depend on the technologies available and system changes that direct and support emissions reductions.

We also considered how the current target and the direction of change from the recommended target line up with the key purpose of the Climate Change Response Act 2002 (the Act) – which is to provide a clear and stable framework for policies that contribute to global action aimed at limiting global warming to 1.5°C above pre-industrial levels.

What we heard

During public consultation in April and May 2024 we heard that opportunities are available to reduce emissions and we incorporated that feedback into our economic modelling. We also heard concerns about the impacts of strengthening the target – including concerns about potential economic hardship, emissions leakage (production replaced by higher emission production elsewhere), land-use change, and reduced rural employment and other impacts on rural communities. This chapter looks at the kinds of impacts that can be expected through an emissions reduction scenario that would meet the recommended target.

During consultation, most submitters supported our approach to assessing the contribution of the 2050 target to global efforts to limit global warming. However, some submitters argued that the Intergovernmental Panel on Climate Change's equity principles were not the only principles to consider.

Many submitters wanted to give priority to supporting Aotearoa New Zealand's commitment to limit the temperature increase to 1.5°C. See 'The recommended target aligns with the purpose of the Act' later in this chapter for how this analysis is considered.

We also heard that to get a full picture of Aotearoa New Zealand's contribution to global efforts to limit warming requires thinking about national characteristics and how they affect what the country can and should do to reduce emissions domestically.

How we considered the feasibility and the purpose of the target

Checking that the recommended target is feasible aligns with the Act's purpose of providing a framework for Aotearoa New Zealand to develop and implement clear and stable climate change policies. The recommended target needs to be realistic and feasible when taking account of the possible impacts across the economy and society. Considering whether the recommended target is realistic and feasible also supports important matters from section 5M of the Act, such as considering economic effects and social circumstances while transitioning to a low emissions economy.

Targets set a level of emissions to reach over a timeframe, and therefore how much change is needed. Targets do not dictate the pathway and policies to meet them. If the target is to be achieved, then the policies will need to add up to meet the target. After setting targets, governments have choices in how to set policy to reduce emissions.

To support judgements on the feasibility of meeting a target we looked at emissions pathways and scenarios that use research across sectors of the economy, to understand the actions that Aotearoa New Zealand can take to reduce emissions and the impact they would have.

One of the Act's purposes is to contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels. Checking whether the recommended target accords with this purpose requires an understanding of how much warming Aotearoa New Zealand would cause if it achieved the recommended target. We use temperature response modelling to show the warming impact of a scenario that meets the recommended target. It also requires an evaluation of how Aotearoa New Zealand's efforts compare to the global task. To provide insight into Aotearoa New Zealand's contribution we considered different international perspectives. Our analysis reflected a range of considerations including, for example, the country's projected emissions per capita, contribution to warming, and capacity for emissions reductions.

By assessing these considerations, we demonstrate that the recommended target is both ambitious and achievable, supporting Aotearoa New Zealand's commitment to addressing climate change.

We considered specific national characteristics

National characteristics are unique social, economic, environmental and political conditions of each country that influence their ability to address climate change. During our consultation and engagement we heard many national characteristics, such as how Aotearoa New Zealand's economy and society are structured, discussed as reasons for why the country should or should not have a particular target for emissions reduction. A wide range of national characteristics were raised throughout our consultation and engagement.

As a result, we included consideration of national characteristics as part of our analysis. For example, the changes required to reduce Aotearoa New Zealand's relatively high biogenic methane emissions are part of considering the impacts of the biogenic methane component of the target. Other national characteristics are relevant for considering the contribution to limiting warming, such as Aotearoa New Zealand's high per capita income relative to the rest of the world.

This chapter includes considerations of national characteristics where relevant when considering both the impacts of emissions reductions and Aotearoa New Zealand's contribution to global efforts.

We used scenario modelling to generate insights

The Commission developed a set of scenarios to demonstrate the range of actions that could be taken to reduce emissions, using dimensions of technology and systems change across sectors of the economy. This scenario analysis focuses on what is possible rather than defining an optimal mix of actions.

These scenarios are useful for generating insights into the temperature impacts and feasibility of the recommended target. Because we are recommending a range for biogenic methane, a scenario that aligns with the top end of the range and one that aligns with the bottom end of the range is needed. The Commission used the scenarios set out in **Table 6.1** to inform the target recommendation. For more detail on the scenarios and the assumptions underlying them see the separate report *Advice on Aotearoa New Zealand's fourth emissions budget*.

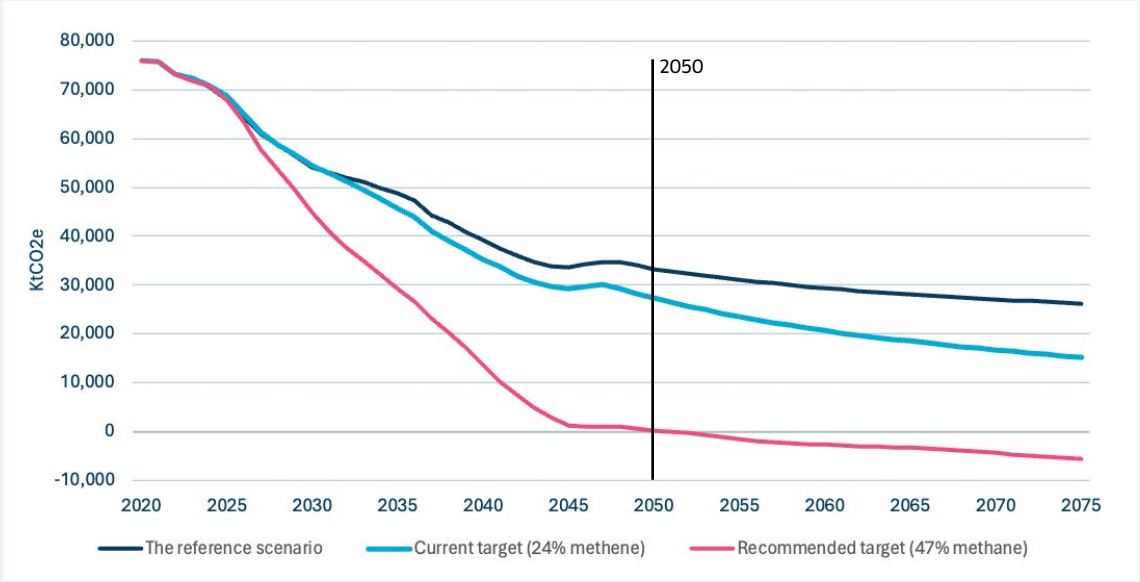
Table 6.1: Scenarios to inform the target recommendation

Scenario name	Alignment with target	Modelling Scenario
Recommended target (47% methane)	This scenario meets the recommended target for non-biogenic methane gases and achieves towards the top of the biogenic methane range.	High technology, high systems change (HTHS): this scenario implements both new and emerging technologies and systems shifts with significant co-benefits.
Recommended target (35% methane)	This scenario is used for the lower end of the recommended biogenic methane range. Note that it does not meet the recommended target for other gases.	EB4 demonstration path: a credible and consistent mix of actions to reduce emissions for the fourth emissions budget. Including consideration of actions that are ambitious while also being technically and economically achievable.
Current target	This scenario meets -24% reduction in biogenic methane and net zero emissions of all other gases.	Low technology, low systems change (LTLS): in this scenario, Aotearoa New Zealand would minimise societal shifts by focusing on emissions reductions for each activity through proven technology options.
Reference scenario	A scenario based on current polices and technologies.	The reference scenario.

The recommended target is feasible

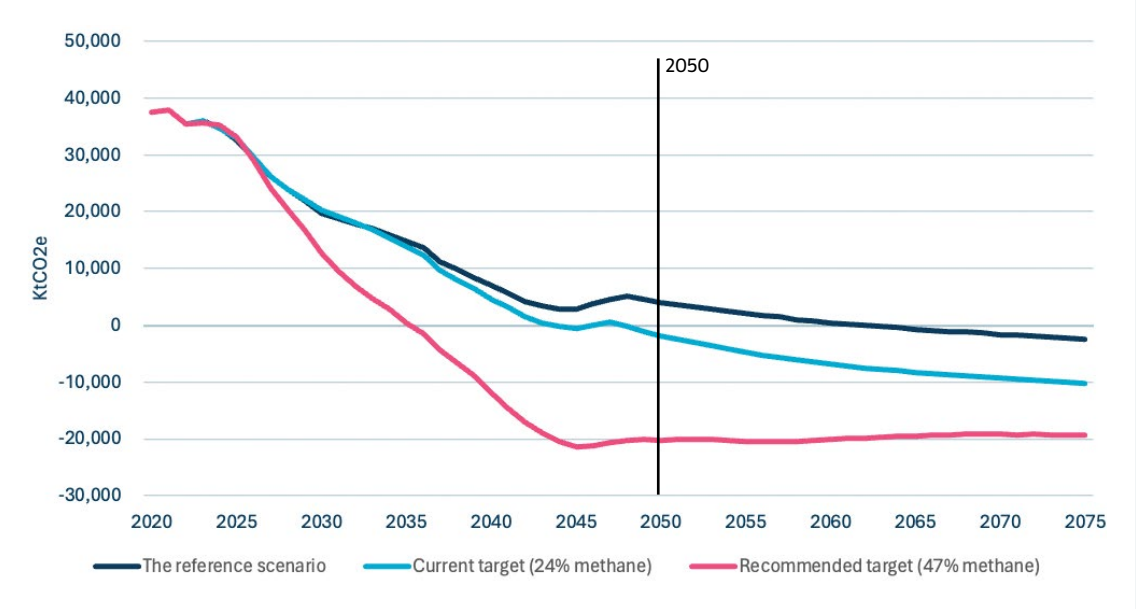
Based on the scenario modelling, achieving the recommended target is feasible. This modelling enables decision-making by giving insights into what is possible using dimensions of technology and systems change. **Figure 6.1** illustrates the net emissions of all gases in the reference scenario, the recommended target scenarios (47% methane) and the current target. **Figure 6.2** shows net emissions excluding biogenic methane, and **Figure 6.3** shows the level of reduction in emissions of biogenic methane from 2017 levels in scenarios showing both a 47% and a 35% reduction in biogenic methane.

Figure 6.1: Net emissions all greenhouse gases using GWP_{100}



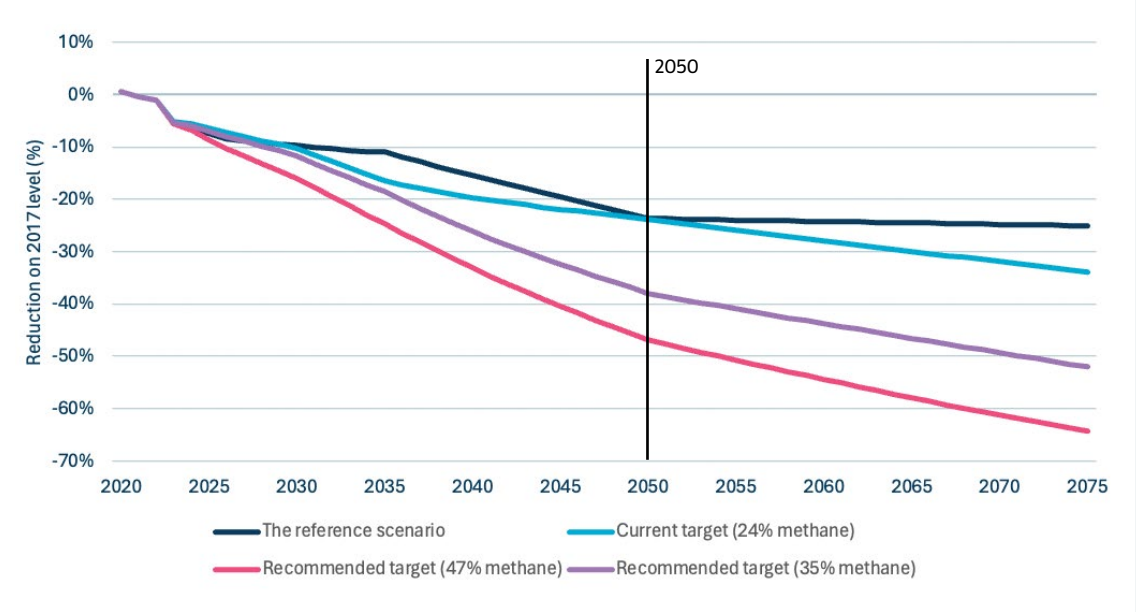
Source: Commission analysis

Figure 6.2: Net emissions excluding biogenic methane using GWP_{100}



Source: Commission analysis

Figure 6.3: Biogenic methane pathway level compared to 2017 level (%)



Source: Commission analysis

The scenario that aligns with the recommended target and achieves around 47% reductions in biogenic methane relies on implementing both new and emerging technologies and systems shifts with significant co-benefits.

As **Table 6.2** shows, many of the changes are system changes that can be influenced by policy. The main new and emerging technologies in the scenario are:

- methane inhibitors and vaccines on farm suitable for Aotearoa New Zealand farm systems (from 2035)
- hydrogen steel production (from 2040) – an innovative method of producing steel using hydrogen instead of traditional fossil fuels; this process significantly reduces carbon emissions
- Green carbon anodes for aluminium production (from 2035) – alternative to traditional carbon anodes used in the electrolytic process of aluminium smelting
- one hundred percent adoption of sustainable airline fuels (from 2050) – typically made from renewable biomass and waste resources.

We consider that it is reasonable to assume new technologies will continue to be developed over the coming decades, and there is room for unders and overs in these assumptions to balance. This scenario represents one feasible pathway to achieving the given rate of emissions reductions, but it can be done in other ways varying the timing and weight of different actions.

Table 6.2: Examples of new and emerging technology and system shifts changes by sector

Sector	New and emerging technologies	System shifts
Transport	Faster adoption of battery electric trucks, faster reduction in EV battery costs, rapid deployment of public charging infrastructure, earlier adoption of electric small aircraft, quicker electrification of public ferries.	Reduction in air travel demand, greater mode shift to active and public transport.
Energy	Faster cost reduction for building new renewable electricity generation, high efficiency recovery boilers for wood/pulp/paper.	Faster fossil gas phase out – by 2050 for buildings, reduced demand for heating from faster rates of retrofit.
IPPU (industrial processes and product use)	Deployment of green hydrogen steel production, deployment of green anodes for aluminium, faster electrification of compressors in urea production.	Further transition to electric arc furnace for steel production with improved scrap steel collection and recycling, faster phaseout and better recovery of F-gases.
Agriculture	Methane reduction technologies for dairy/sheep/beef, greater ambition for low-methane genetics for sheep, inclusion of genetics for dairy.	Greater reductions in stocking rates, further land-use change to horticulture and forests, further reductions in nitrous oxide use, all urea coated with urease inhibitor.
Waste	Greater organic waste to anaerobic digestion and boiler fuel, increased landfill gas capture efficiency.	Greater composting, greater waste avoidance, increased landfill gas infrastructure.
Forests	No new or emerging technologies.	Afforestation of sheep and beef land on land-use (LUC) classes 7 and 8, all land classed as LUC 8 and erosion-prone LUC 7 retired to natives.

Likely economic effects

The insights in this section are based on emissions scenarios that meet the recommended target. They should not be treated as forecasts. There will be choices available to manage and change these results. Policy choices matter for the impacts of achieving climate targets.

We can expect impacts on GDP, and the target will influence the scale of change in the most impacted sectors.

The Commission has estimated the GDP impact of following emissions pathways that align with the recommended target, in comparison to a reference scenario developed to represent current policies and measures. This analysis shows:

- the economy to grow and Aotearoa New Zealand to be richer in 2050
- to be contributing more to limiting global warming to lead to slightly lower GDP in 2050 than would otherwise be the case.

The lower GDP from the analysis using the C-PLAN model in 2050 is compared to the reference scenario, with most of the difference emerging after 2040. Our analysis using the C-PLAN model estimates an impact of about 5% difference of forgone growth in GDP for the recommended target (47% methane) scenario compared to the reference scenario in 2050, but this should be interpretated with caution and used as a ceiling rather than a central estimate.

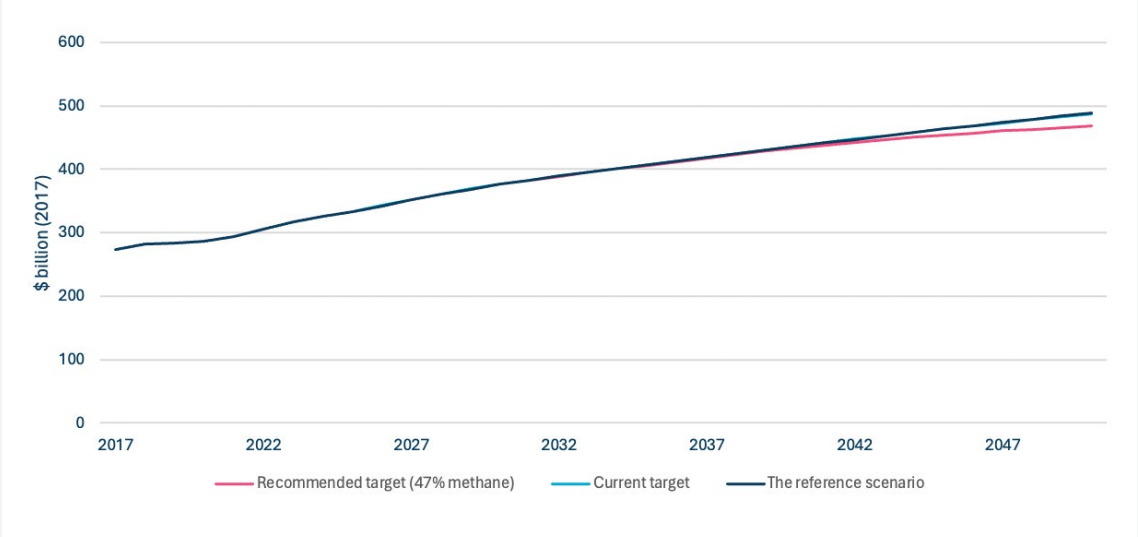
The results of the analysis show that the recommended target (47% methane) scenario is within one percentage point of GDP from the reference scenario in 2040 (see **Figure 6.4**).

This means there is a limited GDP impact of taking actions that are consistent with the target recommendation out to 2040. Modelling of mitigation technologies after 2040 is less certain, and there will be an opportunity to reassess based on more accurate forecasting as part of later reviews.

From 2040 the limitations of the modelling approach begin to limit the insights we can take. The model has limits on technologies that can be included, and this is important for GDP calculations as costly production decreases are the result where a technology to reduce emissions cannot be deployed in the model. The insight here is that research and innovation, and the adoption of available technologies, will be important for ensuring climate targets can be met while limiting any negative impacts on economic growth. This point works to reinforce the importance of changing climate targets to reflect significant changes earlier rather than later. A signal for, and therefore investment into, low greenhouse gas production needs to happen with plenty of time to incorporate new technologies into production.

The estimates from the modelling do not include co-benefits from emissions reduction, or the economic damage from global warming, which we can expect to be much higher if warming is not limited through emissions reduction and removals. See *Advice on Aotearoa New Zealand's fourth emissions budget* for more detail.

Figure 6.4: C-PLAN GDP results ($ billion, real 2017)[xvii]



Source: Commission analysis

Increased productivity

Many actions that are good for the climate are also good for productivity. Examples include:

- electricity is a more efficient and cheaper[121] form of energy[122] than fossil fuels
- energy efficient homes and buildings cost less to heat and cool[123]
- improving farm management practices can lower emissions while maintaining, or in some cases increasing, on-farm profit.[124]

Greater innovation can also support productivity. Creating and deploying solutions for climate change will take research and development. In some areas, such as food production and biogenic methane reductions, Aotearoa New Zealand has an opportunity to be a global technology leader.

Maintaining global competitiveness can support productivity and the economy. Global customers are already demanding lower emissions products.[125] Reducing emissions, especially in food production, will become increasingly important for access to high value markets. If Aotearoa New Zealand loses competitiveness in this area, we will likely end up selling our products at a discount to lower value markets.

xvii The GDP impacts of the current target scenario are very similar to, and therefore obscured by, the reference scenario line.

Social, cultural, environmental, and ecological circumstances, including differences between sectors and regions

The insights in this section are based on emissions scenarios that meet the recommended target. They should not be treated as forecasts. There will be choices available to manage and change these results. Policy choices matter for the impacts of achieving climate targets.

Agriculture

Agricultural production has long been an important source of income for Aotearoa New Zealand and shaped the landscape. The agricultural sector interacts with climate targets through its production emissions of biogenic methane, nitrous oxide and carbon dioxide. Methane is a short-term greenhouse gas, but has a very powerful warming effect over its lifetime.[126,127] Over half of the global warming caused by Aotearoa New Zealand's emissions comes from methane.[128]

Aotearoa New Zealand's emissions from agriculture as a share of total emissions are higher than most other developed countries.[129] There are three main ways to reduce biogenic methane: improving farm management practices, changing land use, and reducing animal numbers. Within each of these categories there are some low-cost options and some high-cost options. Our scenario modelling takes these into account. See *Technical Annex: Modelling and analysis to support final advice on Aotearoa New Zealand's fourth emissions budget and the review of the 2050 emissions target including whether emissions from international shipping and aviation should be included* for more detail.

While there will always be a risk of emissions leakage when countries take action on climate change, the literature suggests that there is no consensus about whether production shifting from one country to the other would increase or decrease global greenhouse gas emissions and how much these changes to emissions would be. The risk of emissions leakage is highly uncertain but appears to be low for agriculture in Aotearoa New Zealand in the near term.[130]

Sheep and beef livestock numbers follow current trends

Beef and sheep numbers are both expected to decline in the reference scenario out to 2050, and declines are slightly higher in the recommended target (35% methane) scenario and higher again for the recommended target (47% methane) scenario. Dairy cattle numbers peaked in 2014 and have been declining since. Sheep numbers peaked at 70 million in 1982 and have been declining to 23 million in 2024 and continue to 14 million in the recommended target (47% methane) scenario path by 2050 compared to 17 million in the recommended target (35% methane) scenario and 18 million in the reference scenario.

In terms of land area, sheep and beef changes from 7.2 million hectares today to 6.1 million hectares in 2050 in the reference scenario. The recommended target (47% methane) scenario reduces to 5.3 million hectares in 2050 while the recommended target (35% methane) scenario reduces to 6.5 million hectares.[xviii] The interaction with forestry where higher afforestation switches land use from sheep and beef is a driver here.

Dairy production is steady

Total milk solid production is expected to be at a similar level in 2050 as 2024, with 1.9 billion kilograms in 2024 through to 2050 in the recommended target (35% methane) scenario and dropping to 1.8 billion kilograms in recommended target (47% methane) scenario. In the absence of meeting these targets, following the reference scenario would have seen production grow to 2.2 billion kilograms.

xviii Note this is higher than the reference scenario.

In terms of land area, dairy land remains at 1.7 million hectares from 2024 to 2050 in both the reference and recommended target (35% methane) scenarios, but decreases to 1.5 million hectares in the recommended target (47% methane) scenario by 2050.

Horticulture advances

Meeting the recommended target (47% methane) scenario sees rapid increases in revenues from horticulture. With 2050 revenue increasing from NZ$3.2 billion in the reference scenario to NZ$7.3 billion in the recommended target (47% methane) scenario, while the recommended target (35% methane) scenario would see more modest gains to NZ$4 billion.

