

## Consistency of NDC1 with efforts to limit global warming to 1.5°C

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## Consistency of NDC1 with efforts to limit global warming to 1.5°C

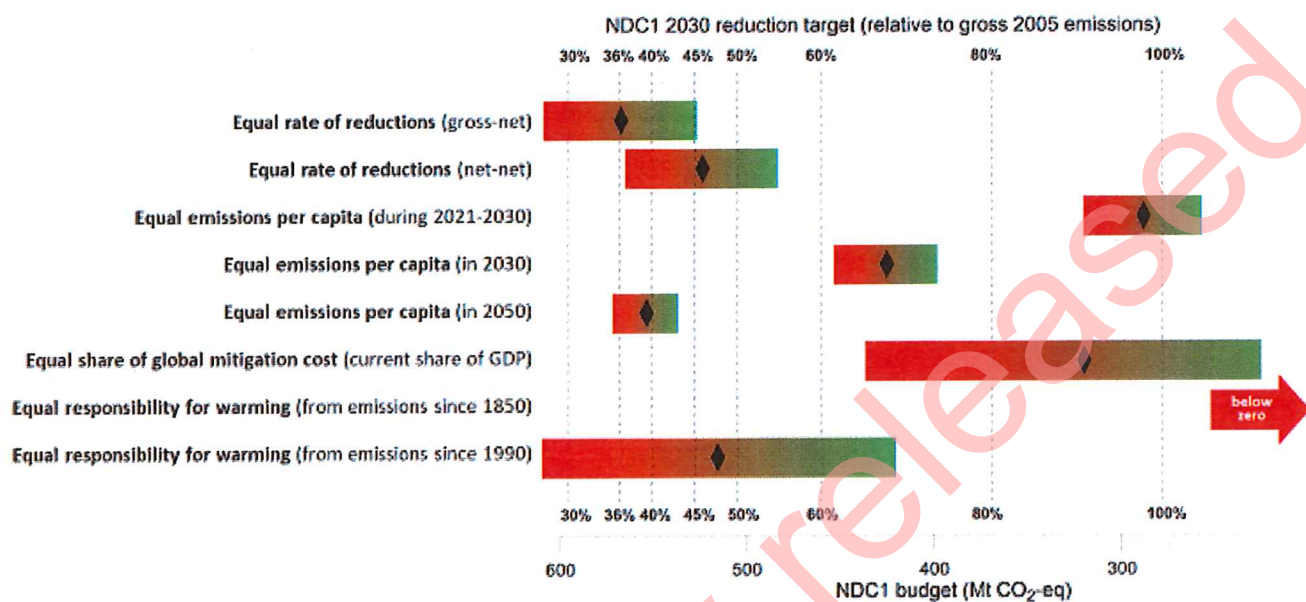
### Key Messages

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1. This paper sets out the key issues and provides illustrative quantifications for New Zealand's first Nationally Determined Contribution (NDC1) to be compatible with the global effort to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels.
2. It follows the Climate Change Commission's (the Commission's) final advice which identified that "science alone cannot determine the share Aotearoa should contribute to those global reductions" (Chapter 21, para 7). In particular the Commission identified three main equity principles which can be used to guide thinking to about sharing the global effort between countries. This briefing is an assessment of those principles to support our advice on an updated NDC (BRF-137 refers).
3. The Climate Change Commission (the Commission) advises that New Zealand's current NDC1 is not compatible with the global 1.5°C goal, and our emission reductions would need to be much more than 36% below gross 2005 levels by 2030 (a budget of much less than 568 Mt CO<sub>2</sub>-eq) to be compatible.
4. The Commission derived the benchmark number of 36% by assuming that New Zealand's emissions should reduce at the same rate as global emissions of those gases in pathways consistent with 1.5°C. The Commission notes, however, that this is only a starting point.
5. Given New Zealand's status as a highly developed country and taking global equity into account, the Commission considers that our emissions should reduce at a greater rate than the global average, but it did not quantify how much greater those reductions should be.
6. This briefing applies equity considerations to assess the question of what NDC1 budget for New Zealand would be consistent with limiting warming to 1.5°C. That is, for the total *global* emissions indicated by science, what New Zealand's "fair share" of those global emissions would be for the NDC1 budget period 2021-2030.
7. There is no single measure of equity – rather there are multiple lenses through which equity can be viewed. Simple global equity lenses include:
  - **equal** rate of emission reductions
  - **equality** (equal emissions per capita)
  - **capacity** (equal share of the global cost of mitigation)
  - **responsibility** (equal overall responsibility for global warming including from historical emissions)
  - **need** (equal right to sustainable development).
8. This briefing provides illustrative quantifications of NDC1 budgets that might be deemed "consistent with" limiting warming to 1.5°C under these approaches. None of these approaches is inherently superior from a scientific perspective but reflect different value judgements. Each gives a different answer for New Zealand's "fair share" budget.
9. When viewed through any of these global lenses, our assessment indicates that our current NDC1 budget is higher (i.e. allows New Zealand to emit more) than would be considered equitable, but by how much depends on the equity lens. Key results are summarised in Figure 1.
10. Note that results also depend on specific assumptions about data and methodologies. The averages and ranges provided in this briefing should therefore be seen as illustrative only.

Alternative assumptions could change the specific numbers but would be unlikely to change the overall picture.

**Illustrative ranges of NDC1 budgets and 2030 reduction targets that would be consistent with 1.5°C based on different equity principles.**



Note: NDC1 budgets and 2030 reduction targets are expressed using the same methodology as for the current NDC1 and used in the Commission’s final advice. Greenhouse gases are aggregated using Global Warming Potentials from the IPCC’s Fourth Assessment Report (AR4).

11. Our analysis is not dependent on the domestic cost of abatement or comparisons of this cost to the global cost of abatement. The NDC is a responsibility target, and New Zealand has stated that the use of offshore abatement is an option for meeting its NDC1 target. If the cost of domestic abatement is higher than in the global average, this might motivate shifting the balance between domestic and offshore abatement, but it does not change what overall level of abatement in our NDC1 might be deemed consistent with 1.5°C based on those global equity lenses.
12. We emphasise that none of those measures fully reflect national circumstances. National circumstances are a complex amalgamation of New Zealand’s geographical and climate features, and social, cultural and economic factors. Some of those are out of New Zealand’s control, while others are subject to policy intervention over time. National circumstances relevant to NDC1 also include the acceptability of the cost and feasibility of New Zealand being able to meet NDC1. New Zealand’s highest possible ambition for its NDC1 will depend on a range of global equity considerations as well as its specific national circumstances, consistent with the expectations set out in the Paris Agreement<sup>1</sup>.
13. The analysis in this paper only compares New Zealand with global 1.5°C-consistent emissions; it does not compare New Zealand with actual policies or targets by other countries. Actual policies and targets do not currently put the world on track to limit warming

<sup>1</sup> Article 4, paragraph 3 states each Party’s successive nationally determined contribution will represent a progression beyond the Party’s then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

to 1.5°C or even well below 2°C. In parallel to this paper, we are providing you with separate information looking at where New Zealand's NDC1 sits relative to other countries' targets.

14. Some stakeholders (section 5 of the briefing) consider that "not adding further warming" is a plausible overall objective for New Zealand's mitigation efforts. Our analysis indicates that such an objective, if taken as a general principle to determine each country's appropriate mitigation effort, would not be compatible with any of the global equity lenses of equality, capacity, responsibility or the right to sustainable development. Not adding further warming is a relevant milestone for countries within the global goal of halting global warming at any level, but it does not in itself represent an equitable distribution of emission reduction efforts across countries.

## Recommendations

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15. We recommend that you:

- a. **Note** that this briefing is part of a package of material relating to the possible update of New Zealand's NDC1

Yes/No

- b. **Note** that the Climate Change Commission (the Commission) advised that our current NDC1 is not compatible with the global effort to limit warming to 1.5°C, and that a reduction of much below 36% below 2005 levels would be required by 2030 to make it compatible

Yes/No

- c. **Note** that the Commission did not advise on how much below 36% our NDC1 should be to make it compatible with 1.5°C, as it considered that relevant equity judgements and other considerations were a task for the Government of the day

Yes/No

- d. **Note** that this briefing provides illustrative quantifications of NDC1 emission budgets and reduction targets that would be consistent with global efforts to limit warming to 1.5°C based on a range of simple global equity principles

Yes/No

- e. **Note** that the Paris Agreement does not prescribe specific equity principles and recognises that a country's highest possible ambition for its successive NDCs will need to reflect its national circumstances