Forestry plays an important role

Meeting either of the recommended target scenarios sees production forestry expand from 2.1 million hectares in 2024 to 2.4–2.6 million hectares. This compares to the reference scenario expanding forestry to 2.8 million hectares. The increase in the recommended target (47% methane) scenario would take production forestry from approximately 10% of Aotearoa New Zealand's land area, to approximately 11%.

Land-use changes over time

Land use is never static on a national level as some industries seek more land and others need less. This change is a result of economic trends and can also be influenced to some extent by climate policy. **Table 6.3** shows the land-use change associated with emission pathways. The differences between the reference scenario and the recommended target (47% methane) scenario can be taken as a guide for the level of change implied by the recommended target. There will be many ways to meet a target, and there is also significant uncertainty. As an example, the arrival of a methane inhibiting bolus that works in Aotearoa New Zealand's farming systems could make the recommend target achievable with very little land-use change from dairy.

Table 6.3: Land area under different scenarios

Land area by sector (Mha)	Year	Reference scenario	Recommended target (35% methane)	Recommended target (47% methane)
Dairy	2024	1.7	1.7	1.7
	2050	1.7	1.7	1.5
Sheep and beef	2024	7.2	7.2	7.2
	2050	6.1	6.5	5.3
Horticulture	2024	0.1	0.1	0.1
	2050	0.1	0.2	0.3
Exotic forest	2024	2.1	2.1	2.1
	2050	2.8	2.4	2.6
Native forest (post 1989)	2024	0.1	0.1	0.1
	2050	0.5	0.7	0.7

Source: Commission analysis

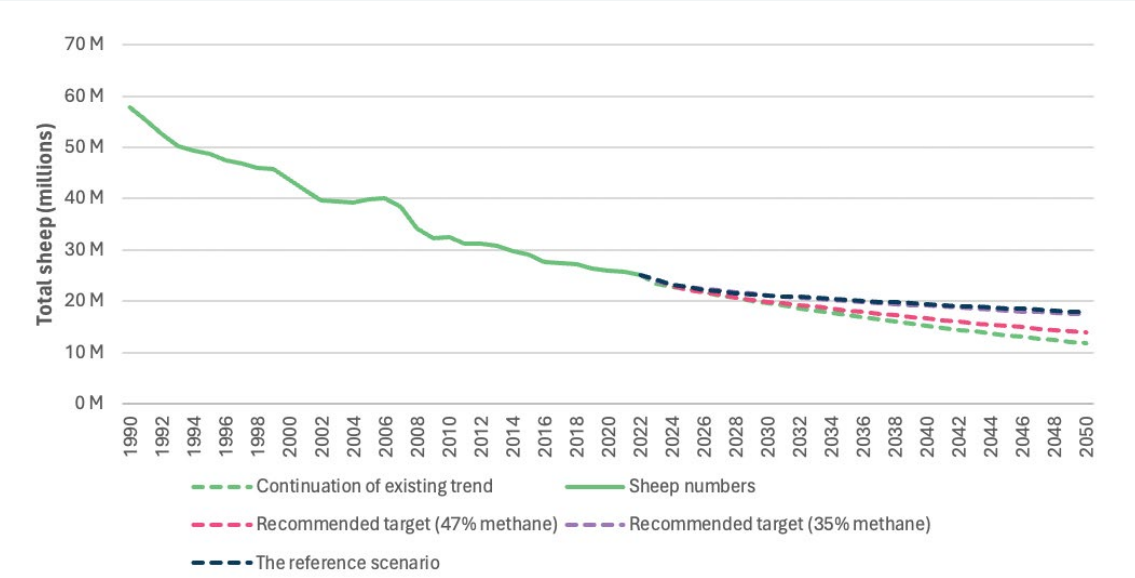
Land-use change, a social consideration

The impact of land-use change is likely to mean there will be more of a transition in rural communities, but the nature of the change is difficult to predict and likely to affect different communities in different ways. Wholesale conversion of sheep and beef farmland to forestry would affect communities in the immediate area. More permanent or native afforestation may also generate fewer jobs than exotic production forestry, particularly if the land is left to revert rather than being planted. Some changes in land use could in turn impact the population of rural communities and reduce expenditure in other businesses that rely on these sectors. More land converting from dairy to horticulture would also affect the nature of work in different regions, as horticulture requires more seasonal workers.

While land-use change is needed as a tool to meet proposed targets, it is also important not to ascribe all land-use change to climate policy. Existing trends of declining sheep stock numbers and land use, related to the underlying economics of sheep farming, are expected to continue. There are a number of causes for this decline, including that the Reserve Bank estimates up to 15% of sheep farms are unprofitable in a baseline scenario without emissions pricing.[131]

This can be seen in **Figure 6.5**, which compares modelling scenarios with a mathematical extrapolation of trends since 1990.

Figure 6.5: Comparison of modelled sheep numbers against historical trend



Source: Commission analysis

Other social considerations

There are risks to inaction. As climate impacts worsen, the world will need to accelerate action. This will likely involve increased global pressure on all countries to transition to a low emissions economy. If Aotearoa New Zealand waits to transition, then that transition may be forced upon the country very quickly. Short sharp economic transitions can result in a lot of economic and social costs.[132]

Aotearoa New Zealand will feel the impacts of a changing global climate. The country will need to adapt to those effects. Many actions that reduce emissions can also be designed to improve adaptive capacity and increase resilience. For example:

- *Energy supply:* electrification can reduce our dependence on imported energy. While climate change can have an impact on renewable electricity generation and electricity networks, using technologies such as smart system management, high-capacity batteries, and distributed generation can create resilience and reduce risk of key point failure in extreme weather.[133]
- *Resilient urban networks:* urban planning and design, and related work to improve transport options to support emissions reduction for passenger transport, can also support adaptation to climate change impacts.[134]
- *Land-use change:* a greater variety of land uses may increase resiliency.[135] Greater use of forests, especially native forests, can also protect against erosion and landslips.[136]

Transport

The EB4 demonstration path includes holding vehicle kilometres travelled to 2022 levels of 47 billion. The reference scenario shows an increase to 63 billion by 2050; the recommended target (47% methane) scenario has a decrease to 42 billion. A phaseout of new internal combustion engines for light vehicles and bus imports begins in 2030 for the recommended target (47% methane) scenario. Public transport increases to 17% of household travel in the recommended target (47% methane) scenario compared to 6% in the reference scenario in 2050.

Industry

The recommended target (47% methane) scenario includes deployment of low emissions technologies for ammonia-urea production, aluminium, steel, and cement production. It also includes greater supply of renewable electricity combined with demand side responses.

Electricity

New Zealand's abundant renewable energy potential and almost entirely energy-independent electricity system may provide an advantage over other countries, suggesting we can add new generation cost-competitively to support the electrification of transport and manufacturing.[137,138] A number of renewable power technologies are now cheaper than the lower range of the fossil generation price.[139]

Aotearoa New Zealand has the capacity to meet most of its energy needs from domestic resources (including high levels of renewable electricity generation) within national borders. This significantly reduces the risk associated with imported fossil fuels.[140]

Regional differences

Analysis has estimated that most regions would experience more jobs (rather than fewer), except for Taranaki and the West Coast (due to jobs in the oil, fossil gas, and mining sectors in these two regions). Recently, interest in offshore renewables and hydrogen in Taranaki has grown significantly, which may offset job losses from oil and fossil gas, should these industries develop.[141] [xix] For the most part, the changes in the patterns of employment that are predicted are expected to be gradual. There will be more opportunities for workers to naturally transition out of sectors through normal turnover or retirement than if there are expected to be abrupt changes in a sector. There are also significant shifts in the patterns of employment expected between sectors over the next 15 years, as some sectors grow and others contract. These changes are expected for several reasons not connected to climate action.

Environmental systems

There are co-benefits from supporting environmental systems. A larger planting of native forests, such as modelled in the recommended target (47% methane) scenario, can improve biodiversity and resilience to the physical effects of climate change (such as flooding and land erosion in high rainfall events), while improved soil and water quality from changes to land use or farm management, such as managing supplementary feed and adjusting stocking rates and fertiliser use.

The distribution benefits, costs and risks between generations

The recommended target would require greater action by current generations, reducing the impact of warming on future generations and driving the transformation of the economy.

Achieving the recommended target reduces the amount of warming caused by Aotearoa New Zealand, which lowers the risk of the impacts of warming on future generations.

The further reductions and removals after 2050 support earlier signalling of long-term goals, enabling a smoother transition and lower transition costs across generations. Meeting the modelled pathway could improve the intergenerational distribution of the co-benefits of emissions reductions such as health improvements and economic gains presented by the transition to a thriving, low emissions economy.

There are significant health benefits associated with electrification of the transport fleet, mode shift to active transport, and warmer and drier houses.[142] These benefits not only make people healthier, but also can lower pressure on the public health system with the associated fiscal savings.

However, an increased reliance on afforestation in the recommended target may decrease future generations' land-use choices.

The Crown–Māori relationship, te ao Māori and the specific effects on iwi and Māori

Throughout our engagement we have heard support for an intergenerational, long-term perspective from iwi/Māori. Iwi/Māori often make decisions around the use of their land with an intergenerational perspective firmly in mind. Through engagements we have heard consistently that the impacts of land use on current and future generations, along with equity, and good environmental and social practices, are foundational to decision-making for many iwi/Māori.

The impacts of current choices on future generations is an important consideration, with whakapapa dictating that decision-making occurs within a framework of intergenerational equity. Onamata, anamata[xx] guides decision-makers to consider equally those who will come after themselves, and to understand decisions around the environment are made on behalf of tamariki and mokopuna.

xix The Commission notes that one of the offshore wind developers is pulling out of Aotearoa New Zealand, citing uncertainties around seabed allocation as one of the reasons they are exiting. See M Daalder (2024, October 10) Offshore wind developer pulls out of NZ amid seabed mining concerns, Newsroom

xx Onamata, anamata refers to the past and future as viewed through a lens of whānaungatanga. Onamata refers to the eyes of those who have gone before, and anamata to the eyes of those who come after.

Iwi/Māori are also addressing climate change through low emissions investments. With an asset base estimated to be worth NZ$70 billion and a projected growth rate of 5% per annum, iwi and Māori landowners hold significant investment potential and will continue to play a leading role in the economy.[143]

The recommended target is more consistent with this approach than the current target. The recommended target would both increase emissions reductions by 2050, and set a longer timeframe for emissions reduction actions to continue post-2050.

The recommended target (47% methane) scenario used to support understanding of the recommended target shows increased reliance on native afforestation to provide long-term carbon removals in comparison to the reference scenario (1.5 million hectares between 2021 and 2050 versus 0.44 million hectares between 2021–2051). Modelling assumes a large increase in new native forests on marginal and erosion-prone land through planting and letting land revert to natives. This can support increasing biodiversity and water quality, positively impacting te taiao.

Historic land policy restricts the economic use cases for much of the Māori land estate. Afforestation policy in the past has disadvantaged iwi/Māori whose forests are often ineligible for crediting under the New Zealand Emissions Trading Scheme while subject to liabilities if they change land use. Increasing afforestation without addressing the inequitable outcomes of past afforestation could erode Māori trust in the Crown, negatively impacting the Crown–Māori relationship.

Māori landowners or collectives are disproportionately invested in pastoral farming, and sheep, beef, and dairy farming account for 72.4% of Māori economy emissions, compared with 53.4% of the whole Aotearoa New Zealand economy.[144] Land-use change away from sheep, beef and dairy and towards lower emissions land uses may therefore have specific negative impacts on iwi/Māori, and Māori businesses may need further support to transition.

Pathways consistent with the recommended target assume livestock reductions that could affect iwi/Māori disproportionately. The recommended target (47% methane) scenario requires a decrease in average dairy livestock per hectare of 21% and sheep and beef 10.8% to 2050, compared to 5% and 6% under the reference scenario. The recommended target (35% methane) scenario sees sheep numbers continue a declining trend from 35.4 million in 2024 to 22.9 million in 2050, rather than a fall to 19.5 million in the recommended target (47% methane) scenario.

The recommended target requires further removals after 2050. This unspecified combination of gross reductions, afforestation, and engineered removals would have to be managed so that it does not exacerbate the above impacts on iwi/Māori.

Reducing biogenic methane in the recommended target (47% methane) scenario relies on the commercialisation of a methane inhibitor feed additive from 2030 and a methane vaccine or bolus from 2035 for dairy, sheep and beef. The recommended target (35% methane) scenario includes a methane vaccine. Through submissions from iwi/Māori we heard concerns regarding the lack of consideration for tikanga and cultural values in the development of methane technologies such as inhibitors, and general unwillingness to incorporate these into pastoral farming. If the recommended target was adopted there would need to be extra support available for iwi/Māori to enable methane reductions in a way that aligns with tikanga.

The recommended target aligns with the purpose of the Act

Aotearoa New Zealand would cause around a third less warming by achieving the recommended target compared to the current target

We have analysed the warming caused by Aotearoa New Zealand's past net emissions[xxi] and the scenarios that align with the current and recommended target. This gives insight into how much Aotearoa New Zealand is contributing to global warming, which is an important part of the Act's purpose to contribute to limiting global warming to 1.5°C.

Temperature response modelling uses a simplified climate model to convert emissions of greenhouse gases into concentrations, and then to the temperature effect directly. This allows us to compare the warming outcome from different net emissions scenarios, and accurately reflect how emissions of each gas contribute to warming. **Figures 6.6–6.8** show the warming caused and expected by emissions in each year over 90 years.

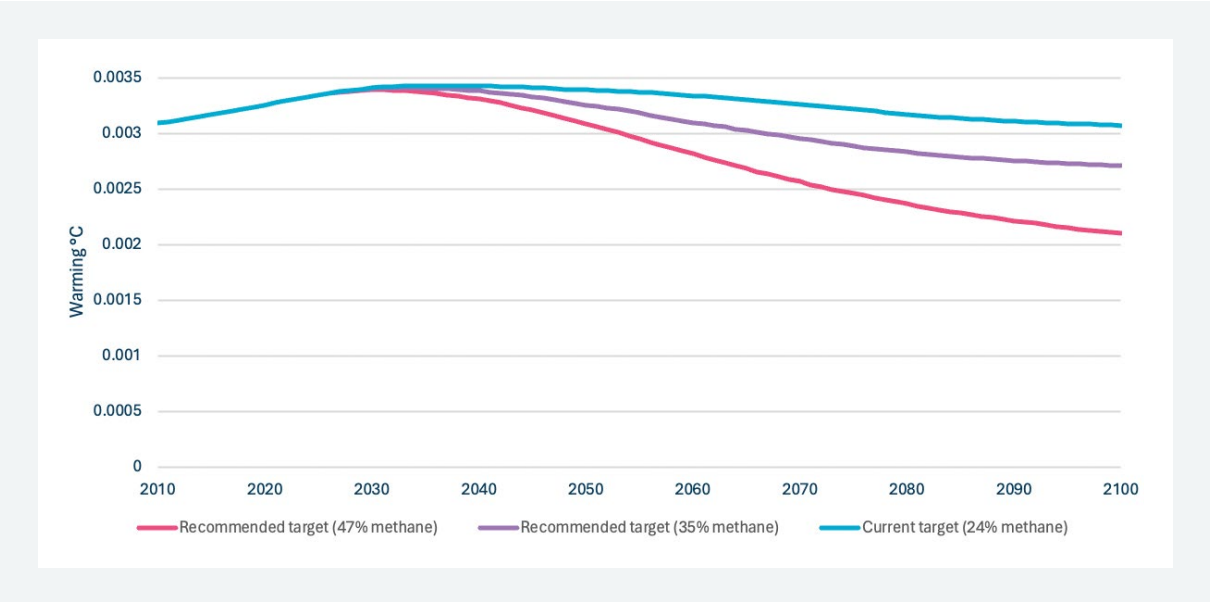
This temperature modelling includes the fact that methane is a short-term greenhouse gas, but has a very powerful warming effect over its lifetime.[145,146]

The scenarios that align with the recommended target would both cause less warming than the scenario that is consistent with the current target. This means the recommended target has better alignment with the Act because meeting it will cause less warming than meeting the current target. As **Figure 6.6** shows, the current target scenario (24% biogenic methane reduction) does little to reduce warming from recent levels, peaking in the 2030s and returning to 2010 warming levels at the end of the century.

The recommended target (47% methane) scenario has a greater reduction in warming, reaching close to 0.002 degrees by 2100. The recommended target (35% methane) scenario reaches close to 0.0027 degrees by 2100. By 2050 this pathway has returned warming caused by Aotearoa New Zealand emissions to levels seen in 2010.

Limiting global warming to 1.5°C requires many countries to cause less warming than they have in the past. For meeting a global temperature goal, the less warming caused by Aotearoa New Zealand emissions the better. The recommended target (47% methane) scenario returns warming to levels last seen in 2010 by 2050, and then reduces warming further.

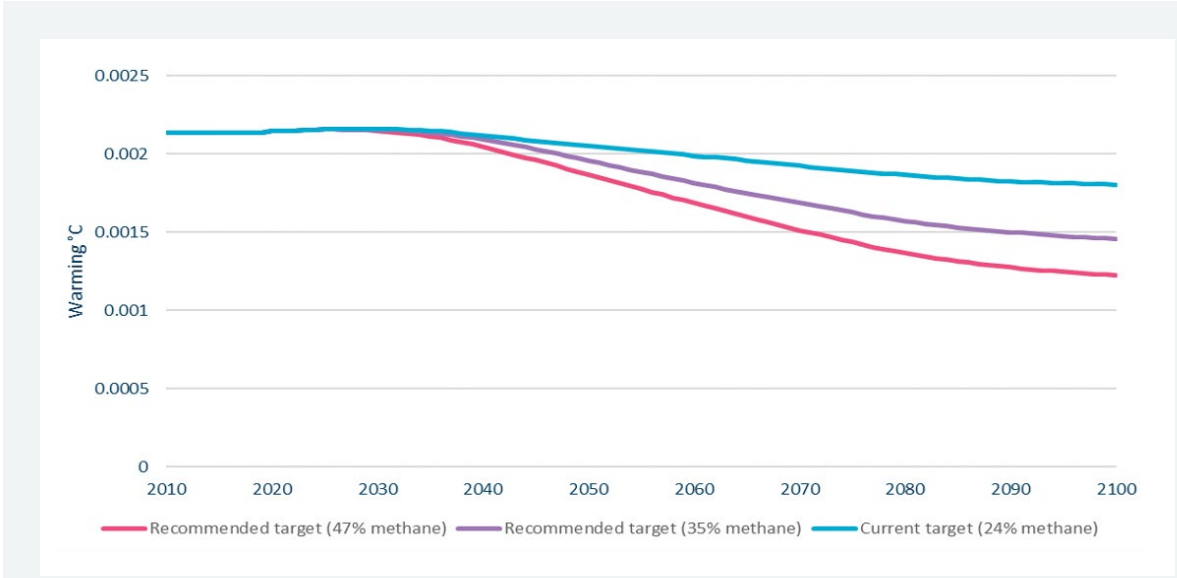
Figure 6.6: Comparison of the warming impact of different emissions pathways, all gases



Source: Commission analysis

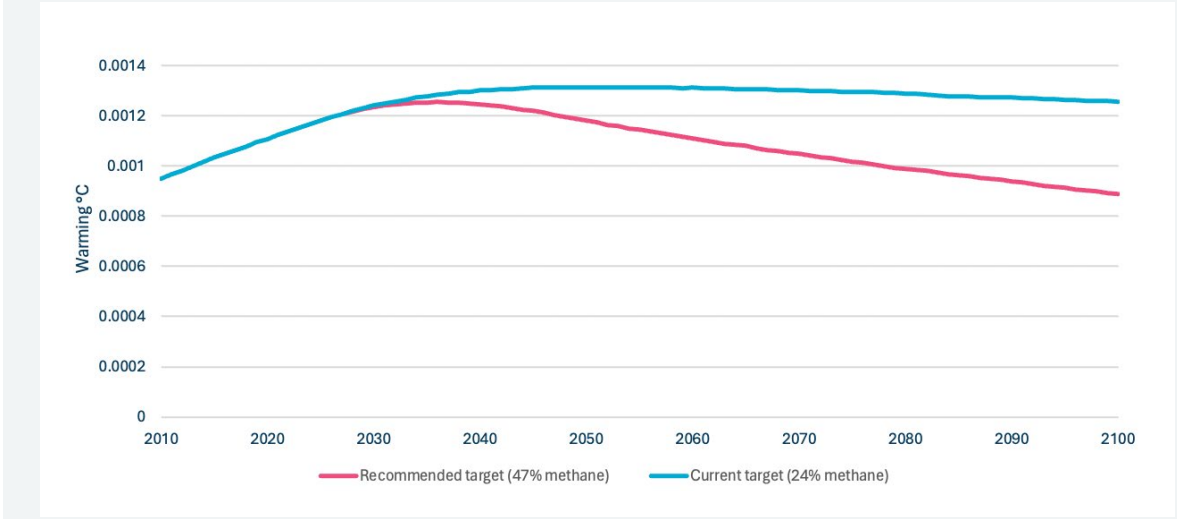
xxi Calculated using target accounting methodology.

Figure 6.7: Comparison of the warming impact of different emissions pathways, methane



Source: Commission analysis

Figure 6.8: Comparison of the warming impact of different emissions pathways, all gases excluding biogenic methane



Source: Commission analysis

Achieving the target would mean Aotearoa New Zealand makes a greater contribution to global efforts to limit warming

There are multiple perspectives that can be applied to understanding a national contribution to global efforts. A national contribution can include helping other nations to make reductions. For understanding the domestic contribution guided by the 2050 target we have used four perspectives from the IPCC that can give insight into how the burden of reducing emissions could be shared across different countries and economies:[147]

- equal per capita emissions
- capacity/ ability to pay
- responsibility for warming
- right to sustainable development.

Each perspective has strengths and weaknesses. We used them as a guide, particularly if taken together they all point the same way. We found that the current target as a whole is not compatible with any of them. This finding itself does not provide a reason to recommend a change to the target; it supports understanding how the target and recommended target support achieving the purpose of the Act. The recommended target moves Aotearoa New Zealand's contribution closer to being compatible with them.

Equal per capita emissions

This perspective assumes everyone in the world has an equal right to use the atmosphere. A target based on equal per capita emissions would require Aotearoa New Zealand's emissions to be around 7 tCO_2e per person in 2020 falling to 1 tCO_2e per person by 2050. The current target has remaining biogenic methane emissions from 2050 of between 3 (47% reduction) and 4.5 (24% reduction) tCO_2e per person from 2050.

While Aotearoa New Zealand is a small country, every fraction of a degree matters. Less than 1% of total world greenhouse gas emissions are produced in Aotearoa New Zealand.[148] Ninety-two percent of countries have individual contributions to emissions of less than 1% of the world's total. Together these countries comprise 25% of world emissions. It is only through the collective effort of all emitters that limiting warming can be achieved.[149]

We also note that emissions per capita in Aotearoa New Zealand are approximately 1.5 times higher than the global average.[150] Limiting warming requires collective action by all emitters, including small countries. Both the current target and recommended target will see Aotearoa New Zealand contribute an outsized share of emissions. However, the recommended target would mean a less outsized share.

Emissions can be apportioned between countries on either a producer basis (emissions are counted where the emissions occur) or on a consumption basis (emissions are counted where the final product is consumed). Neither method is perfect; however, the world has mostly relied on counting emissions on a producer basis since it is much easier to estimate emissions accurately at the point at which they occur. Estimating emissions this way makes Aotearoa New Zealand responsible for all of the emissions associated with the products we export, including food, but free from any responsibility for the emissions associated with the things we import – vehicles, equipment, plastics and metals.

On a consumption basis, Aotearoa New Zealand's emissions (CO_2 only) are still high. At 8.4 tCO_2 per person they are still almost twice the world average (4.7 tCO_2 per person) and higher than both the European Union (8.1 tCO_2 per person) and the United Kingdom (7.6 tCO_2 per person), but significantly lower than the United States (16.7 tCO_2 per person) and Australia (13.2 tCO_2 per person).[151]

Capacity/ability to pay

This perspective looks at the technical, financial, and economic ability of each country or economy to contribute to reducing emissions. Capacity requires economic and financial resources, but also technical skills, sound institutions and the human capacity to make changes. We have taken a simplified approach that uses share of global GDP as a proxy for capacity to reduce emissions.

According to data from the World Bank, Aotearoa New Zealand's per capita GDP, at $54,109 USD, is higher than the world average of $23,009 USD. GDP per capita.[152] This makes Aotearoa New Zealand a relatively high income country.

Under this perspective, Aotearoa New Zealand's total net emissions for all gases would need to reach net zero around 2050 and include ongoing net removals to a small degree in the decades after 2050, which aligns with the recommended target.

Responsibility for warming

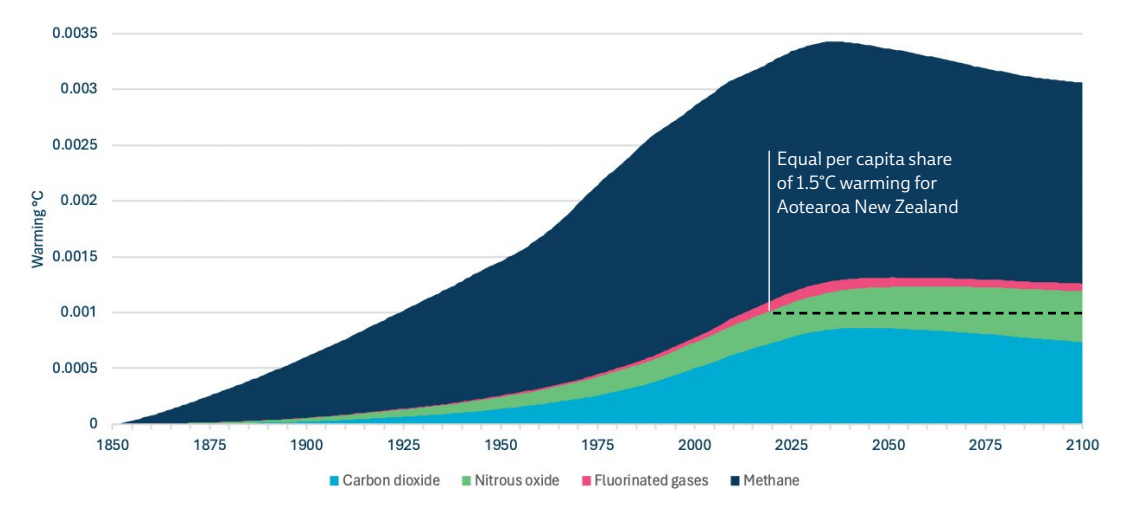
This perspective holds countries responsible for the total amount of warming caused by both historical and future greenhouse gas emissions.

It accounts for how countries have arrived at the current circumstances. Countries that have caused more warming in the past – and benefited economically from doing so – are required to reduce emissions by more to bring the warming they have contributed back down to an equal per capita share.

While the years 1850 and 1990 are frequently used to decide when responsibility for the warming caused by past emission starts, and are used in our analysis, other choices are possible.

In **Figures 6.9** and **6.10**, the 1.5°C of warming is apportioned globally by population (represented by the dashed line). Aotearoa New Zealand's share of the total warming that limits warming to 1.5°C would be a limit of 0.001°C.[xxii] Warming from Aotearoa New Zealand's emissions following the scenario consistent with the current target (at the 24% reduction in biogenic methane end of the range) would peak at over 0.003°C before falling slightly but remaining just above 0.003°C in 2100. The emissions scenario consistent with the recommended target has a similar peak, but the warming caused reduces and almost reaches 0.002°C.

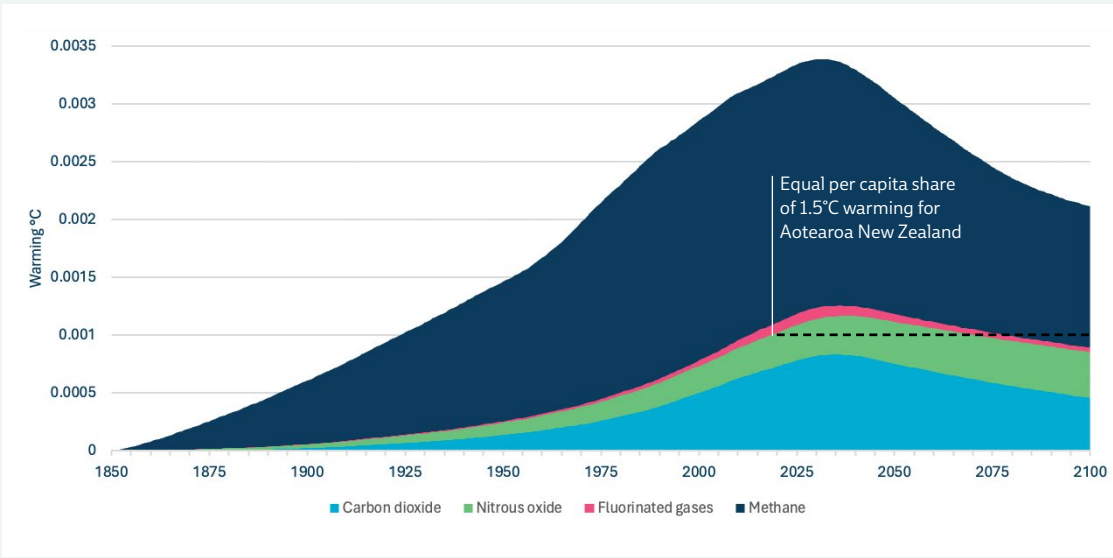
Figure 6.9: Warming from emissions from Aotearoa New Zealand 1850–2100 under the current 2050 target and share of 1.5°C warming from 2024



Source: Commission analysis

xxii Based on Aotearoa New Zealand's share of world population between 2010 and 2070 in 1.5°C scenarios.

Figure 6.10: Warming from emissions from Aotearoa New Zealand 1850–2100 under the recommended 2050 target and share of 1.5°C warming from 2024



Source: Commission analysis

The right to sustainable development

This perspective assumes that meeting basic needs is a global priority before contributing to emissions reductions.

The right to development recognises that many people in different parts of the world are still working towards having their basic needs met – food, housing, clean water, education. It recognises that not all current emitters are equally responsible for climate change, and not all income is equally usable to combat climate change. Under this perspective, it is inequitable for wealthy emitters who developed their standard of living on the basis of fossil fuels and other emitting activities, to require people to reduce emissions before they have developed a minimum standard of living.

Given Aotearoa New Zealand's levels and distribution of income, a sustainable development approach would require deeper reductions than an equal per capita approach, and potentially higher than a capacity/ability to pay approach.

Much of the world's methane emissions in developing countries are for subsistence farming of rice or livestock, and fugitive emissions from fossil fuel production and distribution. Fugitive emissions will reduce as fossil fuels are phased out and monitoring technologies are widely deployed, but agricultural emissions may not. This perspective would suggest that much of the allowable global methane budget for a 1.5°C pathway be reserved for those who are using it to meet their basic survival needs – requiring greater reductions from richer countries like Aotearoa New Zealand.

The recommended target moves closer to this approach by requiring greater emissions reduction.

Box 6.1: Methodology for the analysis of Aotearoa New Zealand's contribution to global efforts to limit warming

For these perspectives, we calculated what Aotearoa New Zealand's share of world emissions would be if world emissions followed a 1.5°C pathway with limited overshoot. We used pathways assessed by the IPCC as limiting warming to 1.5°C in the Sixth Assessment Report (shared socioeconomic pathways 1-1.9). We compared net emissions under the current 2050 target to the country's share of net emissions in the median pathway using decadal timesteps from 2020 to 2070. This was assessed on a split-gas basis, assessing the biogenic methane and net zero components of the target separately, and

Other target options the Commission considered

The Commission considered other target options. They are not recommended. Under the Act, the Commission can recommend changes to the target's timeframe, levels, structure or rules.

An earlier target

The Commission considered advising that the current target be achieved by the earlier date of 2040. This would then give the ten years between 2040 and 2050 to look at a further emissions reductions, and the change would be easy to understand. Our modelling indicates the current target by 2040 can be achieved with a mix of technology and system changes.

However, this target is not recommended because achievable targets that go further to respond to the significant changes and contributing to meet temperature goals are available. As the earlier target option aims at the same level of emissions as the current target, the cumulative difference in emissions between the earlier target and the recommended target are low (~60 $MtCO_2e$).

An early target, achieved through a pathway similar to the recommended target (35% methane) scenario, could reduce warming by 12% from the current target by 2100, whereas the recommended target reduces warming by 2100 by 32% compared to the current target.

The current target

The Commission also considered retaining the current target. This would place a high value on regulatory certainty and be a very achievable target allowing Aotearoa New Zealand to demonstrate sustained action towards it.

This target is not recommended for several reasons. Firstly, it fails to respond to significant changes; there is no course correction for the current global direction, Aotearoa New Zealand remains less ambitious than our competitors and trade partners, no response to the worsening impacts, and no effort to address the shifting balance of intergenerational equity in climate mitigation tasks and impacts.

Additionally, keeping the current target would maintain the projected warming caused by Aotearoa New Zealand. The current target does not set Aotearoa New Zealand on a path to meet equity considerations. Despite analysis that highlight the benefits and opportunities to go further, the current target does not push the boundaries of what is possible. It fails to take full advantage of technological progress. The current target has no provision for further reductions and removals after 2050, despite evidence showing this will be necessary to achieve and maintain limiting warming to 1.5°C above pre-industrial levels.

By achieving quicker emissions reductions, overall warming is reduced, which lowers the cumulative impact of warming on future generations.

Equity or goal driven top-down targets

Targets set based on equity criteria or matching the most ambitious overseas targets can perform well against contribution criteria. The drawback of this approach is that targets that are not set with manageable impacts are unlikely to drive the action required.

As an example, if there was a top-down requirement to return warming for Aotearoa New Zealand emissions to a per capita level of around 0.001°C, then the reductions and removals would be significantly more than is currently planned for. A target might require the delivery of 2400 Mt of net removals between 2050 and 2100. This excludes the effect of historic deforestation, but would return warming for all gross emissions since 1850 to 0.001°C.

50 $MtCO_2e$ net removals per year is roughly twice what Aotearoa New Zealand's forests have ever delivered at their peak of removals. It would require afforesting approximately 3.4 million hectares of additional land in exotic production forest (on top of that necessary to achieve and maintain net zero), or 6.5 million hectares of native forest.

Wehenga C: Te tātari mea ka whai wāhi rānei ngā tukuwaro i ngā kawe ō ā-poti, ā-rererangi hoki ki te whāinga – mea āe, pēhea rā

Part C: Reviewing whether to include emissions from international shipping and aviation in the 2050 target – and if so, how

He kitenga paku kawenga ō ā-ao, ā-rererangi hoki
International shipping and aviation emissions at a glance

International shipping and aviation emissions are not included in Aotearoa New Zealand's 2050 target. The Climate Change Response Act 2002 requires us to advise on whether they should be included in the 2050 target, and if so, how.

International shipping and aviation emissions come from travel or freight movements between Aotearoa New Zealand and other countries. They also include emissions from transport within Aotearoa New Zealand when an international vessel stops at multiple domestic ports as part of an international freight or cruise trip.

Because emissions from international shipping and aviation are not included in the 2050 target, they are also outside the five-year emissions budgets that are set as steppingstones to the target, and outside the emissions reduction plans the Government sets to achieve those budgets.

All other emissions created from transport within Aotearoa New Zealand by ship or plane are considered domestic emissions and are included in the 2050 target. Emissions from fishing vessels are counted in the domestic emissions of the country those vessels refuel in.

When the 2050 target was being set in 2019, a requirement was added to the legislation for He Pou a Rangi Climate Change Commission (the Commission) to advise, by the end of 2024, "on whether the 2050 target should be amended to include emissions from international shipping and aviation (and, if so, how the target should be amended)." This part of our report responds to that requirement.

Important context on international shipping and aviation emissions

Emissions from international shipping and aviation are 98–99% carbon dioxide and are contributing to climate change. Globally, these emissions need to be addressed to limit warming to 1.5°C.

Emissions from these sectors are equivalent to about 9% of Aotearoa New Zealand's net domestic greenhouse gas emissions. If no action is taken to reduce emissions from these sectors, by 2050 they will likely grow to be equivalent to more than one-third of the country's domestic net emissions.

Aotearoa New Zealand relies heavily on international shipping and aviation for tourism, business, imports, exports, and connections with friends and whānau abroad. The choices made about these emissions could affect Aotearoa New Zealand's international relationships, access to overseas markets, and demand for the country's products and services.

There are opportunities to reduce these emissions. While efficiency improvements can lower emissions, a shift to alternative fuels is likely required to achieve significant emissions reductions. This is most likely to mean sustainable aviation fuels for international aviation, and a mix of biofuels, green hydrogen, green ammonia and green methanol for shipping.

Global action is occurring on international shipping and aviation emissions. Two international bodies coordinate global action: the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO). IMO and ICAO have set global goals to reduce the emissions from these sectors to net zero by 2050 and encourage countries to take domestic action to support those goals.

While IMO and ICAO are putting in place instruments like transboundary emissions pricing, domestic policy, such as creating a policy environment that can support alternative fuel production, is required for their goals to be achieved.

Major economies such as the United Kingdom, the European Union and the United States are already putting targets and policies in place to reduce emissions from these sectors.

Our recommendation

As a result of the evidence, analysis and feedback from submissions on our discussion document, the Commission is recommending that the Government:

- include international shipping and aviation emissions in the net zero component of the 2050 target
- adopt the following methods to count emissions:
  - for shipping: an estimate of 50% of the emissions to/from the next overseas port by all international operators and 100% of their emissions travelling between ports in Aotearoa New Zealand and while docked
  - for aviation: refuelling taking place in Aotearoa New Zealand based on bunker fuel use by all international operators
- reconsider the inclusion of other climate impacts from international shipping and aviation in the 2050 target in future reviews
- develop measures for meeting the 2050 target that ensure a specific focus occurs on gross emissions reductions for international shipping and aviation
- does not change the level of emissions reduction of the net zero component of the current 2050 target when adding international shipping and aviation emissions to it.

Implications of including international shipping and aviation emissions in the 2050 target

Including international shipping and aviation emissions in the target is feasible and would mean these sectors become part of Aotearoa New Zealand's emission reduction planning. This would increase certainty, transparency and accountability in Aotearoa New Zealand's efforts to limit warming. It would also align Aotearoa New Zealand with trading partners and international efforts to reduce these emissions.

With the actions underway from IMO and ICAO, 'no change' is not an option for international shipping and aviation emissions profiles. These changes will not be without impacts, but if the transition to reduce these sectors' emissions is supported with smart policy and timely investment, the flow-on economic impacts are expected to be manageable. The change creates benefits including reducing emissions, helping protect market access into the future, and improving health through reduced air pollution. In addition, the production of alternative fuels presents an economic opportunity to increase employment and improve energy security.

The advice set out in this part of the report assesses adding international shipping and aviation emissions to the current 2050 target. How the findings of the international shipping and aviation and 2050 target reviews should combine is set out in *Part D: Recommendations on the 2050 target*.

Wāhanga 7 | Chapter 7

Me pēhea rā e whai wāhi ai ngā kawenga ō ā-ao, ā-rererangi hoki
How international shipping and aviation emissions could be included

This chapter sets out our advice on the most robust options for how the 2050 target should be amended to include international shipping and aviation emissions.

Determining how international shipping and aviation emissions would be included in the 2050 target helps us to understand the potential impacts to decide whether they should be included. We have analysed the potential options and consulted on them.

The full set of options the Commission considered are set out in the *Discussion document: Review on whether emissions from international shipping and aviation should be included in the 2050 target* released in April 2024.

This chapter sets out the feedback the Commission received from consultation, our final advice to the Government on how to include these emissions in the 2050 target, and why we have made this recommendation.

We find the Government should adopt the following options:

- *How to count:* emissions should be counted based on to/from next port for international shipping and refuelling for international aviation because these are the most robust methods to accurately count international shipping and aviation emissions. Whether to count other climate impacts should be reconsidered in a future target review when the science is more certain.
- *Structure:* emissions from international shipping and aviation should be included in the net zero component of the 2050 target as this best ensures the smooth operation of the Act. The 2050 target's level of emissions reduction should not be changed on account of adding international shipping and aviation emissions to it.

The analysis in this chapter is based on the current 2050 target. *Chapter 10: Combined recommendation* sets out considerations for the level of emission reduction in the context of the 2050 target review's findings.

What we heard

For how to count emissions, fairness was a key theme in submissions. The two most preferred methods to count emissions by submitters were refuelling for aviation and to/from next port for shipping. Separate counting methods for each sector help to ensure the most accurate accounting, as these sectors have different emissions profiles and different methods of refuelling.

We heard that alignment with other countries is required to ensure accounting is fair and simple, and that double counting is avoided.

We heard that whichever counting approach is chosen, it may need revising over time to ensure ongoing alignment with other countries, the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO).

There was support for including other climate impacts from some submitters, but no new evidence was presented that the Commission had not considered in its initial analysis which can be found in the *Discussion document: Review on whether emissions from international shipping and aviation should be included in the 2050 target,* released in April 2024.

For structure, we saw a clear preference by industry and individual submitters for international shipping and aviation emissions to be included in the net zero component of the 2050 target, with non-government organisations (NGOs) split between preferring net zero or new separate components. Overseas airlines indicated they support options that allow for a dedicated focus on aviation.

Several submitters that preferred including these emissions in the net zero component still wanted some form of separate accountability and focus on gross emissions, such as separate budgets or separate sectors within emissions reduction plans and separate reporting.

For the level of emissions reduction, we saw a clear preference for high ambition of those who provided a position. However, most submitters had no formal position. Industry submitters indicated analysis of global models from IMO and ICAO adapted for Aotearoa New Zealand should be used to inform the level of emissions reduction.

We also heard technology will change significantly between now and 2050, so the level of emissions reduction to aim for will need to be adjusted over time; and that whether the emissions reductions can be achieved relies on the Government taking policy action.

How to count emissions from international shipping and aviation

Determining how international shipping and aviation emissions would be counted helps us to understand the implications of including these emissions in the 2050 target. There are a range of ways to count emissions from international shipping and aviation. This section sets out recommended options following public consultation.

We recommend emissions be counted based on to/from next port for international shipping, and refuelling for international aviation

Our findings for this area, which have been built into the Commission's recommendation in *Chapter 10: Combined recommendation*, are that the Government:

- adopt the following methods to count emissions:
  - For shipping: an estimate of 50% of the emissions to/from the next overseas port by all international operators and 100% of their emissions travelling between ports in Aotearoa New Zealand and while docked.
  - For aviation: refuelling taking place in Aotearoa New Zealand based on bunker fuel use by all international operators.
- reconsider the inclusion of other climate impacts from international shipping and aviation in the 2050 target in future reviews.

We are recommending these counting methods as our analysis has found them the most robust to accurately count international shipping and aviation emissions for the country.

Our recommendation around other climate impacts aligns with our initial finding that the science is still too uncertain.

Why we recommend counting emissions in these ways

To deliver a clear and stable policy framework, the method of counting needs to be robust and practical. To achieve that we have recommended counting approaches that:

- use different methods for counting emissions for each sector
- cover a reasonable volume of emissions
- are accurate measures that can track progress
- create incentives to produce and use alternative fuels while minimising any negative incentives
- align with other jurisdictions and avoid double counting.

Further information on each of these is set out below.

We have also considered administrative costs for operators, exceptions and other climate impacts from international shipping and aviation.

Use different methods for counting emissions for each sector

Some submitters proposed that the method for accounting for international shipping and international aviation emissions should be different to reflect the different emissions profiles, refuelling practices, technologies, and levers available to the sectors.

The Commission has not identified any barriers to the Government adopting different measures for shipping and aviation. This approach provides a way to address some of the challenges identified with different measurement approaches.

Cover a reasonable volume of emissions

Different methods of counting result in significantly different levels of emissions. Methods that cover a very low volume may not be seen as credible. The same can be said if a method results in double counting emissions or is thought to be 'over-allocating' emissions to Aotearoa New Zealand.

If emissions were counted based on refuelling for aviation and 50% of emissions to/from final port for shipping, estimated emissions would be 6.7 $MtCO_2e$ in 2023.[153,xxiii] This appears to cover a reasonable volume of emissions for these sectors compared to the other options assessed.

This is higher than using a measure of refuelling for both sectors, which was reported to be 4.9 $MtCO_2e$ in 2019. Fuelling in shipping has different dynamics than for air travel, so refuelling may not be seen as credible method.[154] The emissions of the proposed counting method are less than if Aotearoa New Zealand were to count 100% of its emissions to/from the next port or to use a to/from final port measure. A to/from final port estimate of emissions is not available for shipping, but for international aviation it was estimated to be 8.4 $MtCO_2e$ in 2017, meaning total emissions counted would be significantly higher.[155]

Accurate measures that can track progress

If measures are not accurate or do not enable progress to be tracked, they are unlikely to result in a stable policy environment that supports emissions reductions. It is the policy choices the Government makes that will ultimately determine the impacts of changing the target, so it is important the target is designed to encourage the right policy choices.

Our analysis is that refuelling for aviation and an estimate of to/from next port for both shipping and aviation are the most suitable measures to accurately quantify and track progress in reducing emissions over time. See the *Discussion document: Review on whether emissions from international shipping and aviation should be included in the 2050 target* released in April 2024 for comparison of all the measures the Commission considered.

We estimated emissions to/from next port for shipping using Customs data to understand the scale of these emissions. The method would need to be further refined by the Government for use in target accounting to accurately measure progress over time.