Yes/No

- f. **Note** that the simple global equity principles used in this analysis do not capture details of our national circumstances, which are the subject of separate advice

Yes/No

- g. **Agree** that this briefing and appendices will be released proactively on the Ministry for the Environment's website after final Cabinet decisions have been made on updating NDC1

Yes/No

**Signature**

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 10/06/21

Craig Salmon  
**Chief Advisor**  
**Climate Change**

Hon James Shaw  
**Minister for Climate Change**

**Date**

Proactively released

## Consistency of NDC1 with efforts to limit global warming to 1.5°C

### Supporting material

#### Purpose

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1. The purpose of this advice is to set out the key issues and provide illustrative quantifications for New Zealand's NDC1 to be consistent with 1.5°C.
2. This advice builds on the conclusions from the Climate Change Commission (the Commission), which found that our NDC1 would have to reduce emissions much more than 36% below gross 2005 levels by 2030 if it wanted to be compatible with 1.5°C. However, the Commission did not quantify how much below 36% the NDC should be, as it considered that weighing up equity criteria and other considerations was the task of the Government of the day.
3. This advice draws on the global emissions reductions that would limit warming to 1.5°C contained in the Special Report on Global Warming of 1.5°C of the Intergovernmental Panel on Climate Change (IPCC). It then applies a range of simple global equity criteria to determine the NDC1 emissions budget for New Zealand that could be seen as consistent with the global effort required for 1.5°C from those perspectives.
4. This analysis does not consider New Zealand's more specific national circumstances, such as the structure of its economy and society and domestic climate policy architecture, or the most effective way of achieving global emissions reductions. These matters are relevant for considering what might constitute New Zealand's highest possible ambition for its NDC1, including risks and feasibility, and are discussed elsewhere.
5. This analysis only compares New Zealand with global 1.5°C-consistent emissions; it does not compare New Zealand with actual policies or targets by other countries. Actual emission targets, let alone current policies, do not put the world on track to limit warming to 1.5°C or even well below 2°C. This briefing does not address the question of how different emissions budgets for NDC1 compare with the NDCs of other countries.

#### Context

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##### *The IPCC Special Report: Global Warming of 1.5°C*

6. The IPCC Special Report on Global Warming of 1.5 Degrees (SR15) sets out global emission pathways that would limit global warming to 1.5°C above pre-industrial levels. This report was completed in 2018 and represents the most up-to-date comprehensive information on how the world could achieve this ambitious goal.
7. Overarching conclusions from the SR15 are that limiting warming to 1.5°C would require global CO<sub>2</sub> emissions to reach net zero by about 2050 along with deep reductions of other greenhouse gases. This would result in global temperature peaking around 2050.
8. Most pathways to 1.5°C anticipate a temporary overshoot of the 1.5°C limit and rely on further emission reductions beyond 2050 (with carbon dioxide removals exceeding emissions globally) to gradually return warming to below 1.5°C before 2100. The main reason for this overshoot is that, given current emission levels and trends, most economic models consider it infeasible to reduce global emissions rapidly enough to avoid warming of 1.5°C entirely. Pathways that show no or only a limited overshoot of no more than 0.1°C are referred to as '1.5°C-consistent' pathways in the remainder of this analysis.
9. The weaker global mitigation efforts are in the near term, the greater the likelihood of a more substantial and extended exceedance of 1.5°C, and the greater the need for even

stronger reductions and more carbon dioxide removal beyond 2050 to return to 1.5°C.

10. Exceeding warming of 1.5°C, even if only temporarily, increases risks and damages to ecosystems and society. However, 1.5°C is not a scientific threshold. Risks and impacts increase along a continuum with every amount of warming and every year that emissions continue. This has been summarised in the foreword to the SR15 as “Every bit of warming matters, every year matters, every choice matters”.
11. Recent update reports issued by the United Nations Environment Programme (UNEP) (e.g. the annual emissions gap report, and a dedicated report on methane) do not substantially change this overall picture, but emphasise the fact that current global emissions trends and mitigation efforts are not on track to limit warming to 1.5°C. Estimated global emissions in 2019 reached an all-time high of over 59 Gt CO<sub>2</sub>-eq, well above the emissions assumed in global economic models assessed in the SR15. Despite a temporary dip global emissions in 2020, economic recovery is expected to lift emissions back to near pre-Covid levels.