While the Commission has not recommended to/from *final* port as the counting method at this time, there is merit in the Government gathering further data on these emissions. This would aid understanding of Aotearoa New Zealand's contribution to global emissions, any risks those emissions pose to Aotearoa New Zealand, and opportunities that may exist to reduce them.

xxiii The estimate for shipping has been produced by taking Customs data for ship arrivals and departures, using QGIS to obtain the latitude and longitude of ports, estimating the distance between the relevant ports using SeaRoute, applying the average weight of vessels coming into Aotearoa New Zealand by type from Ministry of Transport data, and multiplying these values by the average emissions by vessel type and weight using International Maritime Organization fuel consumption data. This method could be the basis of a government calculation with refinement. Additional data would need to be collected from ships in future about the fuel type they use once alternative fuels began being adopted. A fuller explanation of the methodology is set out in the *Technical Annex.*
Sources: New Zealand Customs Service. (2024). *Arrivals and Departures – All Craft Types – Actual Date of Arrival / Departure;* Gaffuri, J., & Korhonen, J. (2021). *SeaRoute.* www.github.com/eurostat/searoute; QGIS Development Team. (2024). *QGIS*. qgis.org/en/site; Ministry of Transport. (2024). *FIGS: Overseas ship visits*. https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/figs-overseas-ship-visits; International Maritime Organization. (2022). *Report of fuel oil consumption data submitted to the IMO Ship Fuel Oil Consumption Database.* www.imo.org/en/ourwork/environment/pages/data-collection-system.aspx; UNFCCC. (n.d). *Greenhouse Gas Inventory Data – Detailed data by Party*. di.unfccc.int/detailed_data_by_party; Tarr, A., Smith, I., and Rodger, C. (2022). *Carbon dioxide emissions from international air transport of people and freight: New Zealand as a case study. Environmental Research Communications*, 4 (7). https://iopscience.iop.org/article/10.1088/2515-7620/abf15d

Creating incentives to produce and use alternative fuels while minimising any negative incentives

Refuelling is the best measure for counting aviation emissions

Counting aviation emissions based on refuelling creates the greatest incentives to produce and use alternative aviation fuels. Counting only departing flights provides the greatest incentives for alternative fuels to be produced and used in Aotearoa New Zealand.

Due to their fuel storage capacity and the costs of burning additional fuel, international aviation carriers typically refuel every time they come into the country. Airlines can use drop-in fuels in the same engines as conventional jet fuel.[156] This means, subject to blending limits, they can refuel with 100% sustainable aviation fuel (SAF) for one leg of the journey and then refuel with 100% conventional jet fuel to return.

SAF is currently more affordable in overseas markets than in Aotearoa New Zealand, meaning airlines are incentivised to purchase it outside of Aotearoa New Zealand at this stage.[157]

To/from next port is the best measure for counting shipping emissions

Accounting for international shipping emissions to/from the next port would provide the greatest incentive to produce and use green hydrogen, green methanol, and green ammonia in Aotearoa New Zealand. It would also provide an incentive for biofuels to be used by international ships.

International ships typically do not refuel in Aotearoa New Zealand as they have the space to carry additional fuel and carrying more does not significantly affect their fuel consumption. Cruise ships refuel in Aotearoa New Zealand on around 40% of their visits, but cargo ships typically use Aotearoa New Zealand as a top-up location for fuel for long trips only if it cannot be avoided, or for routes that travel only within the Pacific.

International ships can use drop-in biofuels. However, biofuels have supply limits and are considered likely to carry a higher operating cost than fuels such as green hydrogen, green ammonia, or green methanol, so these are considered likely to be the dominant fuels long term.[158] Adopting these fuels requires engine replacement and for ships to refuel more often. While dual fuel vessels do enable fuel switching, this means where green hydrogen, green ammonia or green methanol are used, it would likely change the fuel being used to and from the country.

Other risks regarding incentives

The proposed counting methods may risk incentivising tactics to avoid emissions being counted such as changing refuelling locations, adding additional stops, and changing speed or fuel type for different legs of the journey that are monitored. In addition to risking adding time or cost to journeys, submitters noted avoidance can make the country more dependent on intermediary ports, lowering Aotearoa New Zealand's resilience.

For aviation, our analysis found that this risk is relatively small, as it would cause a significant cost to the airlines for additional fuel.

These risks can be reduced through how policy measures are applied under the target, such as not counting an overseas stop unless freight or passengers are loaded or unloaded there, and by harmonising policy approaches with Australia, where this risk is greatest due to its location.

Alignment with other jurisdictions and avoiding double counting

Different global counting methods can make it difficult for international shipping and aviation to operate efficiently. Considering alignment with other jurisdictions is important to considering how these emissions should be counted.

The proposed counting approach would minimise most double counting. Significant areas of alignment to note are:

- Bunker fuels refuelling is the measure used under the United Nations Framework Convention on Climate Change.[159]
- The European Union (EU) has included shipping charges under its emissions trading system (EU ETS) – 100% of emissions from one EU port to another and 50% of emissions to/from a non-EU port.[160] Alignment with the EU may reduce compliance costs for shipping companies.
- A national operator's approach is used by the United States of America (USA) for its non-binding international aviation target.[161] For its Clean Shipping Act requiring use of alternative fuels, the USA counts 100% of emissions to/from the next port.[162] There would be double counting for flights from Aotearoa New Zealand to the USA by USA-based national carriers and vessels travelling directly to or from the USA.

It is difficult to estimate the overlap with the USA precisely, but our calculations show that it is around 0.2–0.25 $MtCO_2e$.[xxiv] There is no alternative measure that would avoid double counting with the USA without creating double counting with another country. To address this, the Government could implement special rules under any policies for craft that have already accounted for some of their emissions in another jurisdiction.

It is likely that the counting methods being used by other jurisdictions will continue to shift, so the Government may need to be open to revising its counting approach over time. The Government will need to determine the extent to which it specifies the details of how international shipping and aviation emissions will be counted in the legislation. Currently, it can change accounting under New Zealand's Greenhouse Gas Inventory for other sectors as needed to align with global standards. If the method of counting these emissions is fixed in the Act, five-yearly target reviews could re-examine the method.

Administrative costs for operators and exceptions

There are some administrative matters for the Government to consider in how it might operate the counting methods.

Estimates of emissions to/from the next port could be calculated by self-reporting or government estimation. Different approaches will have different levels of cost and accuracy.

It has been estimated in the EU ETS for shipping that self-reporting costs ship owners around NZ$12,000 per ship per year.[163,xxv] The EU ETS excludes small vessels to reduce administration costs; this could also be considered for Aotearoa New Zealand.[164]

Some overseas countries exclude specific types of travel such as firefighting or humanitarian aid to prevent an impact on operators of those types of travel. This may be worth considering at a policy level, but at a target level, the emissions from such operations are unlikely to be large enough to make the risks of an exemption being misused outweigh the benefits it would create. Such services are included within the target currently for domestic travel.

xxiv For shipping: extract of trips between Aotearoa New Zealand and the USA from the Commission's calculation of Aotearoa New Zealand's shipping emissions on a 50% of to/from next port basis.
For aviation: calculations based on multiplying the number of passengers by the distance flown for flights from Aotearoa New Zealand to the United States of America by United States based carriers only and then multiplying the total passenger kilometres by an emissions factor: United States Bureau of Transportation Statistics. (n.d.). *T-100 International Market (US Carriers Only).* https://www.transtats.bts.gov/Fields.asp?gnoyr_VQ=GDJ
The emissions intensity factor is from: The International Council on Clean Transportation. (September 2019). *CO_2 emissions from commercial aviation, 2018*. theicct.org/sites/default/files/publications/ICCT_CO_2-commercl-aviation-2018_20190918.pdf

xxv EUR€6,700 per ship – conversion to New Zealand Dollars accurate as at 17 October 2024.

Other climate impacts from international shipping and aviation

Our assessment is that other climate impacts from international aviation are contributing to further warming. However, there is still too much uncertainty about the exact extent of that warming to consider including other climate impacts in the 2050 target at this point.

Both international shipping and aviation are contributing to a warming climate. Some of that warming comes from greenhouse gases that would be covered if the sectors were included in the 2050 target. However, the sectors also have other climate impacts, usually called non-CO_2 radiative forcing, that would not be covered without further regulatory change. These other climate impacts appear to be disproportionately large for aviation compared to other sectors, so it is worth considering them if international shipping and aviation are included in the 2050 target.[165]

Most of the warming caused by international shipping is the result of carbon dioxide and other greenhouse gas emissions.[166] Other climate impacts from shipping have an overall cooling effect, such as enhanced ocean reflection from ship wakes and making marine clouds more reflective.[167]

The cooling effect of other climate impacts from international shipping is now lower than when most of the studies of these effects were done. This is due to the IMO's introduction of low-sulphur regulations in 2020, which reduce shipping's impact on cloud reflection. International shipping was previously considered to be net cooling in the short term, but warming over a 100-year horizon. Now international shipping's exact contribution to warming is subject to debate, increasing the urgency of reducing CO_2 emissions to prevent warming.[168]

For international aviation, contrails and aviation-induced cirrus clouds, two cloud types created by aircraft, trap heat and have been identified as causing more warming than the direct greenhouse gas emissions from aircraft.[169] While the science is settled that this is causing warming, studies vary on how large the effect is. Estimates have ranged in different studies from 1.9 to 3 times the impact of the sector's CO_2 emissions.[170] Some more recent studies following COVID-19 that looked at the change in cloud levels when flying reduced during the pandemic, found that previous model-based estimates may have overestimated the amount that aviation is involved in the formation of contrail and cirrus cloud types.[171]

There are ways to reduce warming from other climate impacts for international aviation, such as switching to sustainable aviation fuels.[172] Changing flight routes may reduce other climate impacts. However, trials with modified flight paths have shown limited effect so far and there is a risk of increasing overall warming if impacts are miscalculated, as changing flight paths can increase fuel consumption.[173]

Currently, there is no scientific consensus on how other climate impacts could be accounted for in targets, or examples of policy approaches. No jurisdictions include other climate impacts as part of international shipping and aviation emissions reduction targets, although the EU is looking at it for the EU ETS.[174]

ICAO has stated that it will adopt a multiplier for aviation when the scientific community reaches a general agreement on the issue and is collaborating with the IPCC on a methodology.[175] The International Air Transportation Association has identified further work that airlines consider needs to occur.[176]

How to include international shipping and aviation emissions in the 2050 target structure

Emissions from international shipping and aviation cannot be included in the 2050 target without determining which component of the target they should be included in. This section sets out why we recommend emissions from international shipping and aviation be included in the net zero component of the 2050 target.

We recommend emissions from international shipping and aviation be included in the net zero component of the 2050 target

Our findings for this area, which have been built into the Commission's recommendation in *Chapter 10: Combined recommendation*, are that the Government:

- include emissions from international shipping and aviation in the net zero component of the 2050 target
- develop measures for meeting the 2050 target that ensure a specific focus occurs on gross emissions reductions for international shipping and aviation
- does not change the level of emissions reduction of the net zero component of the current 2050 target when adding international shipping and aviation emissions to it.

Our analysis shows this is the most effective target structure and aligns with what we have heard through consultation and engagement.

Adding the emissions to the net zero component of the 2050 target provides a framework for making clear and stable policy decisions. Compared to separate components for these sectors, it better balances risks of uncertain technology developments across sectors and enables the Government to design policy that ensures emissions are reduced in ways that have the lowest cost or the highest benefits throughout the economy.

While including these emissions in the net zero component provides flexibility, there is a chance that either other sectors are forced to reduce emissions on behalf of international shipping and aviation, or gross emissions levels stay high and there is higher demand for removals through forestry.

There is merit in the Government taking steps to ensure gross emissions reductions for international shipping and aviation emissions occur within the net zero component of the 2050 target.

Adding international shipping and aviation emissions to the 2050 target increases the total volume of emissions that Aotearoa New Zealand must reduce under the Act. This increases the risk of the target not being met. Moreover, the technology pathways for these sectors are uncertain, and they are considered hard-to-abate sectors.

However, results from the Commission's analysis indicates that the current 2050 target remains achievable in multiple scenarios with international shipping and aviation emissions included.

The 2050 target's emissions reduction level aligns with the approaches being taken to international shipping and aviation emissions by other countries, which is likely to help maintain market access into the future.

Why we recommend including international shipping and aviation emissions in the net zero component of the 2050 target

It is important that international shipping and aviation emissions are included in the 2050 target in the right way with an achievable level of emissions reduction sought. We've proposed including these emissions in the net component at its current level because:

- the net component of the 2050 target provides a clearer and more stable policy framework than other target structures for these sectors
- it aligns with other approaches
- there are opportunities to focus on gross emissions reductions in these sectors
- options to address the risk of overlap with international regimes are available
- analysis of international models shows significant reductions are possible
- the current 2050 target is still likely to be met in multiple scenarios
- Aotearoa New Zealand's location does not justify lowering the emissions reduction level of the net zero component if international shipping and aviation emissions are added to it.

The analysis of each of these is set out below.

The net component of the 2050 target provides a clearer and more stable policy framework than other target structures for these sectors

Including international shipping and aviation emissions in the net zero component of the 2050 target means they will be included in emissions budgets together with other emissions. This enables the Government to design policy that ensures emissions are reduced in ways that have the lowest cost or the highest benefits throughout the economy. This flexibility helps to create a clearer and more stable framework for climate change policies.

In contrast, separate components of the 2050 target for these sectors would likely result in less efficient emissions reductions overall if cheaper options in other sectors cannot be used to help meet the target. There is also greater risk of the level of the component not being achievable, requiring more frequent target revisions.

The technology pathways for international shipping and aviation are uncertain and could change significantly by 2050, meaning inclusion in the net zero component is less likely to affect an emissions budget or the 2050 target being met. The is the most robust approach to take in the face of the known uncertainties.

Aotearoa New Zealand already has international obligations to support emissions reductions in these sectors. However, including them in the 2050 target would then include them in the framework under the Act. This means emissions budgets, emission reduction plans and policies to meet those budgets and plans will likely prompt government policy action to reduce these emissions. If no domestic policy is deemed necessary, at the very least emissions levels will be assessed and scrutinised over time.

The policy choices made will matter. The Government can choose at a policy level where the costs of meeting the 2050 target should lie and where to direct effort at a given time: international shipping and aviation emissions reductions, emissions reductions in other sectors, or removals such as forestry. While this flexibility brings benefits, it could lead to higher costs and flow-on impacts for other sectors outside of international shipping and aviation. It can also change what co-benefits will emerge.

Including international shipping and aviation in the net zero component aligns with other approaches

By including international shipping and aviation emissions in the net zero component of the target, Aotearoa New Zealand would be acting consistently with global efforts and in a way that is likely to best protect demand for Aotearoa New Zealand's goods and services into the future.

IMO and ICAO both have net zero 2050 targets.[177] Jurisdictions that have accounted for international shipping and aviation emissions have typically included these emissions in their overall target or set a separate net zero 2050 target for them.[178]

International shipping and aviation greenhouse gas emissions are 98 to 99% CO_2.[179] As these emissions are primarily CO_2, it makes sense to treat them in the same way as other long-lived greenhouse gases covered by the 2050 target.

Taking a lead in emissions reduction may increase costs and could result in displacement of Aotearoa New Zealand's goods and services with higher emitting alternatives from other countries. Conversely, lagging behind other countries could see market access restricted from regulatory measures and customers' willingness to buy Aotearoa New Zealand products decreasing.

There are opportunities to focus on gross emissions within the net component

Including international shipping and aviation emissions in the net zero component of the target may create greater incentive to focus on removals rather than gross emission reductions. While removals may be the lowest short-term abatement cost option, they can carry additional risk if they are not permanent. This could mean a larger cost in the long term if enduring gross emissions reductions are not made. This issue is not unique to international shipping and aviation and can be addressed by the Government at a policy level. See the Commission's *2023 Advice on the direction of policy for the Government's second emissions reduction plan* for more information on our thinking about the approach to removals.

International shipping and aviation emissions present specific risks that warrant them having greater focus, even if that is not reflected at a target level.

While the Commission is not recommending specific policies, the Government can develop measures that focus on gross emissions reductions for international shipping and aviation. Examples of changes that the Government could make to the Act at the same time as changing the target to incentivise a greater focus on gross emissions reductions, or to recognise the global regimes covering these sectors, include:

- Separate emissions budgets: no ability to trade emissions reductions with other sectors to meet emissions budgets – this would ensure a focus on removals but significantly reduces flexibility.
- Limit within emissions budgets: a maximum level of accountability in budgets for these sectors based on expected emissions at the time the emissions budget is set – this would prevent excessive removals if emissions were larger than expected.
- Agreed proportion of emissions budgets: emissions budgets required to indicate what proportion of the budget is to be international shipping and aviation emissions on advice of the Commission – this would ensure the economy had clear signalling on focus.
- Advice on proportion of emissions budgets: the Commission would advise what proportion of a budget should be international shipping and aviation emissions, which is the current approach for removals – this would ensure the Government can consider the role these sectors played in the Commission recommending the emissions budget level proposed.
- Identified sectors for emissions reduction plans: this would require the Government to include these sectors separately in emissions reduction plans rather than including them with all of transport. The Act could also allow ICAO and IMO national action plans to constitute the emissions reduction plan for those sectors, provided it was completed within the last three years in line with IMO/ICAO reporting cycles.

The Act does not need to be changed to ensure separate reporting of international shipping and aviation emissions. This will occur as a result of Paris Rulebook requirements regardless of the change in the target.

Policies that the Government could implement to reduce gross shipping and aviation emissions are discussed in *Chapter 8: Whether to include international shipping and aviation emissions* and *Chapter 9: Implications of including international shipping and aviation emissions.*

Options to address the risk of overlap with international regimes are available

International offset schemes can present a risk of doubling up with removals under the 2050 target. While this could be addressed through target design, it is possible to design policy under the 2050 target to avoid double counting, double pricing, or double offsetting.

This is a difficult area to analyse because the international system is subject to constant change. The Government will need to be mindful how the landscape could change out to 2050.

Overlap risks should be considered in the context of overall global emissions. The world is currently not on track to limit warming to 1.5°C. Overlap between action being taken by governments, businesses and other regimes occurs in many sectors and ensures a greater emissions reduction to close that gap than would otherwise occur.

The Commission has assessed the risk of overlap with ICAO's Carbon Offsetting and Reduction Scheme for Aviation (CORSIA) scheme. CORSIA obligations fall on airlines based on global emission levels, not countries. However, as a proxy, it is possible to assess how much Aotearoa New Zealand's estimated emissions from refuelling exceed 85% of 2019 levels. Results from the Commission's ENZ model show this is up to 5.2 $MtCO_2e$ in total over the 10 years of the second and third emissions budget periods in the reference scenario where no action is taken to reduce emissions. In a high technology, high systems change scenario this falls to 0.7 $MtCO_2e$. If the budgets are set at a level that does not require offsetting for international aviation during that time, there is low risk of overlap.

Currently, CORSIA ends in 2035, while IMO does not have a pricing scheme in place yet for shipping and is considering pricing options that do not necessarily involve offsets.[180] Accordingly, these regimes do not currently cause a double offsetting issue if international shipping and aviation were added to the 2050 target. Therefore, they do not require change at a target level currently.

If there were to be overlap with global offsetting regimes in future, there are a range of ways this could be addressed from recognition of units from other schemes to adjusting emissions budget or target levels to account for overlap. However, all of these carry risks of undermining the effectiveness of the target as a whole that would need to be considered.

Global pricing instruments can also create a fairness issue for operators about whether they are paying for the same emissions twice. This should not affect target design decisions, but it is a policy issue the Government will need to consider if it were to put in place pricing. This issue is addressed in *Chapter 9: Implications of including international shipping and aviation emissions.*

International analysis shows significant reductions are possible

The first step in assessing the potential level of reduction is to consider global analysis. The global level of ambition set for these sectors by IMO and ICAO is net zero in 2050.

International analysis shows multiple ways to achieve net zero for international shipping and aviation:

- IMO's 2023 *Strategy on Reduction of GHG Emissions from Ships* demonstrates the ability to reach net zero emissions from international shipping through technology change.[181]
- International Energy Agency analysis shows that CO_2 emissions from domestic and international shipping could fall 91% by 2050, primarily through use of biofuels and hydrogen. For aviation it shows a 74% fall by 2050 primarily from using SAF. Under this scenario, e-SAF (SAF produced using renewable electricity) would provide approximately 40% of the sector's energy.[182]
- The International Renewable Energy Agency concluded reducing emissions from international shipping consistent with limiting warming to 1.5°C by 2050 means increased energy efficiency, and a transition to green ammonia as the primary energy source.[183]
- ICAO developed three scenarios for understanding how it could achieve its emissions goal. The scenario results were a 60% increase in gross emissions, a 20% reduction, and a 65% reduction between 2019 and 2050.[184]
- International Air Transportation Association analysis indicated it would achieve its 2050 goal through: a 65% emissions reduction from SAF, 13% from new technology including electric or hydrogen planes, 3% from operational efficiency, and 19% from offsets or carbon capture.[185]

This evidence suggests the most ambitious gross reductions in line with results from globally modelled pathways would be 91% for international shipping and 65% for international aviation.

However, these figures include the emissions involved in producing alternative fuels, which would already be captured by the existing target. In the higher ambition scenarios of these pathways, they have assumed alternative fuels reach 100% uptake, meaning that in-sector emissions would be eliminated. In-sector emissions are what would be added if international shipping and aviation emissions were added to the 2050 target.

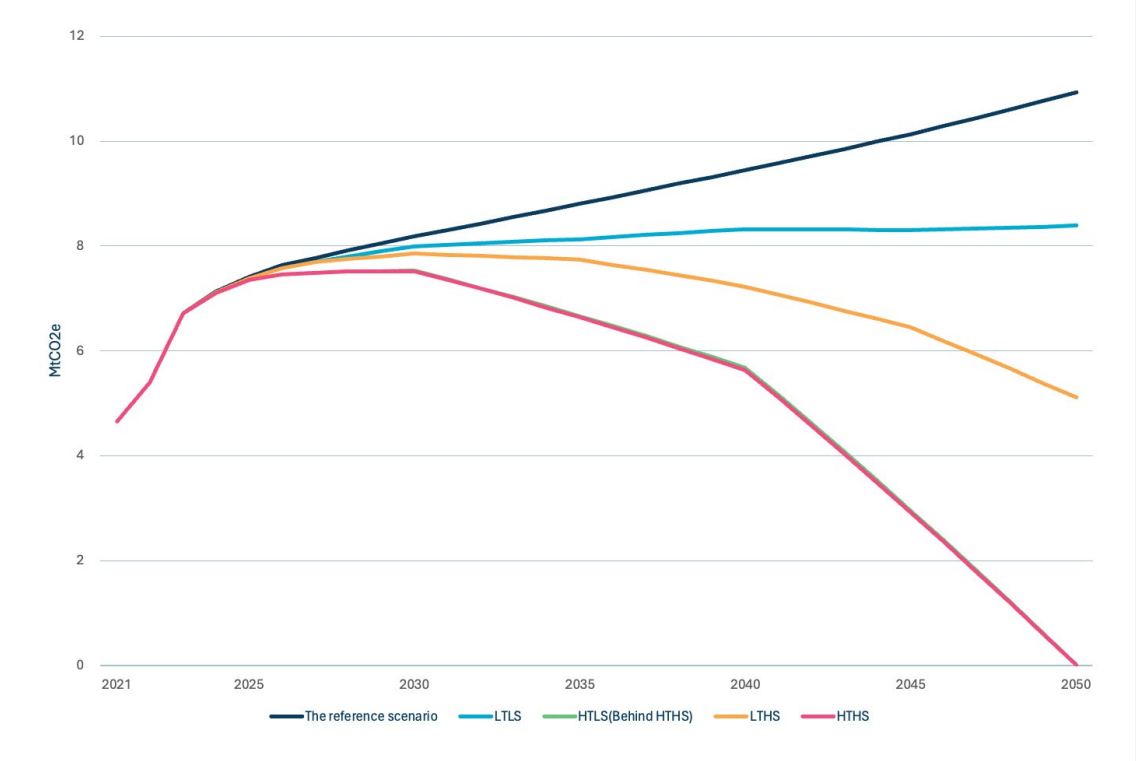
The current 2050 target is still likely to be met in multiple scenarios

If international shipping and aviation emissions are included in the net zero component of the current 2050 target, this increases the risk of the target not being met. Adding these emissions increases the total volume to reduce, the technology pathways for these sectors are uncertain and they are considered hard-to-abate sectors. However, the Commission's analysis indicates the target remains achievable with these emissions added.

International shipping and aviation emissions under the Commission's scenarios

Based on global trends, the Commission has analysed what could happen to Aotearoa New Zealand's international shipping and aviation emissions out to 2050 in different scenarios using our proposed method to count emissions. The results show a wide range of possible outcomes (**Figure 7.1**).

Figure 7.1: Total international shipping and aviation sector emissions under Commission scenarios



Source: Commission analysis[xxvi]

More detail on this is set out in *Technical Annex: Modelling and analysis to support final advice on Aotearoa New Zealand's fourth emissions budget and the review of the 2050 emissions target including whether emissions from international shipping and aviation should be included* and the *Assumptions Log*.

This shows that the in-sector emissions for international shipping and aviation would rise to 10.9 $MtCO_2e$ in a reference scenario where no further action is taken to reduce emissions from these sectors. In a high technology change scenario, the in-sector emissions would fall to zero.

xxvi LTLS refers to low-technology, low systems change; HTLS refers to high-technology, low systems change; LTHS refers to low-technology, high systems change; and HTHS refers to high-technology, high systems change.

In-sector emissions falling to zero does not mean international shipping and aviation would not be contributing to warming. The model results only account for what emissions would be added to the 2050 target by these sectors' emissions being included. Our estimate is alternative fuel production emissions would be up to an additional 0.9–3.8 $MtCO_2e$, which would already be counted under the current 2050 target if they are produced here, but if imported would be counted overseas.[xxvii] It is unlikely 100% of alternative fuels would be produced here.

Impact of international shipping and aviation emissions on achievement of the target in the Commission's scenarios

Overall, results from the Commission's analysis show that the current 2050 target with international shipping and aviation emissions included would likely be met in three of five modelled scenarios:

- high-technology, high systems change
- high-technology, low systems change
- low-technology, high systems change.

In a low-technology, low systems change scenario, the target would be exceeded by approximately a net 6.8 $MtCO_2e$ on these results.

If the EB4 demonstration path in the Commission's fourth emissions budget advice was adopted by the Government, the current target including international shipping and aviation emissions could be met if these sectors followed one of the high-technology scenarios. But it would require greater removals or reductions in other sectors if they followed one of the low-technology scenarios.

Even if international shipping and aviation emissions were not reduced, the current 2050 target would likely still be met in a high-technology, high systems change or low-technology, high systems change scenario, with these emissions remaining at their reference level.

xxvii Estimate is based on alternative fuel production emissions in a high-technology, high systems change scenario, where the sectors shifted to 100% alternative fuels using woody biomass as the primary feedstock.

Modelling results are dependent on assumptions and have limitations; policy will play a critical role in what reductions are achieved

For international aviation, demand is assumed to remain in line with Ministry of Transport Te Manatū Waka projections in all scenarios. This results in international passenger kilometres growing 3.5 times between 2023 and 2050. These demand assumptions were consulted on with the sector by the Ministry of Transport and sit at the higher end of assumptions for demand growth, when compared to the assumptions in international models.

For international shipping, demand has been assumed using expected demand growth results out of the Commission's C-Plan model based on assumptions around growth in GDP, population, and changes in different sectors that are built into the model. This results in demand growth of 50% between 2023 and 2050.

The different scenarios assume different levels of efficiency and alternative fuel uptake:

- In a high-technology scenario, alternative fuel uptake is 100%, in line with high-ambition scenarios in global models.
- In a low-technology, low systems change scenario, alternative fuel uptake is 22%.
- In a low-technology, high systems change scenario, alternative fuel uptake is 70%, in line with medium-ambition scenarios in global models, which is assumed to occur due to consumer behaviour change.
- In a low-technology, high systems change scenario, a 20% reduction in demand for international aviation is assumed compared to the baseline due to consumer preference change or government policy change.
- In a high-technology, high systems change scenario, the Commission has assumed the only demand reduction is that which might be caused by the high uptake of alternative fuels itself, if alternative fuels were more expensive than conventional jet fuel.

Analysis of international shipping and aviation emissions is highly dependent on the assumptions made around demand and alternative fuel use. The Commission has drawn on the best local and international data available to set assumptions around the paths demand and fuel use could take as of 2024. However, there are significant gaps in the data available. It is possible that demand or alternative fuel use could be higher or lower than what is assumed.

The purpose of these scenarios is to show a range of plausible pathways to inform decision-making on the potential impacts of adding these emissions to the 2050 target. The scenarios are not intended to represent a recommended path for the Government to follow, and just adding the emissions to the target does not cause them to occur. It would be the task of future emissions reduction plans and emissions budgets to determine a demonstration path if these emissions are added to the 2050 target.

High levels of alternative fuels production and supply are unlikely to occur in Aotearoa New Zealand without the Government putting in place policies to support that.

Aotearoa New Zealand's location does not justify lowering the emissions reduction level of the net zero component if international shipping and aviation emissions are added to it

Because of Aotearoa New Zealand's distance from other major economies, it has larger international shipping and aviation emissions relative to the benefits it gains from those. This means it may face higher costs to decarbonise, compared to other countries. However, these factors do not justify lowering the emissions reduction level of the 2050 target, particularly given analysis indicates the 2050 target remains achievable with international shipping and aviation included.

If all countries that rely on long-distance travel, and therefore cause the most emissions, put less effort into reducing them it would be extremely difficult to meet the global goals for reducing international shipping and aviation emissions.

Viable options for reducing international shipping and aviation emissions exist. While decarbonising using international land transport may be cheaper for countries where that is possible, it is not a viable substitute for all international shipping and aviation. Most international travel and trade is by international shipping and aviation. In 2021, 57% of inbound tourism and 79% of freight transport travelled by sea or by air globally.[186] All countries will need to address these sectors' emissions.

It may be reasonable to amend the 2050 target to reflect a stronger contribution to reducing emissions overall. It is unlikely that Aotearoa New Zealand could push its emissions reduction contribution from international shipping and aviation beyond net zero. Therefore, a net negative emissions target for Aotearoa New Zealand is likely to mean deeper reductions and removals in other sectors. Consideration of how international shipping and aviation emissions should be included within a revised target is addressed in *Chapter 10: Combined recommendation.*

Wāhanga 8 | Chapter 8

Me whai wāhi rānei ngā kawenga ō ā-ao, ā-rererangi hoki
Whether to include international shipping and aviation emissions

This chapter sets out the Commission's assessment of whether to add international shipping and aviation emissions to the 2050 target.

International shipping and aviation emissions globally are causing warming and must be reduced or offset as part of efforts to limit warming to 1.5°C. Aotearoa New Zealand has a choice whether to leave it to international efforts to address these emissions, or to take a more active role by bringing them into the country's 2050 emissions reduction target (and its supporting budgets and plans).

No change is not an option for the international shipping and aviation sectors. Global action will cause change to international shipping and aviation, whether these emissions are included in the 2050 target or not. The choice for the country is to what extent it plays an active role in the change.

The decisions on whether and how to include these emissions in the target are intertwined, as is consideration of the potential impacts of change. See *Chapter 7: How international shipping and aviation emissions could be included, and Chapter 9: Implications of including international shipping and aviation emissions* for our consideration of those issues.

This chapter sets out our conclusions on whether international shipping and aviation emissions should be included in the 2050 target.

Based on evidence, analysis and feedback, our assessment is that the Government should include international shipping and aviation emissions in the 2050 target.

Our approach to providing advice on whether to include international shipping and aviation emissions in the 2050 target

We have considered the purpose of the Climate Change Response Act 2002 (the Act) in recommending whether to include international shipping and aviation in the 2050 target. International shipping and aviation are important in contributing to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels. The Act also provides a framework by which Aotearoa New Zealand can develop and implement clear and stable climate change policies. This makes the presence of options and a way to guide implementation of them important.

This chapter sets out our recommendation, with analysis structured into addressing three questions:

1. whether there is warming from international shipping and aviation emissions that needs to be addressed
2. whether options are available to reduce emissions
3. whether including international shipping and aviation emissions in the 2050 target will help guide emissions reduction.

What we heard

The Commission consulted on whether to include international shipping and aviation emissions in the 2050 target. We heard a clear preference for including international shipping and aviation emissions in the target. Inclusion was preferred by most industry, individual and NGO submitters.

While submitters typically supported including these emissions in the 2050 target, many expressed that it should not come at the expense of cohesive global action. Submitters considered that Aotearoa New Zealand should be aligned with the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) and other jurisdictions the country relies on for trade and tourism.

Some industry submitters indicated that their support for including the emissions in the target was in principle, wanting greater certainty around the policy direction and impacts, including a view that the Government needed to implement additional domestic policies to support reducing international shipping and aviation emissions. Concern was expressed around using an approach that relied solely on the New Zealand Emissions Trading Scheme (NZ ETS) to meet a revised target.

We recommend international shipping and aviation emissions are included in the 2050 target

Our finding for this area, which has been built into the Commission's recommendation in *Chapter 10: Combined recommendation*, is that the Government include international shipping and aviation emissions in the 2050 target.

International shipping and aviation emissions are contributing to climate change globally and must be reduced or offset using removals to limit warming to 1.5°C by 2050. Aotearoa New Zealand is creating international shipping and aviation emissions and has obligations to support emissions reductions in these sectors.

Options exist to reduce international shipping and aviation emissions. An approach combining a high level of both international and domestic action is likely to achieve the greatest reductions in these emissions.

IMO and ICAO encourage member states to take action to reduce international shipping and aviation emissions.[187] Adding these emissions to the 2050 target will support Aotearoa New Zealand's international obligations to reduce these emissions with domestic obligations and monitoring.

This change will not be without impact. Increasing the emissions covered by the target means taking further action on emissions and that can have negative impacts, but it also carries benefits – see *Chapter 9: Implications of including international shipping and aviation emissions.*

Other developed and developing nations are implementing targets and policies to reduce international shipping and aviation emissions. The timing of Aotearoa New Zealand addressing these emissions relative to its overseas counterparts will affect access to high value markets overseas, demand for its products and services, and the number of high-contributing tourists coming to Aotearoa New Zealand. Without attention being placed on these emissions, there is a risk of Aotearoa New Zealand falling behind.

Given this, it is likely to be in the best interests of both Aotearoa New Zealand and the climate to include international shipping and aviation emissions in the 2050 target. *Chapter 9: Implications of including international shipping and aviation emissions* looks at what the impacts of including the emissions in the target could be. These considerations have informed our assessment of whether international shipping and aviation emissions should be included in the 2050 target.

Why we recommend international shipping and aviation emissions are included in the 2050 target

International shipping and aviation emissions are contributing to warming, options are available to reduce them, and including them in the 2050 target can guide the reduction of these emissions.

Aotearoa New Zealand's international shipping and aviation emissions are contributing to warming and need to be reduced

International shipping and aviation greenhouse gas emissions are 98 to 99% CO_2.[188] Scientists have found that CO_2 emissions, including those from international shipping and aviation, must reach net zero in the 2050s followed by net negative emissions to limit warming to 1.5°C.[189] To do this, international shipping and aviation emissions must be reduced or offset through removals or reductions in other sectors. (See *Chapter 9: Implications of including international shipping and aviation emissions*.)

The Commission estimates that Aotearoa New Zealand's 2023 international shipping and aviation emissions are equivalent to around 9% of Aotearoa New Zealand's domestic net emissions for 2023. If no further action was taken to reduce those emissions, Aotearoa New Zealand's shipping and aviation emissions would grow to be equivalent to a third of Aotearoa New Zealand's domestic net emissions in 2050 in the reference scenario. In a scenario where the Government followed the demonstration path identified in the Commission's fourth emissions budget advice, international shipping and aviation would be equivalent to close to 60% of Aotearoa New Zealand's net emissions in 2050 (see *Chapter 7: How international shipping and aviation emissions could be included* for more information on these scenarios).[190]

Aotearoa New Zealand taking steps to support the decarbonisation of international shipping and aviation is consistent with its obligations to contribute to global efforts to limit warming to 1.5°C. While the Government can act outside of the target framework, it is likely to prioritise emissions that are in the 2050 target. Emissions that are excluded from the 2050 target may experience less focus than if the 2050 target did not exist, which may not result in the most efficient ways to reduce emissions being prioritised.

Options to reduce international shipping and aviation emissions are available now but require scale and policy change to improve affordability

There are a range of options to reduce greenhouse emissions from international shipping and aviation if they were included in the 2050 target:

- Increasing efficiency (such as improved engines and craft) and operational changes (such as powering vessels with electricity when stationary) are options.
- Demand changes, such as people choosing to travel less or buying fewer goods produced overseas, can reduce emissions.
- Shifting to alternative fuels is necessary to achieve a large emissions reduction.

Opportunities exist to reduce emissions, but will require domestic action as part of a combination of approaches

While some technologies such as green ammonia for shipping require further development for commercialisation, there are alternative fuels that can decarbonise international shipping and aviation globally available now. Certainty of demand and investment to reduce the costs of these fuels over time is needed so that they can achieve scale and be widely deployed. The Commission's analysis is that for that to occur, enabling policy should be put in place at a global level and by individual governments.

Both IMO and ICAO encourage countries to implement domestic policies for alternative fuels. The Government has committed to plan for transitional low carbon fuels, including the infrastructure needed to increase the use of methanol and hydrogen to achieve sovereign fuel resilience.[191]

Achieving maximum use of alternative fuels requires a two-pronged approach:

- investment to stimulate research and development
- growth of an alternative fuel supply, and the creation of certainty of demand through measures such as emissions pricing or fuel requirements. This is to attract the capital required for production plants.

IMO is looking to develop a goal-based marine fuel standard by 2027, which would phase down emissions-intensive fuels over time. This may mean domestic requirements for alternative fuel use for shipping are unnecessary, and domestic focus would need to be on supporting fuel production.

For aviation, decisions around alternative fuel use requirements sit with member countries. ICAO encourages countries to adopt SAF requirements and support production through research and development, targeted incentives or tax relief, and ensuring regulatory settings support their use.[192] ICAO estimates states need to invest US$75 to US$870 billion[xxviii] in research and development by 2050 to achieve its most ambitious emissions reduction scenario.[193]

Adding international shipping and aviation emissions to the 2050 target will guide emissions reduction.

We conclude it is likely to be in Aotearoa New Zealand's best interests to include emissions from international shipping and aviation in the 2050 target when considering the benefits.

Adding international shipping and aviation emissions to the 2050 target makes them part of overall emissions reduction planning and monitoring

If the Government decided to include international shipping and aviation emissions in the 2050 target, these emissions would become part of emissions budgets. Subsequently, they would need to be included in the Government's emissions reduction plans. The Commission would then consider progress in reducing these emissions as part of its annual monitoring.

Adding these emissions to targets and budgets would likely lead to more policy action and faster emissions reductions within international shipping and aviation than if the emissions were not included in the 2050 target. The potential impacts of this are set out in *Chapter 9: Implications of including international shipping and aviation emissions.*

If emissions are added to the 2050 target, one of the considerations for the Government is likely to be if they can and should be managed through emissions pricing. One of the reasons Parliament identified for not originally including these emissions was uncertainty around whether emissions could be priced. Though not part of our policy advice, **Box 8.1** provides details about emissions pricing and the international context.

xxviii Equates to NZ$124 billion to NZ$1.4 trillion. Conversion accurate as at 17 October 2024.

Box 8.1: Emissions pricing

Our analysis indicates there are ways the Government could price these emissions domestically. However, there are legal barriers to some forms of aviation pricing, and it could undermine global efforts if domestic pricing unfairly doubled up with international pricing. There are options to address doubling up, and options to ensure emissions reductions beyond pricing.

NZ ETS

Adding international shipping and aviation emissions to the 2050 target does not mean they are automatically added to the New Zealand Emissions Trading Scheme (NZ ETS). The Commission is not providing recommendations on the NZ ETS as part of this advice. Whether and how international shipping and aviation emissions should be priced is a separate policy decision.

Emissions pricing for these sectors is happening or likely to happen internationally

The nature of these sectors means emissions pricing is most efficient at an international level and domestic pricing could undermine effective global transport emissions pricing efforts. However, there are not currently international emissions pricing mechanisms delivering a strong enough price on these emissions to change behaviour.

ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) prices aviation emissions globally with some exceptions. Offsetting is only required for emissions above 85% of 2019 levels, which is not consistent with ICAO's net zero CO_2 2050 target. To drive significant emissions reductions, CORSIA needs strengthening.

IMO has committed to developing a market-based measure, which may provide an effective pricing mechanism for international shipping. Several options are being considered including a universal levy. Decisions are due to be made in 2025 with implementation in 2027. The levy price options considered in the impacts assessment range between US$30–300 per tCO_2e.[194,xxix]

There are legal barriers to some forms of aviation emissions pricing but there are other options

There may be legal barriers to Aotearoa New Zealand adopting some forms of aviation emissions pricing. The Chicago Convention and Aotearoa New Zealand's air services agreements exempt aviation fuel from customs duties and any similar charges. A direct tax on fuel may breach international obligations. It could be argued an emissions trading scheme is outside of these provisions on the basis it is not a customs duty or similar charge; this was found for the European Union's scheme in 2011, but that decision may not hold in other jurisdictions.[195] A departure tax on passengers would not fall within these legal provisions and Aotearoa New Zealand has existing pricing on international tourists through the International Visitor Levy.[196]

In shipping, legal challenge is less likely. The European Union includes international shipping in its emissions trading system, and several ports around the world adopt variable port charges, where better environmentally performing ships pay lower port fees.

There are options to avoid double pricing

If domestic pricing is adopted to supplement international pricing systems, there is a need to ensure companies are not unfairly charged twice for the same emissions.

This can be done through several mechanisms, including limiting which emissions are subject to pricing, adjusting the price to account for what has already been paid internationally, or recognising international payments made as reducing liability.

xxix NZ$50–500. Conversion accurate as at 17 October 2024.

Internationally targets and policy are being put in place for international shipping and aviation emission reductions

How other jurisdictions are acting on international shipping and aviation should also inform decisions on whether to include those emissions in the 2050 target.

IMO and ICAO are coordinating global action to reduce international shipping and aviation emissions and have set targets for net zero emissions by 2050. IMO and ICAO both encourage member states to take steps to support these goals.[197]

Several major economies have set targets to reduce these emissions and are taking policy steps to achieve their targets including the United Kingdom, the European Union, and the United States. Other countries in the Asia-Pacific region are taking action to incentivise alternative aviation fuel production and use without formally adopting a target for those emissions. See discussion in *Chapter 9: Implications of including international shipping and aviation emissions*. Including these emissions in the 2050 target would be consistent with action being taken internationally.

Over 80% of Aotearoa New Zealand's exports by value are going to countries with mandatory climate-related disclosures proposed or in force, and 40% of Aotearoa New Zealand's exports by value are going to countries with carbon border adjustment mechanisms in place or under consideration.[198]

A recent study by Zespri and international shipping company ANL (part of the CMA CGM Group) concluded:

> "New Zealand trails other countries in climate and transport policy and investment for low emissions shipping."[199]

Aotearoa New Zealand is currently at risk of substantially falling behind the progress of other developed countries if it does not take further action to address its international shipping and aviation emissions. This could impact its access to international markets.

The 2050 target can guide policy action

After the 2050 target is set, five-yearly budgets and emissions reduction plans set out policy detail to achieve it. This enables flexibility for the approach to reducing emissions, adjusting over time to achieve the best outcomes and to accommodate new technology.

Our analysis and feedback from submitters show there is a range of potential domestic policy measures available for international shipping and aviation. The Government would have choices about how it wanted to shape the policy programme to achieve the 2050 target if it included these emissions. Targets can guide policy action; the choice of policies will be the main thing that determines whether any target is met.

The Government can take decisions on the direction of policy together with or in advance of its decision on the target. The Government signalling its policy intentions at the time of making the decision could give greater certainty to the sector around the likely near-term policy direction.

Wāhanga 9 | Chapter 9

Ngā pānga tukuwaro o te kawenga ō ā-ao, ā-rererangi hoki
Implications of including international shipping and aviation emissions

Decisions about including international shipping and aviation emissions in Aotearoa New Zealand's 2050 target require a clear view of the potential implications. The possible implications we have analysed are laid out in this chapter.

Considering the current circumstances and potential implications is a key part of our task to advise whether and how international shipping and aviation emissions should be included in the 2050 target. This chapter provides our assessment across the relevant areas.

Section 5M of the Climate Change Response Act 2002 (the Act) sets out the matters we must consider when providing advice to the Government. These are:

- current available scientific knowledge
- existing technology and anticipated technological developments
- the likely economic effects
- social, cultural, environmental, and ecological circumstances, including differences between sectors and regions
- the distribution of benefits, costs, and risks between generations
- the Crown-Māori relationship, te ao Māori, and specific effects on iwi and Māori
- responses to climate change taken or planned by parties to the Paris Agreement or to the Convention.

Our analysis of these matters is based on a review of the evidence and research available along with feedback from submitters.

What impacts will occur depends on the policy choices made. For our assessment of the impacts below we have assumed that including emissions from international shipping and aviation in the 2050 target is likely to prompt further government policy action to encourage alternative fuel use. Our analysis finds this is the most effective way to achieve a significant reduction in these emissions.

What we heard

We heard through consultation that the international shipping and aviation sectors are aware of their emissions but cannot effectively reduce those emissions without government policy changes to support production and uptake of alternative fuels.

Multiple producers are interested in investing in alternative fuel production in Aotearoa New Zealand. The country is seen as having a competitive advantage in its renewable electricity generation capacity and in having feedstocks available. However, we also heard there is a potential limit on how many types of alternative fuels Aotearoa New Zealand could produce and supply. Industry submitters indicated that there is a need for certainty on what new fuel types would be serviced in Aotearoa New Zealand to enable long-term planning and investment.

We heard that reducing international shipping and aviation emissions is important for the tourism and export sectors' ability to market themselves, but these sectors do not have all the levers to make change happen on their own.

Some exporters considered that market access and signals should be considered in Aotearoa New Zealand's approach to and structure of a target. A theme from submissions was that market access impacts will not be felt evenly across all exporters. Some highlighted risks for exporters if they were to reduce emissions significantly ahead of their key competitors.

Some submitters also said it is important to align Aotearoa New Zealand's approach with the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO) and other countries.

Other submissions highlighted the importance of fostering Aotearoa New Zealand's connection with Australia and the Pacific Island countries to ensure partnership and progress is achieved.

Submitters highlighted the importance of recognising impacts for iwi/Māori and the need for collaboration and partnership between the Crown and iwi/Māori. We also heard through consultation that addressing these emissions would have positive impacts for many iwi/Māori, including economically.