*The role of different sectors and gases in modelled global pathways to limit warming to 1.5°C*

12. Detailed emissions pathways for specific gases and sectors reported in SR15 are based on global economic models. Such emissions pathways limit warming to 1.5°C at the least global cost, based on assumptions about abatement potentials in different sectors and some societal constraints (such as food demand and availability of land to provide carbon removals). Different models can give different answers about the balance between:
  - a. the rate of reduction of gross CO<sub>2</sub> emissions
  - b. the rate of CO<sub>2</sub> removal (via afforestation or novel technologies)
  - c. the rate of reduction of non-CO<sub>2</sub> emissions (methane, nitrous oxide, fluorinated gases).
13. Based on a range of assumptions in different models, emissions pathways assessed in SR15 reduce global net CO<sub>2</sub> to zero by about 2050 and agricultural methane emissions by 24-47% below 2010 levels by 2050. The range reflects differing assumptions in global economic models while limiting warming to 1.5°C at least global cost.
14. Methane emissions do not decline to zero in those pathways because economic models assume that there are fewer and more expensive options than for other gases. Those models recognise that methane is a short-lived gas, but if it were cheap to reduce methane, models would reduce it to zero as this would avoid more expensive abatement in other sectors. For this reason, fossil methane emissions (which can be avoided often at low or even no cost) are reduced much more than biogenic emissions in 1.5°C-consistent pathways. Box 1 elaborates on the different contributions of long and short lived gases.
15. To recognise the different trajectories of different gases in global emission pathways, and to reflect their different abatement costs and potentials, the equity analyses in this briefing are undertaken on a gas-by-gas basis where possible. That is, the global emissions for each greenhouse gas are obtained from the IPCC SR15 scenarios, the different equity lenses are applied to derive a share of those global emissions for New Zealand, then these are amalgamated into an overall budget.

### Box 1: The different contributions of long- and short-lived gases to global warming

- All greenhouse gases contribute to warming of the atmosphere, but their emissions and abatements have different effects over time.
- Some greenhouse gases remain in the atmosphere for centuries to millennia. Carbon dioxide is a key example, but nitrous oxide also has a lifetime of more than one century. Emissions of these gases build up in the atmosphere so that overall warming at a given point in time largely reflects the cumulative emissions of those gases up to that point. Past emissions of carbon dioxide and nitrous oxide during the 19<sup>th</sup> and 20<sup>th</sup> century will still contribute to global warming in 2050; emissions between now and 2050 will add further to this warming.
- Reaching global net-zero emissions of long-lived gases is necessary to limit warming at any level; the sooner this point is reached, the less warming will occur overall.
- Other greenhouse gases have shorter lifetimes of years to decades. Methane is a key example. The warming caused by emissions of these gases at any given point in time depends mainly on their rate of emissions over the preceding few decades; methane emissions during the 19<sup>th</sup> or 20<sup>th</sup> century will contribute very little to warming in 2050. Most of the warming in 2050 from methane will come from emissions that have yet to occur.
- Emissions of short-lived gases do not need to be reduced to zero to limit warming, but the lower the global rate of future emissions, the less warming will occur overall.
- For a global goal of limiting warming to 1.5°C, peak temperature would need to be reached around 2050. Despite their differences, emissions of short- and long-lived gases are similar in that every emission from now on will make Earth warmer in 2050 than it would be otherwise, and every emission avoided will reduce the amount of warming that Earth will experience.
- Globally, overall warming is dominated by carbon dioxide emissions. Reaching net-zero carbon dioxide emissions as soon as possible is therefore the primary global goal. However, methane mitigation is a crucial additional measure to limit warming to 1.5°C.
- Greater sustained reductions of short-lived gases do not avoid the need for net-zero emissions of long-lived gases but allow this point to be reached later. Vice versa, weaker reductions of short-lived gases requires net-zero emissions of long-lived gases to be reached earlier to remain within the same warming limit.