Current available scientific knowledge on international shipping and aviation emissions

In this section we consider the scale of emissions from international shipping and aviation, and what needs to happen to these emissions if global warming is to be limited to 1.5°C above pre-industrial levels. This helps to determine the size of the issue that needs to be addressed to inform the decision on whether to include these emissions in the 2050 target.

International shipping and aviation emissions are significant and increasing

Historically, international shipping and aviation caused a relatively small share of greenhouse gas emissions, but their emissions are growing. In its Sixth Assessment Report (AR6), the Intergovernmental Panel on Climate Change (IPCC) stated that international shipping and aviation caused 2% of total historical human-caused net carbon dioxide (CO_2) emissions between 1950 and 2019.[200]

While the sectors have been improving their efficiency, rising demand continues to push up their emissions. Analysis by IMO and ICAO shows growing emissions from international shipping and aviation can be expected if action is not taken.[201]

As set out in *Chapter 7: How international shipping and aviation emissions could be included,* Commission analysis indicates that Aotearoa New Zealand's international shipping and aviation emissions will increase by 2050 if no further action is taken to reduce their emissions.

Emissions from international shipping and aviation need to be addressed to limit warming to 1.5°C

International shipping and aviation primarily use fossil fuels. This creates emissions that are 98–99% CO_2, which traps heat in the Earth's atmosphere, leading to temperature increases.[202]

According to the IPCC, limiting global temperature rises to 1.5°C depends on reducing CO_2 emissions to net zero by the 2050s, followed by net negative emissions in later years.[203] Achieving this requires immediate greenhouse gas reductions in all sectors, including international shipping and aviation.[204]

If sectors like international shipping and aviation are not included in emission reduction efforts, change may be more difficult and costly, while the risk increases that international targets, including those in the Paris Agreement, will not be met.

If international shipping and aviation emissions are added to the 2050 target, to limit temperature rises to 1.5°C any residual international shipping and aviation emissions in 2050 will need to be offset by deeper reductions in non-CO_2 greenhouse gases in other sectors such as agriculture, or by removing CO_2 from the atmosphere such as through planting trees.

Existing technology and anticipated technological developments to reduce emissions from international shipping and aviation

Comprehending the technology opportunities for reducing international shipping and aviation emissions is critical for understanding the implications of including these emissions in the 2050 target. This section covers our analysis of current and anticipated technology, barriers to their adoption, and the potential for alternative fuel production to support emission reductions.

The 2050 target being changed does not in itself change the technologies used. Government policies and behaviour change by companies and individuals will ultimately determine which technologies are adopted. Government choices about how it addresses demand for international shipping and aviation can also help to limit emissions.

International shipping and aviation technology options

Our analysis shows opportunities to reduce emissions through efficiency in both international shipping and aviation. However, alternative fuels are required including biofuels, methanol, ammonia, or hydrogen for shipping and SAF for aviation. Battery electric craft are available for domestic shipping and aviation, but range issues mean they are unlikely to be viable for long-distance transport in the coming decades.
Table 9.1: *International shipping and aviation technology options* sets out the key technologies.

Table 9.1: International shipping and aviation technology options

	International shipping	International aviation
Efficiency measures		
Design and retrofits	Opportunities include wind-assisted propulsion, solar panels, waste heat recovery, hybrid propulsion, shore power, and hull design.	Opportunities include retrofitting winglets, lightweight aircraft cabin equipment, electric or assisted taxiing, ground power, and more aerodynamic exterior paint.
Operational measures	Route optimisation, slow steaming, efficient port operations.	Route optimisation, efficient airport operations.
Alternative fuels		
Green methanol	New vessels need to be built or significant retrofitting required, but the technology is commercialised. Globally, there are over 100 vessels on order. [205]	Green methanol is not a primary technology option being considered for international aviation due to its low energy density.
Green ammonia	Ammonia vessels are not yet commercialised but are expected to be available soon and become significant. In 2022, 150 ammonia-ready vessels were on order globally.[206]	Green ammonia is not a primary technology option being considered for international aviation due to its low energy density.
Biofuels	Biodiesel can be used in existing vessels either as replacement fuel, or through blending with existing fossil fuels.	Biofuels are expected to be a significant aviation fuel and can be used in existing planes. Emissions reductions depend on how the biofuels are made.
Fossil gas	Fossil gas is being considered globally as a temporary transition fuel, particularly for cruise vessels. Required infrastructure is not available for Aotearoa New Zealand.	Fossil gas is not an option being considered for international aviation due to its low density and changes to infrastructure and equipment required.[207]
E-fuels	E-fuels are not a primary technology option being considered for international shipping due to comparative costs.	E-SAF is expected to be used and is likely to reduce emissions more than, but be more costly than, biofuels.
Green hydrogen	Green hydrogen emits no CO_2 when used and can be produced with near-zero greenhouse gas emissions.[208] It requires new vessels. Fuel density is an issue, but research suggests this can be overcome.[209]	Green hydrogen reduces emissions more than biofuels but requires new planes that are not expected until the 2030s–2040s. It requires new infrastructure, and it has more limited range.

Economic opportunities from international shipping and aviation technology

There are economic opportunities for Aotearoa New Zealand to become a producer of alternative fuels. Our analysis and feedback from submissions has indicated that the country could have the resources and ability to produce a range of alternative fuels including:

1. woody biomass based SAF and biofuels for shipping
2. municipal solid waste based SAF
3. e-SAF (a sustainable aviation fuel derived from renewable energy)
4. green hydrogen, green ammonia and green methanol.

Domestic production of alternative fuels could help increase global supply, supporting the cost of these fuels to reduce in future. It is also likely to increase employment opportunities in regions with high potential like Northland, Bay of Plenty, or Taranaki. It has been estimated that producing 50% of the country's jet fuels domestically by 2050 would create 6,400 temporary infrastructure development jobs, 1,800 new permanent direct jobs, and 5,000 additional indirect jobs.[210]

Aotearoa New Zealand will not be able to produce all its alternative fuel needs with one solution and is likely to need multiple feedstock types and some imported fuels. In a high technology, high systems change scenario, results from the Commission's analysis indicate the biomass available from wood waste and pulp logs for fuels after industrial process and electricity use would provide enough energy to meet up to approximately one third of demand. Short rotation forestry potential is not accounted for in our analysis and could increase this total.

There is joint government and aviation sector investment in research to understand the viability of using woody biomass, municipal solid waste, or power-to-liquid methods to produce SAF in this country. The preliminary findings of one study indicates it is feasible to produce 102 million litres of unblended SAF each year from woody biomass in Aotearoa New Zealand, increasing annual gross domestic product (GDP) by NZ$430 million.[211] In addition, there are several other privately funded investigations of other ways to make SAF, including development of a biorefinery at Marsden Point.[212]

International research has shown similar benefits. In the United Kingdom, the potential value of a domestic sustainable fuels industry has been estimated to be between NZ$2 and $4.2 billion per year in 2035, supporting between 6,400 and 13,600 jobs.[xxx,213] In Australia establishing a domestic SAF industry has the potential to contribute approximately NZ$14 billion in GDP per year by 2040 while supporting nearly 18,000 new jobs.[xxxi,214]

Long-term contracts and financial support to increase alternative fuel production are on offer from international transport providers.[215] If Aotearoa New Zealand does not support establishment of local production before other sources become established, it may be more difficult to secure finance to establish production.

More efficient planes and ships can also help to reduce costs. While the upfront cost of new craft may be up to 20% more expensive, the ongoing fuel savings would help to limit increases in price from alternative fuel use.[216]

xxx Converted from GB£915m-1.952 billion. Conversion accurate as of 6 November 2024.
xxxi Converted from AU$13 billion. Conversion accurate as of 6 November 2024.

Barriers to international shipping and aviation technology

Cost and supply are the largest barriers to alternative fuels for international shipping and aviation, which can be up to five times more expensive than fossil fuels.[217] This is largely due to the limited availability of feedstocks and infrastructure needed, meaning the supply of fuels is not meeting demand. If production of alternative fuels is supported with policy and investment, the cost can fall to two times the cost of fossil fuels or lower.[218]

Several companies are interested in investing in alternative fuel production in Aotearoa New Zealand. However, investors require confidence, and industry participants may hesitate to fund alternative fuel infrastructure without a clear regulatory framework and market stability. Aotearoa New Zealand's policy framework could be updated to better support production of alternative fuels.

There is uncertainty about which alternative fuel will be best for international shipping. Aotearoa New Zealand ports do not often refuel international vessels currently. However, this could change with adoption of alternative fuels such as methanol, and there may be a limit on what Aotearoa New Zealand can offer. If trading partners move to alternative fuels, other than drop-in biofuels, some ships may be unable to visit this country if they cannot refuel in the region. This would limit Aotearoa New Zealand's market access.

Ship to shore power providing electricity to vessels while they are in berth, removing the need for them to burn fuel, is not available in Aotearoa New Zealand. A study by EnergyNZ found that ship to shore power could be viable for Aotearoa New Zealand, but it would need to be used by all ship types to be affordable, not just cruise ships where it is often highlighted.[219]

Some submissions during consultation raised concerns that SAF may not be a viable option. Some of the concerns raised by research on SAF include limited and expensive supply, insufficient production capacity, land-use trade-offs, it still produces some emissions, some types of SAF have significant ecological downsides, and SAF production aims have been missed in the past.[220]

A range of technical barriers also face these technologies which will need to be monitored including: weight or density issues, safety, the long lifespan of shipping vessels, the varying routes for bulk carriers, and the vessel size Aotearoa New Zealand's ports can take.

Likely economic effects

As an island nation, distant from major economies, Aotearoa New Zealand is highly dependent on international shipping and aviation.

Aotearoa New Zealand's exports of goods and services including tourism were worth NZ$96 billion in 2023, while imports were worth NZ$108 billion.[221] The sectors also provide significant employment opportunities. One estimate of aviation's job creation indicated the industry supports 45,000 direct jobs and 329,000 jobs in total.[222]

Aotearoa New Zealand's international shipping emissions come mostly from the movement of imports and exports, and a smaller amount from international cruise ships.[223] The Commission's estimate is that in 2023 cruise ships made up around 6% of the total international shipping emissions on our proposed emissions counting approach.[xxxii]

Tourism creates most international aviation emissions, but other factors such as imports also play a role. In 2017, 51% of Aotearoa New Zealand's international aviation emissions were related to international visitors, 31% to New Zealanders travelling, 11% to imports, and 9% to exports.[224] Air freight and tourism emissions are closely intertwined – around 80% of air freight travels in passenger planes.[225]

Most of Aotearoa New Zealand's freight by sea travels long haul, while most flights are medium haul (less than 6 hours). In 2023, 13% of Aotearoa New Zealand's exports went to Australia, and 11% of imports came from Australia, while 62% of flights travelled to and from Australia, and 11% of flights travelled to and from the Pacific islands.[226]

Impacts from alternative fuel use

The policy choices the Government makes matter. In a well-supported transition to alternative fuels, where the price difference is brought down and efficiency increases, the flow-on impacts of a fuel cost increase to the rest of the economy are likely to be relatively small.

In aviation, fuel is on average a third of an airline's costs, meaning increases in fuel costs are only partially represented in ticket prices. One Australian report found that a 28% SAF mandate by 2040, would only have a 0.3% impact on flying costs between 2025 and 2040.[227] Analysis by the Mission Possible Partnership found fully decarbonising aviation could increase fuel costs 90–190%, but efficiency improvements could mean the overall change in aviation costs would range between a 5% increase and a 5% decrease.[228]

In shipping, the shipping cost is generally a small part of the cost of a product, meaning increases in fuel cost do not usually result in large price increases for products. An example from a shipping company submission was that switching to green methanol for a container of sneakers being shipped to Aotearoa New Zealand would triple the fuel cost but only amount to around 10 cents per pair of shoes. This means the wider economic costs of an increase in shipping costs is relatively limited for most products. IMO analysis of a levy of US$30–$300 on international shipping emissions found it would increase prices by 0.2% to 0.38% and have a global GDP impact of 0.08% to 0.16% in 2050.[229,xxxiii]

xxxii Commission calculations based on: New Zealand Customs Service. (2024). *Arrivals and Departures – All Craft Types – Actual Date of Arrival / Departure*; Gaffuri, J., & Korhonen, J. (2021). *SeaRoute*. github.com/eurostat/searoute; QGIS Development Team. (2024). *QGIS*. qgis.org/en/site; Ministry of Transport. (2024). *FIGS: Overseas ship visits*. https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/figs-overseas-ship-visits; International Maritime Organization. (2022). *Report of fuel oil consumption data submitted to the IMO Ship Fuel Oil Consumption Database*. imo.org/en/ourwork/environment/pages/data-collection-system.aspx

xxxiii NZ$50–500. Conversion accurate as of 17 October 2024.

IMO analysis of its proposed levy also found it would impact import/export volumes in 2050 by 0.23% to 0.97%. Impacts on import and export volumes were found to be smaller for developed countries than less developed countries.[230] This indicates the impact for Aotearoa New Zealand on demand from decarbonising international shipping would likely be limited, provided it did not decarbonise at a significantly different rate to the global average.

The Commission estimated that if the international aviation sector used 100% alternative fuels at two times the cost of conventional jet fuel, that would result in 7% lower demand in 2050.[xxxiv] However, demand would still be 2.2 times higher than in 2019. This indicates that the aviation demand impact of a shift to alternative fuels is likely to be small, if these fuels are supported to reduce in cost over time.

If refuelling is too expensive in Aotearoa New Zealand because the cost of alternative fuels has not been addressed, this may encourage refuelling overseas. If refuelling is not happening where it is most efficient, this could increase costs as well as global emissions.

Access to overseas markets and tourism

How Aotearoa New Zealand addresses international shipping and aviation emissions will affect its access to overseas markets and tourism. There are increasing expectations and regulatory requirements that these emissions be addressed.

"TIAKI – Our drive to care for people, place and planet for our future" is one of four core values underpinning the *New Zealand Story*, which government and industry use to brand the country's tourism and exports. Brand Finance estimates this brand to be worth around NZ$400 billion.[232,xxxv]

Research by Kantar New Zealand found that greenhouse gas emissions from air travel is one of the sustainability issues of greatest concern for tourists, particularly those from the United States and United Kingdom.[233] A 2023 survey found that between 73% and 95% of respondents in each of Aotearoa New Zealand's key markets reported they intended to travel more sustainably in future.[234]

Increasingly, countries that Aotearoa New Zealand exports to are implementing climate and sustainability disclosures and trade-related measures. Eighty percent of Aotearoa New Zealand's exports are going to markets that have mandatory climate-related disclosures (CRD) in force or proposed, and forty percent are going to markets that have carbon border adjustment mechanisms to charge for the emissions in imported goods enforced or proposed.[235] Aotearoa New Zealand's exporters are paying for their international shipping emissions on goods travelling to the European Union under the EU ETS, which is increasing freight costs.[236]

xxxiv Comparing a high technology, high systems change scenario to a reference scenario where no alternative fuels are used. We used the ENZ model to understand the scale of the emissions reductions that are achievable in each sector over time. ENZ is an economy-wide model that covers all the main emitting sectors in Aotearoa New Zealand – energy, industry, transport, agriculture, forestry and waste.

xxxv Converted from US$248 million. Conversion accurate as of 17 October 2024.

Businesses are increasingly reporting on these emissions under global standards, and overseas customers are looking to Aotearoa New Zealand suppliers to help them meet emissions reduction targets and supply chain emissions.[237] Large global brands like Nestlé, Royal Philips, IKEA, Unilever, and international supermarkets are increasingly seeking supply chains that have reduced greenhouse gases.[238]

Market access impacts will not be felt evenly across all exporters. Submissions indicated that exporters to Europe and North America are already receiving demands for change, while in other markets there are risks for exporters if they reduce freight emissions faster than overseas competitors. For some goods, such as kiwifruit, international freight emissions may make up a very high proportion of the total production, transport, and use emissions of the product, meaning reducing those emissions carries greater benefit than for products where these emissions make up only 1–2%.

Some submissions said Aotearoa New Zealand routes are less profitable than other routes, so decisions could affect whether transport operators cover routes. Based on our understanding of the size of the possible impacts this appears unlikely, but increased costs would likely be passed on to consumers.

The Government has an opportunity to prioritise international shipping emissions reduction by developing green shipping corridors for key markets where it will create the most economic benefit.

Economic resilience

Adoption of policies and technologies to reduce international shipping and aviation emissions could help improve Aotearoa New Zealand's economic resilience.

Aotearoa New Zealand currently imports almost all its fuel. Producing alternative fuels represents an opportunity to reduce import expenditure and increase the security of fuel supply. This means when overseas supply chains are disrupted, Aotearoa New Zealand would be able to supply some its own fuel needs.

Alternative fuel production built with electrolysers, that allow production to be ramped up and down for peaks or dry years, can improve the security of supply for the electricity grid. Similarly for ship to shore power in emergency situations, electricity generated by vessels could flow back to shore to support lifeline utilities.[239]

Removals or reductions in other sectors

Adding international shipping and aviation emissions to the 2050 target could also change the level of action for other sectors. How this might occur would depend on Government policy choices. The Commission has considered this as part of its analysis of including the emissions in the net zero component of the target in *Chapter 7: How international shipping and aviation emissions could be included.*

Domestic shipping

Domestic coastal shipping companies in Aotearoa New Zealand are currently at a disadvantage compared to international operators. While international shipping operators conducting domestic shipping in Aotearoa New Zealand waters are not covered by the NZ ETS, domestic operators are.[240]

Including international shipping emissions in the 2050 target may mean the conditions for doing business between international and domestic shipping becomes more even.

Social, cultural, environmental, and ecological impacts

If the 2050 target is amended to include international shipping and aviation emissions, a shift to alternative fuels is likely to bring health benefits, as well as reducing emissions and environmental impacts. It is important to consider those alongside any potential negative impacts.

Benefits for health

Increasing the use of alternative fuels could reduce the negative effects on human health from shipping and aviation emissions. International research estimates that pollution from jet fuel is a factor in 16,000 deaths globally each year, and that a shift in fuels to a 50% blend of SAF could reduce premature deaths by 18%.[241]

Emission Impossible estimates roughly 200,000 New Zealanders may be living and working in proximity to harmful ship emissions.[242] New Zealand Institute of Economic Research analysis showed the recent switch to low sulphur fuel requirements should save Aotearoa New Zealand around NZ$75 million in health costs from shipping pollution each year.[243] However, there would still be NZ$70 million of residual health impacts per year, which could be further reduced through a shift to alternative fuels or shore power.[244]

Impacts if the costs of imports or travel increase

As set out in the *Impacts from alternative fuel use* section above, the impact on the cost of travel and demand is expected to be small in a well-managed transition.

However, if the cost of international shipping and aviation increased, higher travel costs could reduce connectivity for people to friends or relatives overseas, and for Māori overseas to connect back with their culture. Many New Zealanders live overseas, and more than 1 in 4 people living in Aotearoa New Zealand were born overseas.[245] Around 40% of international flights to and from Aotearoa New Zealand are to see friends and family.[246] There are strong familial and cultural connections to other countries, including around Te Moana-nui-a-Kiwa (the Pacific Ocean) and further afield to other 'homelands' for current residents.

Survey results have indicated higher income households from Aotearoa New Zealand are twice as likely to travel internationally as lower income households, meaning increased travel costs would fall largely on higher income households.[247] However, increased travel costs may have a disproportionate impact on people with lower disposable incomes and people who may already be disadvantaged through lower socio-economic conditions.

If international travel became more expensive, or policy to reduce demand in order to reduce emissions is implemented, growth in Aotearoa New Zealand's tourist numbers could be slower than it might otherwise have been. Decreasing tourist numbers could have negative social impacts, in particular reduced employment, which could disproportionately impact younger, female, Māori, and migrant workers who make up a large part of the tourism workforce.[248]

Impacts on international relationships

The inclusion of international shipping and aviation emissions in Aotearoa New Zealand's 2050 target could have varying effects on the country's relationship with other countries. Including these emissions in the 2050 target may strengthen perceptions of the country's response to climate change. However, policies implemented to achieve the target could impact its relationship with other countries if it affects their residents' ability to travel and trade.

There may be opportunities for trans-Tasman cooperation to reduce international shipping and aviation emissions faster. Australia is accelerating investment in renewable hydrogen, low carbon liquid fuels, and manufacturing of clean energy technologies as part of a NZ$22 billion funding package in Australia's priority industries.[249,xxxvi]

The Australian and New Zealand Governments have agreed to work together on green shipping routes; investigate the conditions required to develop a regional sustainable aviation fuel industry; and to develop a Guarantee of Origin scheme for green hydrogen, sustainable fuels, and green metals among other commitments.[250] These initiatives provide an opportunity to further progress the decarbonisation of international shipping and aviation cohesively with Australia.

Ensuring connection with the Pacific is maintained is important to protect family links as well as diplomatic, trade and security ties. Pacific governments and regional bodies are strong proponents of greater action on climate change, including on international shipping and aviation emissions. At the same time, the peoples of the Pacific need to maintain international connections and may need support to access alternative fuels.

Aotearoa New Zealand is the main access point for some Pacific countries and is the only country with flights directly to Niue. In addition to trade and tourism, some Pacific countries draw income from Aotearoa New Zealand through seasonal employment schemes, which require international travel.

Environmental and ecological benefits

Reducing emissions of greenhouse gases has environmental and ecological benefits. In *Chapter 7: How international shipping and aviation emissions could be included* we discuss the extent of possible emissions reductions from including international shipping and aviation in the 2050 target; this section considers other environmental and ecological benefits.

Switching to alternative fuels would reduce air pollution which can decrease the spread of disease, improve air quality, and reduce toxic stress on ecosystems.[251] If international shipping and aviation demand slowed, environmental benefits could include reductions in noise pollution and impacts from development.

Specific to shipping, there are further environmental and ecological impacts:

- Switching to alternative fuels that do not contain sulphur removes both sulphur and the need for scrubbers, which can contaminate water and contribute to ocean acidification.[252]
- Ships collect unwanted microorganisms on their undersides. This can transport microorganisms to new environments impacting biodiversity. It also creates drag, which increases fuel consumption up to 20%.[253] More frequent cleaning for fuel efficiency or reduced growth in demand for shipping would limit these impacts.
- Degradation of shallow marine habitats by ships would reduce if growth in demand for international shipping reduced. Ship anchoring is seen as a major driver, killing marine species and releasing carbon stores trapped in the sediment.[254]

xxxvi Converted from AU$19.7 billion. Conversion accurate as of 17 October 2024.

Environmental impacts from production of alternative fuels

Care needs to be taken to ensure alternative fuels are sustainably produced so that one environmental problem is not replaced by another if their use increases.

Ensuring the production of feedstocks for biofuels is sustainable will reduce the potential environmental impacts that are associated, such as contamination, biodiversity loss, and land-use change. Presence of local species can be up to 49% lower at sites planted with first generation biofuel crops and there can be issues with soil erosion and toxic runoff.[255]

Producing alternative fuels using renewable energy and renewable sources of CO_2 (such as from direct air capture) provides much more significant emissions reductions than those produced using fossil fuels.

Distribution of benefits, costs, and risks between generations

Including international shipping and aviation in the 2050 target is likely to change the distribution of benefits, costs, and risks associated with these emissions between generations.

While action to reduce international shipping and aviation emissions may have impacts on the current population, it also prevents higher impacts for future generations, rather than leaving the effects of climate change to accumulate and intensify for the country's children and their children.

Reducing emissions from international shipping and aviation will take time, as it depends on the introduction and commercialisation of new technology and alternative fuels. Future generations will benefit most from faster action. Our analysis in *Chapter 8: Whether to include international shipping and aviation emissions* shows that including international shipping and aviation emissions in the target is likely to prompt policy action to reduce emissions faster. Implementing change sooner may also reduce the cost of action for future generations, for example by supporting alternative fuels to be produced at lower cost at scale.

The Crown–Māori relationship, te ao Māori, and specific effects on iwi/Māori

An effective and equitable relationship between iwi/Māori and the Crown based on partnership is more likely to lead to effective and durable emissions reductions, to the benefit of all New Zealanders, while ineffective relationships could lead to delays and increased costs.

International shipping and aviation emissions are impacting the natural environment and ecosystems, which are important sources of wellbeing and prosperity, and deeply tied to iwi/Māori identity.

Addressing these emissions would have positive impacts for many iwi/Māori, including economically. For example, for some iwi/Māori with strong interests in forestry and agriculture, a transition to alternative fuels could present a significant opportunity, with potential benefits from increased demand for the source materials such as wood waste that can be used to make fuel.

Within te ao Māori, caring for the environment must be considered to have a similar level of importance as maintaining livelihoods and ā-tinana (in person) connection with whānau living overseas (including the need for aviation when people may need to urgently return for activities such as tangihanga (funerals)).

Including international shipping and aviation emissions in the 2050 target could create short-term cost increases related to exports and tourism, but also help secure long-term demand. These are important sectors for Māori:

- Around 50,000 Māori are employed in export industries as of 2023.[256]
- Māori businesses owned NZ$4.9 billion in assets in the dairy sector alone in 2018.[257]
- Māori authorities exported NZ$816 million worth of goods in 2023.[258]
- There were 537 Māori tourism businesses in Aotearoa New Zealand in 2020.[259]

Māori trusts and corporations own more than 30% of production forestry land and large areas of indigenous forest.[260] If including international shipping and aviation in the 2050 target increases offsetting through planting trees, Māori interests in commercial forestry may be affected.

Any consideration of international shipping and aviation emissions must acknowledge the developing nature of Māori export interests. Treaty settlements have seen over NZ$2.7 billion of land, assets and capital returned to iwi, including fisheries and forests.[261] Subsequently, iwi/Māori have developed a substantial export market.[262] As Treaty settlements mature, further growth in the Māori economy is anticipated. If Māori are unable to develop assets that they receive through Treaty settlements because they are unable to access international shipping or aviation, there is a risk this could be considered a restriction on their Treaty rights.

An effective and equitable relationship between iwi/Māori and the Crown based on partnership is more likely to lead to effective and durable emissions reductions, to the benefit of all New Zealanders, while ineffective relationships could lead to delays and increased costs.

Responses to climate change taken or planned by parties to the Paris Agreement or to the Convention

This section sets out our analysis of action being taken by international agencies and other economies.

Overseas action affects the impacts of including international shipping and aviation emissions in the 2050 target. Results from global modelling on emissions reductions have indicated they are unlikely to happen at the same rate globally.[263] Shipping and aviation companies are likely to focus their emissions reduction efforts on routes where there is government support or alternative fuels are more readily available. This means what action Aotearoa New Zealand takes relative to other countries can affect its rate of emissions reduction and access to international markets.

Aotearoa New Zealand's international obligations to address international shipping and aviation emissions

Aotearoa New Zealand has international legal obligations to take action to reduce international shipping and aviation emissions. Inclusion in the 2050 target will help meet the obligations and support international relationships.

Under the Kyoto Protocol, Aotearoa New Zealand has an enduring obligation to work with two international bodies to reduce international shipping and aviation emissions: IMO and ICAO.[264] Under the United Nations Convention on the Law of the Sea, it has direct obligations to reduce emissions from international shipping and aviation.[265] Under the Paris Agreement it is up to Aotearoa New Zealand to determine what it includes in its emission reduction commitments, although as a developed nation it is encouraged to set strong, economy-wide targets.[266] The Paris Rulebook requires international shipping and aviation emissions to be reported separately for national inventories, but this does not affect setting targets.

While not legally binding, Aotearoa New Zealand has also signed up to several international declarations to reduce emissions from international shipping and aviation. These include the Declaration on Zero Emission Shipping by 2050, the Clydebank Declaration for Green Shipping Corridors, International Aviation Climate Ambition Coalition, and Aviation Net Zero Declaration.[267]

Initiatives underway globally

There are significant benefits to Aotearoa New Zealand aligning its target for international shipping and aviation with bodies such as IMO and ICAO and other countries.

International Maritime Organization

The *2023 Strategy on Reduction of GHG Emissions from Ships* from IMO aims to reduce carbon intensity through energy efficiencies and technologies. Its overall goal is to reach net zero international shipping emissions by or around 2050, while promoting an equitable transition.[268]

IMO strategy sets indicative checkpoints on a path to reach net zero, with goals to:

- by 2030 reduce total annual greenhouse gas emissions from international shipping by at least 20%, striving for 30%, compared to 2008 levels
- by 2040 reduce total annual greenhouse gas emissions from international shipping by at least 70%, striving for 80%, compared to 2008 levels.[269]

IMO outlines two major policy levers, which it says should be developed and agreed by 2025, and in place by 2027. One of these is technical – a marine fuel standard to reduce the emissions intensity of marine fuel. The other is economic – a pricing mechanism.[270] This means there is potential for global emissions pricing and fuel regulations for international shipping to be in place within three years.

IMO's *2023 Strategy on Reduction of GHG Emissions from Ships* includes developing national action plans to address international shipping emissions. So far, eight countries have submitted their national action plans.[271] Aotearoa New Zealand has not yet submitted a plan.

International Civil Aviation Organization

ICAO has adopted a long-term aspirational goal of reaching net zero international aviation CO_2 emissions by 2050.[272]

ICAO's long-term aspirational goal favours measures that directly reduce aviation emissions at their source, including faster adoption of new aircraft technologies, streamlining flight operations, and increasing production and use of sustainable aviation fuels (SAF).

One of ICAOs key levers is the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which requires airline operators in the scheme to offset their CO_2 emissions above 85% of 2019 emissions. CORSIA is currently voluntary; from 2027, it becomes mandatory except for some specific developing countries.[273] Aotearoa New Zealand is participating in the voluntary stages.[274] The scheme is due to end in 2035 subject to a review in 2032 considering if it should be extended.

ICAO launched the State Action Plan initiative in 2010. States are encouraged to select appropriate emissions reduction measures from ICAO's 'basket of measures', and to calculate their emissions reductions. States are encouraged to update their plans every three years. To date 148 states representing 98.99% of air travel have submitted a State Action Plan and many have routinely updated their plans. Aotearoa New Zealand submitted a plan in 2016 but has not updated it since.[275] A recent ICAO conference resolution in 2023 encouraged setting state level targets and/or mandates for emissions reduction levels.[276]

Other organisations' targets

As well as the action by the United Nations sector bodies, other bodies are setting their own targets and supporting strategies for international shipping and aviation. These include the Global Maritime Forum, International Chamber of Shipping, the Poseidon Principles, Cruise Lines International Association, International Air Transportation Association, the World Economic Forum, International Airlines Group, and Airports Council International.[277]

Action by individual countries

While the international air and sea transport sectors are targeting net zero greenhouse gas emissions by 2050, current global action is inadequate to deliver the emissions reductions to achieve that. Further action is required, and individual countries are increasingly adopting targets and setting policies for these sectors. A summary of the current state of policy response as at October 2024 is set out in *Appendix 1: Action on international shipping and aviation by individual countries*.

Policy and the international regime

There are several policy areas not regulated internationally where domestic action is necessary to support reduction in international shipping and aviation emissions. Including these emissions in the 2050 target could create a framework to support these policies being prioritised and implemented in a consistent way.

There is international policy action on pricing and efficiency standards for both shipping and aviation and for alternative fuel requirements for shipping. However, not all actions can be taken at an international level. Some areas of the transition require changes that can only be made domestically. These include:

- Supporting alternative fuel production – both IMO and ICAO encourage states to adopt policies to support alternative fuel production, such as incentives or research and development support.
- Fuel standards – ICAO has left responsibility for implementing fuel standards to states and encourages them to take action.
- Infrastructure – ensuring port and airport infrastructure supports alternative fuels and improved efficiency can only be done at a state level.
- Efficiency – some elements of efficiency can only be regulated at a domestic level, such as air traffic management and operational procedures.
- Regulatory environment – ensuring regulatory standards support emissions reductions, such as consenting and health and safety requirements, can only be done domestically.
- Managing demand – demand management policies beyond pricing can only be done domestically.
- Green shipping corridors – the establishment of green shipping corridors needs to be done through bilateral or multilateral negotiations between states.

Wehenga D: Ngā tūtohu ki te whāinga 2050

Part D: Recommendations on the 2050 target

Wāhanga 10 | Chapter 10

He whakakotahitanga tūtohu
Combined recommendation

This chapter considers the impact of combining findings of the 2050 target review and the international shipping and aviation review, and puts them together into a single recommendation for the Government.

The recommendations of the 2050 target and international shipping and aviation reviews are closely intertwined. The effect of the findings of both reviews is to increase the overall level of emissions reduction required by the 2050 target. It is important that the recommendations of the two reviews are able to operate together coherently.

He Pou a Rangi Climate Change Commission (the Commission) has therefore decided to provide a single joint recommendation across both reviews to provide clarity about how it intends its findings to operate together. These findings are intended as a package. If elements of the proposed changes to the target are not accepted, the revised target would not limit warming as intended by the Commission.

This recommendation is made on the basis that the other elements of the 2050 target remain the same: in particular, the requirement in section 5Q(2) of the Climate Change Response Act 2002 (the Act) that the 2050 target will be met if emissions reductions meet or exceed those required by the target.

Figure 10.1: The current 2050 target and the recommended target

Source: Commission analysis

Recommended revision to the 2050 target

The findings of both the 2050 target review and the international shipping and aviation review are that the 2050 target be amended to respond to the increased risks and impacts from climate change, and to provide a smooth transition for Aotearoa New Zealand to a low emissions economy.

The combined findings of the 2050 target review and the international shipping and aviation review result in a revised 2050 target, which would require lower emissions at levels that are realistic for Aotearoa New Zealand's industry sectors and communities. These changes take account of the potential costs, impacts and benefits of transition to a lower emissions future, and are consistent with ongoing economic growth in the coming decades.

Recommendation

We recommend that the Government:

Amend the emissions reduction target (the 2050 target) to require that:

a. net accounting emissions of greenhouse gases other than biogenic methane, including international shipping and aviation emissions, are at least negative 20 $MtCO_2e$ by the calendar year beginning on 1 January 2050
b. gross emissions of biogenic methane in a calendar year –
    i. are at least 10% less than 2017 emissions by the calendar year beginning on 1 January 2030; and
    ii. are at least 35–47% less than 2017 emissions by the calendar year beginning on 1 January 2050
c. there are further reductions and removals of greenhouse gases beyond these levels after 1 January 2050.

Calculate emissions from international shipping and aviation using the following measures:

- for aviation: refuelling taking place in Aotearoa New Zealand based on bunker fuel use by all international operators
- for shipping: an estimate of 50% of the emissions to/from the next overseas port by all international operators and 100% of their emissions travelling between ports in Aotearoa New Zealand and while docked.

And to:

- reconsider the inclusion of other climate impacts from international shipping and aviation in the 2050 target in future reviews
- develop measures for meeting the 2050 target that ensure a specific focus occurs on gross emissions reductions for international shipping and aviation.

Key considerations used to assess how to combine our reviews

We have used the 'feasibility and impacts' and 'purpose of the Act' criteria set out in *Chapter 1: Introduction* to assess the effects of combining the recommendations from the 2050 Target review and the international shipping and aviation review.

- *Purpose of the Act:* how does the combined recommendation meet the purpose of the Act?
- *Feasibility and impacts:* is the combined recommendation feasible, what are the impacts and does combining them increase the risk of the target not being achievable?

This chapter does not assess the interaction of findings of the 2050 target review with the current target without international shipping and aviation emissions included (covered in *Chapters 3–6*) or international shipping and aviation emissions with the current target (covered within *Chapters 7–9*).

Purpose of the Act

The key purpose of the 2050 target is to contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels. The significant change analysis conducted for the 2050 target review demonstrates that the world is not on track to achieve 1.5°C, and countries need to strengthen their targets to achieve it.

International shipping and aviation emissions are 98–99% carbon dioxide.[278] Carbon dioxide emissions need to be reduced to net zero globally by the 2050s, followed by net negative emissions to limit warming to 1.5°C.[279] As these emissions are primarily carbon dioxide, it makes sense to treat them in the same way as other long-lived greenhouse gases captured by the target.

Including emissions from international aviation and shipping in the target means Aotearoa New Zealand would need to make more emissions reductions than under the current target. This means that Aotearoa New Zealand would cause less warming, which means the combined recommendation is a greater contribution to limiting warming than the individual recommendations.

Feasibility and impacts

Our analysis has found making greater reductions in emissions is realistic and feasible for Aotearoa New Zealand and is consistent with ongoing economic growth in the coming decades. The combined recommendation is also consistent with global goals for international shipping and aviation emissions. Achieving the combined recommendation has the potential to bring significant benefits.

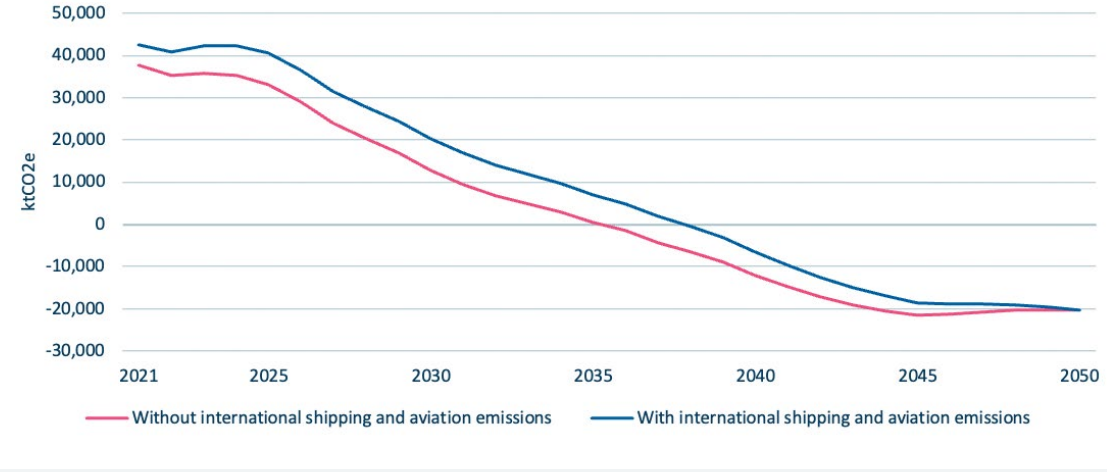
The combined recommendation also spreads responsibility for reducing emissions more broadly across the economy, meaning all sectors are playing their part in Aotearoa New Zealand's overall reduction in emissions.

To gain insight about the potential feasibility and impacts of the combined recommendation we used the scenario analysis discussed in *Chapter 6: Implications of our recommended 2050 target.*

The recommended target requires following a scenario that includes a high level of technology change and a high level of system change.

Achieving net negative 20 $MtCO_2e$ including international shipping and aviation is feasible under a high technology, high systems change scenario for international shipping and aviation emissions or if further steps, beyond those indicated in the high technology, high systems scenario, are taken in other sectors to meet the combined recommendation (see **Figure 10.2**). These combined scenarios present a creditable and consistent path to meeting the combined recommendation.

Figure 10.2: Net emissions of all greenhouse gases excluding biogenic methane in a high technology, high systems change scenario



Source: Commission analysis

Adding international shipping and aviation emissions to the 2050 target increases the risk that the target may not be achieved. Adding these emissions increases the total volume that must be reduced, while the technology pathways for these sectors are uncertain and international shipping and aviation are considered hard-to-abate sectors. However, our high technology scenarios have emissions from international aviation and shipping declining sharply in the 2040s primarily due to switching to lower emissions fuels.

The high technology, high systems change scenario that aligns with the recommended target includes assumptions about using new and emerging technologies while targeting systems shifts with significant co-benefits (see the *Technical Annex* for more information). In this scenario, there is a faster reduction in costs for electric vehicle batteries, which drives greater adoption of electric vehicles earlier, including trucks, public ferries and small aircraft. This scenario also includes introduction of methane-reducing feed additives for dairy cows and higher diversion of organic waste from landfills to anaerobic digestion (energy recovery).

It is likely that some of these technologies will not emerge exactly as suggested by this scenario. However, there are also ways emissions reductions could go further than the results from this scenario. Examples include:

- Forestry levels do not exhaust the potential land that could be converted to forestry.
- New carbon dioxide removal technologies such as direct air carbon capture and storage or bioenergy carbon capture and storage that are not included in the scenario.
- Carbon capture and storage at industrial sites is not included in the scenario, it is only assessed for geothermal energy.
- Some technologies may be more effective than is anticipated; for example, the Commission assumes 30% efficacy for a methane inhibitor bolus or methane vaccine, which some trials have indicated could be higher.[280]

Impacts of combining the recommendations

Adding international shipping and aviation emissions to the recommended 2050 target without adjusting the level increases the total required net emissions reduction by 6.7 $MtCO_2e$ in 2050 compared to 2023.

The findings of the international shipping and aviation review are that reducing these emissions results in limited price impacts for consumers and relatively small flow-on impact to demand. Production of alternative fuels presents an economic opportunity to increase employment and improve energy security. To achieve net zero for these emissions requires removals such as through forestry or greater reductions in other sectors.

Both the 2050 target review and the international shipping and aviation review found potential co-benefits from measures to reduce emissions and a limited impact on gross domestic product (GDP), and no additional effects from combining them.

Both reviews found similar potential social, cultural and economic benefits including:

- increased productivity
- greater energy security and independence
- greater innovation
- maintaining global competitiveness
- healthier people
- avoiding costly inaction
- increased resiliency.

Both reviews found there could be specific impacts for iwi/Māori concerning the forestry and agricultural sectors, as well as potential benefits to te taiao from a te ao Māori perspective. Through engagements we have heard consistently that the impacts of land use on current and future generations, along with equity, and good environmental and social practices, are foundational to decision-making for many iwi/Māori. The combined recommendation is more consistent with these approaches than the individual recommendations.

The 2050 target review found potential co-benefits for environmental systems from potential increased indigenous afforestation and improvements to soil and water quality from land-use or farm management changes. The international shipping and aviation review found there are potential environmental benefits from reduced use of scrubbers with a switch to alternative fuels and if demand growth were lower for international shipping and aviation. However, there would also be new environmental risks to manage around the production of alternative fuels.

The recommendations in both the 2050 target review and the international shipping and aviation review would require greater action by current generations, reducing the impact of climate change on future generations and driving the transformation of the economy.

As both reviews' proposals could result in an increase in removals, the combined effect of them could also mean the marginal cost of removals is higher. For example, if the total level of removals through forestry were higher, it is likely the cost of land purchased for offsetting would become more expensive as additional land is purchased.[281]

Next steps

Section 5U of the Act sets out that within 12 months after receiving a recommendation to amend the 2050 target, the Minister of Climate Change must advise the Commission in writing of the Government's response. This response must be made publicly available and be presented to Parliament. The response must include reasons for any departure from the Commission's recommendation.

If the Government accepts our advice, the Act would need to be amended to implement a new target. The Act can only be amended through new legislation.

The Government sets out emissions budgets for at least 15 years in advance. If the Act is amended, the Commission may then provide advice that the relevant emissions budgets be changed to reflect the change in the 2050 target. If we do so, then notified and future emissions budgets can be revised accordingly. The Government can only revise previously notified budgets if the Commission recommends that they do so.

The second emissions reduction plan is due to be set by the Government in December 2024, around the same time the Commission delivers this advice. Under the Act, the Government can revise this plan to put Aotearoa New Zealand on a path to meet the new target. Failing that, the next statutorily mandated opportunity is the third emissions reduction plan, due by December 2029. Then policies would have to be put in place or amended (for example, any changes to the New Zealand Emissions Trading Scheme) to achieve those new emissions reduction plans. The Commission would then monitor progress towards those new targets, budgets and plans as part of its annual monitoring function, which would begin as soon as the legislation was amended.

Tāpiritanga

Appendices

Piringa 1 | Appendix 1

Ngā mahi i ngā kawenga ō ā-ao, ā-rererangi hoki o tēnā, o tēnā whenua takitahi ake

Action on international shipping and aviation by individual countries

Some major economies, including the United Kingdom, European Union and United States, are taking further action. A summary of those actions is provided in **Table A.1.** This shows how domestic action can be taken that is complementary to the international regimes. It also shows that some of the economies Aotearoa New Zealand typically compares itself to are currently ahead in addressing these emissions.