#### *The Commission's advice on the compatibility of NDC1 with 1.5°C*

1. In 2020, you requested advice from the Commission on:
  - a. whether the NDC1 is compatible with contributing to global efforts to limit global average temperature rise to 1.5°C above pre-industrial levels
  - b. recommendations on any changes to the NDC required to ensure it is compatible with global efforts to limit global average temperature rise to 1.5°C.
2. In its final advice, the Commission concludes that New Zealand's current NDC1 (30% reduction on 2005 emissions) is not compatible with contributing to the global 1.5°C effort.
3. The Commission advises that making the NDC1 compatible with 1.5°C would require it to be strengthened to 'much more than 36% below 2005 gross levels by 2030'. This is a minor change from the draft advice (35%) due to methodological changes in the underlying data and does not represent a change in recommended ambition. A reduction of 36% equates to an NDC1 emission budget of 568 Mt CO<sub>2</sub>-eq during 2021-2030.
4. There are significant variations across different global emission pathways that would all limit warming to 1.5°C. The Commission captured this uncertainty by using the interquartile range of scenarios in the SR15 rather than just one central scenario. This results in a range of 1.5°C-consistent NDC1 budgets for New Zealand between 527 and 608 Mt CO<sub>2</sub>-eq. A budget of 527 Mt CO<sub>2</sub>-eq (i.e. the lower end of the range) would translate into a headline

reduction target of 45%. Figure 21.2 from the Commission's final report (copied below) shows where the -36% and -45% figures sit relative to the current NDC1.



Figure 21.2: The current NDC and NDC targets associated with the IPCC 1.5°C interquartile range

5. The Commission used the global emission reduction rates between 2010 and 2030 for carbon dioxide, agricultural methane, nitrous oxide, and synthetic gases separately, and applied the same reductions to New Zealand's emissions to arrive at the 36% figure.
6. In the global aggregate, greenhouse gases reduce by 39-55% by 2030 in 1.5°C-consistent pathways. The rate of 36% is less because of New Zealand's specific emissions profile. Globally, carbon dioxide emissions from the energy sector are dominant and reduce rapidly in 1.5°C-consistent pathways, while agricultural emissions of methane and nitrous oxide reduce less. Given the large share of agricultural emissions in our emissions profile, applying the global reduction rates for each gas and major source separately results in a lesser overall rate of reduction for New Zealand than in the global average.
7. The Commission presented its advice on the NDC using conversion factors (for the contribution of emissions of different gases to global warming) from the 4th Assessment Report of the IPCC (AR4), but has recommended that the Government set its enhanced NDC using values from the 5th Assessment Report (AR5). Updating the NDC to AR5 factors will not significantly affect percentage reductions, but will increase the NDC budget number associated for a given level of mitigation effort. The Commission presented its final advice on domestic budget quantities in the AR5 metric. The use of AR5 for the NDC would be the same as what New Zealand is required to use for its GHG inventory reporting. The analysis in this paper uses Global Warming Potentials from the AR4 for consistency with the final advice from the Commission.

#### *Remaining questions following the Commission's advice*

8. The Commission quantified only one interpretation of consistency with 1.5°C, namely that the percentage reductions for each gas in New Zealand should mirror the global rate of reductions of those gases and key sectors in 1.5°C-consistent emission pathways.
9. The Commission states explicitly that applying the same rate of emissions reductions across all countries is *not an equitable* approach. The Commission discusses other equity perspectives, including equality, historical responsibility and capability/need, but does not quantify those other perspectives. It notes that from most of those equity perspectives, New Zealand should do more than the global average rate of reductions.
10. These qualitative considerations underpin the Commission's final advice that for New Zealand's NDC1 to be compatible with global efforts to limit warming to 1.5°C, a reduction of net emissions of 'much more than 36 per cent' below gross 2005 levels by 2030 would be required, i.e. a NDC budget much below 568 Mt CO<sub>2</sub>-eq.
11. The Commission did not quantify how much below 568 Mt CO<sub>2</sub>-eq New Zealand's NDC1 budget should be, as it considers that equity perspectives and other factors need to be weighed up by the Government of the day.

## Analysis and Advice

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12. This briefing applies a range of simple global equity considerations to assess the question of what NDC1 budget for New Zealand would be consistent with global efforts to limit warming to 1.5°C. That is, for the total global emissions indicated by science, what would be New Zealand's "fair share" of those global emissions for the budget period 2021-2030.
13. This advice is structured in five sections:
  - a. section 1 provides an overview of what 'consistency with 1.5°C' means and the role of equity and value judgements in determining consistency of national actions with a global goal, including more detailed advice from the Commission on this
  - b. section 2 discusses how the global equity principles of equality, capacity, responsibility, and right to sustainable development could be applied to determine emission budgets consistent with 1.5°C
  - c. section 3 provides illustrative quantifications of our NDC1 budget on the basis of those global equity principles
  - d. section 4 explains how equity-based emission budgets can be translated into NDC1 budgets that match the target accounting approach that New Zealand adopted when it set its current NDC1
  - e. section 5 provides a brief summary of results from other analyses and stakeholder perspectives on equity considerations, including the role of national circumstances to determine New Zealand's 'fair share'.