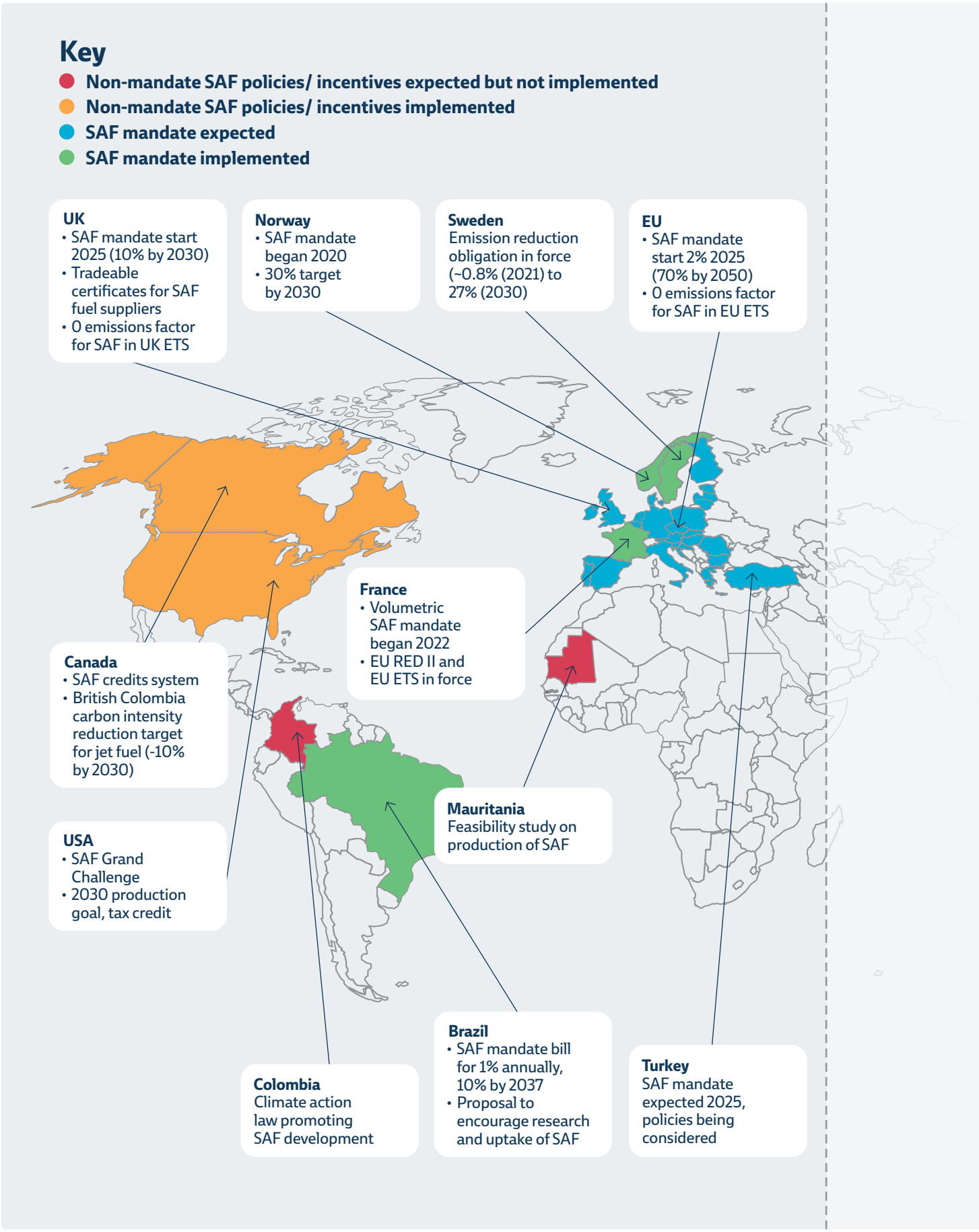
Table A.1: Summary of international shipping and aviation action by some major economies

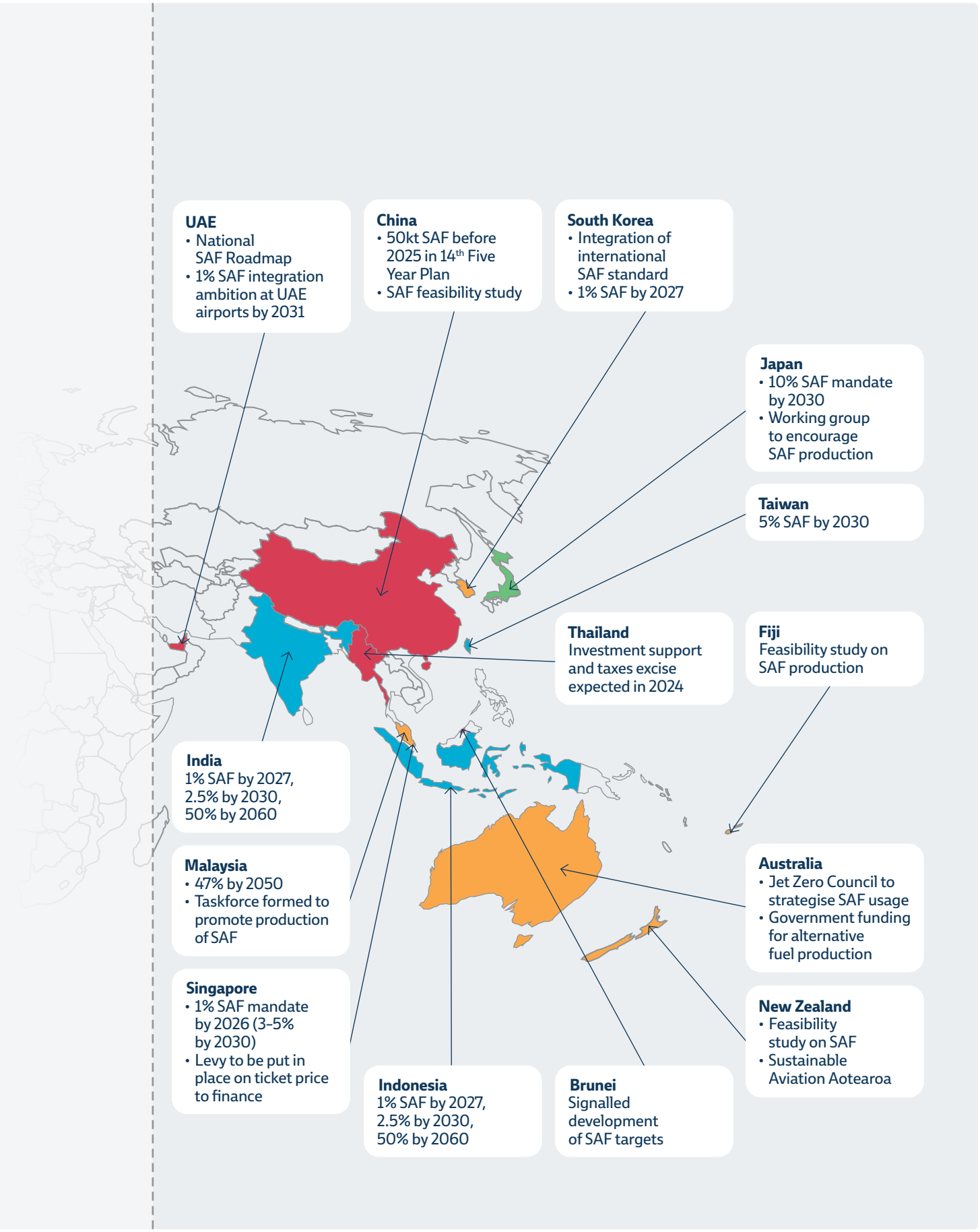
Economy	International shipping and aviation action
United Kingdom	**Net zero target and emissions budget:** United Kingdom targets and budgets cover the whole economy, including international shipping and aviation emissions.[282] **Emissions trading scheme:** prices emissions for flights between the United Kingdom, European Union (EU) countries (excluding outermost regions), and Gibraltar.[283] **SAF:** use of SAF required from 2025. Government investment in production will guarantee revenue for producers.[284]
European Union	**Nationally determined contribution:** accounts for some of its international shipping and aviation emissions.[285] **Emissions Trading System:** prices CO_2 emissions of all large ships entering EU ports from January 2024.[286] Prices emissions for flights between countries in the EU and to/from the United Kingdom and Switzerland.[287] Intended to cover all international flights; currently paused due to CORSIA until 2027. **FuelEU Maritime:** requires an 80% reduction in greenhouse gas emissions intensity by international shipping in the EU while sailing, and use of shore power in port by 2050.[288] **ReFuelEU Aviation:** sustainable aviation fuel requirement will be applied to all flights departing EU airports (70% by 2050).[289] **SAF:** subsidising the use of sustainable aviation fuels on a cost recovery basis.[290]
United States of America	**Clean Shipping Act:** seeks to set carbon intensity standards on marine fuels to reach 100% zero emissions fuels by 2040.[291] **Aviation Climate Action Plan:** aims to achieve net zero greenhouse gas emissions from the United States aviation sector by 2050.[292] **SAF:** subsidies of up to NZ$0.75 per litre[xxxvii] on SAF.[293]
Australia	**Federal Budget:** funding for alternative fuels and clean energy technologies to catalyse clean energy supply chains and increase renewable energy.[294] Aligns with Future Fuels and Vehicles Strategy (2021).[295] **Jet Zero Council:** advisory body to achieve net zero aviation emissions and support alternative fuel development.[296] **SAF:** investigating requiring use of SAF.

Other economies that have announced sustainable aviation fuel requirements include Türkiye (from 2025), India (from 2027), Singapore (from 2026), British Columbia in Canada (from 2028), and Japan (from 2030). Development of SAF requirements has also been signalled in other countries, including Thailand and China.[297] **Figure A.1** sets out the policy measures across different countries on international aviation emissions as of October 2024.

xxxvii Converted to NZD per litre from US$1.75 per gallon. Conversion accurate as at 1 October 2024.

Figure A.1: Countries that have mandates, policies or other incentives to increase sustainable aviation fuel




UAE
• National SAF Roadmap
• 1% SAF integration ambition at UAE airports by 2031
China
• 50kt SAF before 2025 in 14th Five Year Plan
• SAF feasibility study
South Korea
• Integration of international SAF standard
• 1% SAF by 2027
Japan
• 10% SAF mandate by 2030
• Working group to encourage SAF production
Taiwan
5% SAF by 2030
Thailand
Investment support and taxes excise expected in 2024
Fiji
Feasibility study on SAF production
India
1% SAF by 2027, 2.5% by 2030, 50% by 2060
Malaysia
• 47% by 2050
• Taskforce formed to promote production of SAF
Singapore
• 1% SAF mandate by 2026 (3–5% by 2030)
• Levy to be put in place on ticket price to finance
Indonesia
1% SAF by 2027, 2.5% by 2030, 50% by 2060
Brunei
Signalled development of SAF targets
Australia
• Jet Zero Council to strategise SAF usage
• Government funding for alternative fuel production
New Zealand
• Feasibility study on SAF
• Sustainable Aviation Aotearoa

Piringa 2 | Appendix 2

He iringa kupu | Technical glossary

Note: there is a te reo Māori glossary provided at the end of *Chapter 2: What we heard,* which provides English contextual translation of kupu Māori used in that chapter.

Technical term	Definition
afforestation	The conversion of land from another use, such as pasture for grazing, to forest.
alternative fuels	Liquid fuels derived from sources other than petroleum or diesel.
biogenic methane	Biogenic methane is all methane emitted in the agriculture and waste sectors, mainly from ruminant animals and decomposing waste (as reported in New Zealand's Greenhouse Gas Inventory).
biofuels	Biofuels are renewable fuels made from biomass, such as ethanol, biodiesel, and renewable hydrocarbons.
biomass	Biomass is organic material from living sources – such as wood and wood waste, crops or animal manure – that can be used as an energy source.
bunker fuels	International shipping and aviation emissions as measured based on refuelling from international fuel bunkers. For international aviation this covers emissions from flights that depart in one country and arrive in a different country. Includes take-offs and landings for these flight stages. For international shipping this covers emissions from fuels used by vessels of all flags that are engaged in international water-borne navigation. The international navigation may take place at sea, on inland lakes and waterways and in coastal waters. Includes emissions from journeys that depart in one country and arrive in a different country. Excludes consumption by fishing vessels.
carbon border adjustment mechanism	A fee or tariff levied on imported goods based on the greenhouse gases emitted during their production.

carbon capture and storage (CCS)	Refers to a suite of technologies that capture carbon dioxide emissions from an industrial or energy-related point source for permanent storage in a biological or geological reservoir. A subset of carbon capture and storage is direct air carbon capture and storage (DACS). This is a technology that removes CO_2 from the atmosphere using electricity and stores it underground or uses it for other purposes.
carbon dioxide removals	See 'removals'
Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)	A global market-based measure to harmonise emissions reductions from international aviation, minimising market distortion, while respecting the special circumstances and respective capabilities of ICAO Member States.
cirrus clouds	Cirrus clouds are short, detached, hair-like clouds found at high altitudes forming from the ascent of dry air, which makes the small quantity of water vapour in the air undergo deposition into ice (to change from a gas directly into a solid). Cirrus is made up completely of ice crystals.
Climate Change Response Act 2002	The Act that establishes the Climate Change Commission and contains the framework for the 2050 emissions reduction target and emissions budgets. It also provides a legal framework to enable Aotearoa New Zealand to meet its international obligations under the United Nations Framework Convention on Climate Change, the Kyoto Protocol and the Paris Agreement; and provides for the implementation of the New Zealand Emissions Trading Scheme (NZ ETS) and the synthetic greenhouse gas levy.
CO_2e	Carbon dioxide equivalent. This is a way to describe different greenhouse gases on a common scale. It relates the warming effect of emissions of a particular gas to that of carbon dioxide, over a specified period of time. It is calculated by multiplying the quantity of that greenhouse gas by the relevant global warming potential (GWP). The current values used are the 100-year GWPs from the Intergovernmental Panel on Climate Change (IPCC) 5th assessment report (AR5), which are shown in short form as GWP_{100}.
Combined Global Temperature Change Potential (CGTP)	An emissions metric that relates an emissions step-change in a short-lived gas to a pulse of carbon dioxide without relying on GWP in its methodology. Instead, the metric directly compares the temperature change of a short-lived gas step-change emission to the temperature change of a carbon dioxide pulse. The metric is in a unit of time because it compares a rate change to an absolute change.
contrails	A streamer of cloud sometimes observed behind an airplane flying in clear cold humid air (appears as a white line left in the sky). A contrail forms when water vapour produced by the combustion of fuel in airplane engines condenses upon soot particles or sulfur aerosols in the plane's exhaust.
decarbonise	To reduce the levels of carbon emissions (such as carbon dioxide) caused by or involved in something, such as an activity or process.

deforestation	The conversion of forest land to another use such as grazing. In greenhouse gas emissions accounting and policy relevant to Aotearoa New Zealand, deforestation is defined as clearing forest and not replanting within four years. It does not include harvesting where a forest is replanted.
demonstration path	A pathway for how Aotearoa New Zealand could meet emissions budgets and the 2050 target. It is a set of measures and action within sectors that could deliver recommended emissions budgets.
direct air capture and storage (DACS)	See 'carbon capture and storage'.
drop-in fuels	Drop-in fuels are a synthetic and completely interchangeable substitute for conventional petroleum-derived hydrocarbons (gasoline, jet fuel, and diesel), meaning it does not require adaptation of the engine or the fuel system. It can be used "as it is" in currently available engines, either blended with conventional fuels, or even in pure form.
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 or CO_2e) that can be released over a five-year period (or four years in the case of the first emissions budget covering 2022–2025).
emissions intensity	The ratio of greenhouse gas emissions to a unit of activity or output. This could be emissions per unit of economic output, such as GDP, to give a measure across an entire economy, or relative to other variables such as per kilometres travelled for modes of transport, or per unit of revenue or of a good produced in firms' production processes, such as per litre of milk solids. Measures of emissions intensity allow comparison of emissions performance across different activities and tracking of progress over time, where changes in economic activity can obscure some types of progress such as efficiency improvements.
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 did not reduce. Emissions leakage risk is created by the uneven implementation of climate policies around the world.
emissions reduction plan (ERP)	A plan setting out the policies and strategies for meeting an emissions budget, as required by the Climate Change Response Act 2002.
energy security	The uninterrupted availability of energy sources at an affordable price.

European Union Emissions Trading System (EU ETS)	Emissions trading is a market-based mechanism that uses price signals to encourage emissions reductions. The EU ETS is based on a 'cap and trade' principle. The cap refers to the limit set on the total amount of GHG that can be emitted by installations and operators covered under the scope of the system. This cap is reduced annually in line with the EU's climate target, ensuring that overall EU emissions decrease over time.
feedstocks	Material inputs to industrial processes needed to manufacture products. Potential sources of low-carbon feedstocks include clean hydrogen, bio-based feedstocks, and end-of-life materials like scrap steel and recycled plastics. These can be used to generate alternative fuels.
GHGs	See 'greenhouse gases'.
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 over a specified period of time. See also 'CO_2e'.
green ammonia	Ammonia produced using renewable energy, and which derives its hydrogen from water and its nitrogen from air.
green hydrogen	Hydrogen produced by splitting water into hydrogen and oxygen using renewable electricity.
green methanol	Methanol produced using carbon dioxide obtained from renewable sources. This includes bioenergy with carbon capture and storage and direct air capture, and green hydrogen (hydrogen produced with renewable electricity).
greenhouse gases (GHGs)	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).
greenhouse gas inventory	A greenhouse gas inventory is the official annual report of all anthropogenic (human induced) emissions and removals of greenhouse gases by countries. See 'New Zealand's Greenhouse Gas Inventory'.
gross domestic product (GDP)	GDP measures the value of a country's economic activity, and is Aotearoa New Zealand's official measure of economic growth.
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.
International Civil Aviation Organization (ICAO)	United Nations agency that coordinates international air navigation and transport standards and practices.

International Maritime Organization (IMO)	United Nations agency that sets global standards for safety, security and environmental performance of international shipping.
Intergovernmental Panel on Climate Change (IPCC)	Intergovernmental panel under the United Nations, which prepares comprehensive Assessment Reports about the state of scientific, technical and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place.
international shipping and aviation emissions	These are greenhouse gas emissions from shipping and aviation to and from Aotearoa New Zealand; they are currently not counted in the country's 2050 target, emissions budgets, or emissions reduction plans which cover only the shipping and aviation emissions related to domestic travel and transport.
Kyoto Protocol	Protocol which operationalised the United Nations Framework Convention on Climate Change by committing industrialised countries and economies in transition to limit and reduce greenhouse gas emissions in accordance with agreed individual targets. The Kyoto Protocol was the predecessor to the Paris Agreement.
ktCH_4	kilotonnes of methane (one Mt is one million tonnes)
limit warming to 1.5°C	When discussing the Paris Agreement, this reflects that agreement set a goal of limiting global warming to well below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit it to 1.5 degrees Celsius. When discussing the Act, this refers to Aotearoa New Zealand contributing to the global effort to limit warming to 1.5 degrees Celsius (1.5°C).
long-lived greenhouse 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, we refer to all greenhouse gases other than biogenic methane collectively as long-lived gases, although this includes a small amount of other short-lived gas emissions (non-biogenic methane and certain fluorinated gases). See also 'short-lived greenhouse gases'.
low-carbon liquid fuels	Fuels that emit significantly lower amounts of carbon dioxide and other greenhouse gases when burned, compared to traditional fossil fuels. These include biofuels (derived from organic materials such as plants, algae, and waste), synthetic fuels (produced from renewable energy sources, water, and carbon dioxide through chemical processes), and advanced biofuels (derived from non-food biomass feedstocks such as agricultural residues and woody crops).
mandatory climate-related disclosures	In 2021, the Government introduced a new regime making climate-related disclosures mandatory for certain large entities (climate reporting entities). Those entities are required to disclose information about climate-related risks and opportunities that could reasonably be expected to affect their cash flows, access to finance or cost of capital over the short, medium, or long terms.

market access	Ability to enter a foreign market by selling goods and services.
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.
model, modelled	Representation of an idea, object, process, or system to describe or explain phenomena that cannot be experienced directly, to discover features of and ascertain facts about a system and its behaviour.
MtCO_2e	Megatonnes of carbon dioxide equivalent (see 'tCO_2e').
nationally determined contribution (NDC)	Each country that is party to the Paris Agreement must define its contribution to achieving the long-term goals set out in the Paris Agreement. The Nationally Determined Contribution of New Zealand (as updated in November 2021) is to reduce net greenhouse gas emissions to 50 per cent below gross 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 through absorption by forests as trees grow.
net negative emissions	net negative emissions is achieved when, as result of human activities, more greenhouse gases are removed from the atmosphere than are emitted into it.
New Zealand Emissions Trading Scheme (NZ ETS)	The NZ ETS is Aotearoa New Zealand's main emissions pricing policy. It creates a market for emissions by requiring certain businesses to acquire and surrender one New Zealand Unit (NZU) for every tonne of CO_2e emitted.
New Zealand's Greenhouse Gas Inventory (GHG Inventory)	Official annual report of all human-induced emissions and removals of greenhouse gases in Aotearoa New Zealand. It is the key source of evidence on Aotearoa New Zealand's greenhouse gas emissions trends. Emissions from fuel sold for use in international transport (e.g. international bunker fuels) are reported separately as a memo item, as required.
non-governmental organisation (NGO)	A voluntary group of individuals or organisations, usually not affiliated with any government, that is formed to provide services or to advocate a public policy.
no additional warming	The term 'no additional warming' is sometimes used to describe an approach in which the warming caused by emissions of a greenhouse gas should be stabilised at current or recent levels.

novel carbon dioxide removal (CDR) techniques	Over 99% of current CDR is from conventional methods including afforestation. Novel methods (non-conventional) include techniques such as biochar, bioenergy with carbon capture and storage (BECCS), and direct air capture with carbon capture and storage (DACCS).
offsetting	Emission reductions or absorption counted toward the efforts of an entity that did not directly reduce or absorb them.
Paris Agreement	An international treaty aimed at post-2020 climate change action that was adopted by Parties to the UNFCCC in December 2015.
Paris Rulebook	Sets the Paris Agreement in motion by laying out the tools and processes that countries should use to enable its full, fair, and effective implementation.
permanence	When relating to removals of carbon dioxide through forestry: the expected duration of the carbon storage.
projections, projected	Estimated value of a future quantity (such as emission levels) based on a prescribed set of assumptions.
radiative forcing	The difference between the amount of energy that enters the Earth's atmosphere and the amount of energy that leaves it. Energy travels in the form of radiation: solar radiation entering the atmosphere from the sun, and infrared radiation exiting as heat. Positive radiative forcing means the planet is getting hotter; negative radiative forcing means it is getting cooler. In our advice, we sometimes refer to radiative forcing impacts as 'other climate impacts'. These are factors contributing to warming not currently covered by the Climate Change Response Act 2002.
removals	The removal of carbon dioxide from the atmosphere, also called sequestration. In Aotearoa New Zealand, this usually refers to absorption of carbon by forests as trees grow.
scenarios (for Commission modelling)	A plausible set of assumptions about economic and social development, and technological and behavioural changes between now and 2075.
shared socioeconomic pathway	IPCC's 6th Assessment Report (2021–22) shifted to a new core set of future representative scenarios, based on Shared Socio-economic Pathways (SSPs). These comprise different socio-economic assumptions that drive future greenhouse gas emissions. The scenarios span a wide range of plausible societal and climatic futures, based on greenhouse gas emissions, that result in the stabilisation of global warming at 1.5°C to over 4°C warming by 2100.
ship to shore power (also called cold ironing)	The power supply given to a boat, ship, or any other maritime vessel when it is docked at the port. This system allows the ship's electrical equipment and machinery to function without using the ship's own generators, minimising resources like fuel and reducing environmental pollution.
short-lived greenhouse gases	Greenhouse gases that have a short lifetime in the atmosphere, typically shorter than two decades – see also 'long-lived greenhouse gases'.

sustainable aviation fuel (SAF)	There are multiple types of sustainable aviation fuel. Some of the more common ones include bio-based aviation fuels – produced from renewable feedstocks like animal fats, waste, and crops or forests without major environmental or land-use impacts, and e-fuels (also called power-to-liquid fuels) – which are created by using renewable electricity and water to produce green hydrogen, and then combining that green hydrogen with CO_2 from the air.
sustainable development	Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.
target accounting	The accounting system used to measure progress towards Aotearoa New Zealand's emissions reduction targets. Target accounting emissions include all gross emissions, but only a subset of emissions and removals from land use and forestry – namely emissions and removals that are the result of recent and future forestry activities. Target accounting is designed to incentivise emissions reductions and to avoid relying on actions that occurred before 1990 (such as forest planting in the 1970s and 1980s) that continue to result in emissions and removals today. It also applies an averaging approach to production forests to smooth out emissions and removals over harvest cycles.
tCO_2e	Tonnes of carbon dioxide equivalent.
Te Tiriti o Waitangi/The Treaty of Waitangi	Aotearoa New Zealand's founding document, signed between Māori and representatives of the British Crown in a series of signing events beginning 6 February 1840. See Schedule 1 of the Treaty of Waitangi Act 1975.
UNFCCC	The United Nations Framework Convention on Climate Change is the major foundation global treaty focused on climate change. It was signed in 1992 at the Earth Summit in Rio de Janeiro.
2050 target	The target set out in the Climate Change Response Act 2002, for Aotearoa New Zealand 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 fluorinated-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. The target does not currently include international shipping and aviation emissions.

Piringa 3 | Appendix 3

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