### Section 1: What does it mean for our actions to be 'consistent with' 1.5°C

*There is no scientific way to define consistency with 1.5°C*

14. Limiting warming to 1.5°C is a zero-sum problem: if one sector, gas or world region reduces its emissions by less than indicated in modelled global pathways, emissions of the same or another gas, sector or region have to reduce by more than modelled in those same pathways for the world to remain within the same overall warming limit.
15. Physical climate science cannot prescribe how the emissions reduction effort should be allocated between countries. The SR15 pathways set out what the world as a whole needs to do to meet the 1.5°C goal, and what least cost strategies might be, but the modelled pathways alone cannot tell us an individual country's *equitable* contribution.
16. The question of what national-level of emissions reduction is consistent with limiting warming to 1.5°C depends on the assumptions one makes about how mitigation effort should be distributed between countries globally.
17. This allocation depends almost entirely on value judgements relating to equity, i.e. in which way a country wishes to be consistent with the necessary global effort. This assumes that all other countries should also adopt the same principle for the global goal to be met.
18. Various approaches have been used in the international literature. There is no single measure of equity to guide countries decisions - rather there are multiple lenses through which equity can be viewed, for example:
  - a. the same percentage rate of emission reductions
  - b. the same future level of emissions per capita
  - c. the same contribution to the global cost of mitigation
  - d. the same contribution per capita to global warming including from past emissions.

19. Each of these approaches, if followed by all countries, would result in the same global emissions and warming. None of these principles is superior from a physical climate science perspective, but the distribution of emissions across countries would differ markedly and each country will inevitably have different views in this.
20. These approaches to determining 'consistency' with 1.5°C reflect only a limited set of details about individual countries, namely their per capita emissions, their capacity to pay for the cost of mitigation, and the contribution to future warming from historical emissions.
21. National circumstances will be necessary to inform a broader judgement. The Paris Agreement states that NDCs should represent a country's "*highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances*". These provisions go well beyond simple equity metrics such as per capita emissions or capacity to pay. In the case of New Zealand, relevant national circumstances include the nature of our economy, society and environment; abatement costs and potential for transformational change; existing climate policy architecture and feasible changes during NDC1 as well as future NDCs; and the availability and environmental integrity of offshore abatement to complement domestic mitigation efforts to achieve a more stringent target by 2030.

*What does the Commission's analysis tell us about consistency from an equity perspective?*

22. The Commission's quantitative analysis could be viewed as one interpretation of the principle of 'equality', i.e. each country undertaking equal rates of reductions. This approach invokes grandfathering as principle: countries with higher than average absolute emissions in the past would be able to have higher than average emissions in future, whereas those with lower than average emissions in the past would be required to have lower than average emissions in future.
23. For these reasons, an equal rate of reduction across all countries is seen by many scholars as inherently inequitable as it directly contradicts other principles such as every person having the same right of access to the atmosphere. Using the lower range rather than mid-point of the NDC budgets provided by the Commission (i.e. 527 rather than 568 Mt CO<sub>2</sub>-eq) does not introduce any additional equity principle; it only reflects the uncertainty range for the rate of reductions found across global emission scenarios consistent with 1.5°C.
24. The Commission applied a gross-net approach in its quantitative analysis: it calculated the rate of reductions for carbon dioxide by comparing New Zealand's net emissions in 2030<sup>2</sup> with gross emissions in 2010, and relating this to the rate of reductions of global net carbon dioxide emissions between 2010 and 2030 (which are on a net-net basis). The reason the Commission gives for this approach is that removals in New Zealand in 2010 due to past afforestation measures do not provide on-going removals, and hence on-going planting would be required merely to sustain that level of net emissions. Using net emissions in 2010 as reference point for the required reductions by the year 2030 would therefore constitute an undue burden.
25. The Commission's approach embodies an additional value judgement about how past efforts should be treated when allocating future responsibilities among countries. An alternative approach would be to apply the global rate of net carbon dioxide emissions reductions to New Zealand's net carbon dioxide emissions both in 2010 and 2030. This would represent the downside of grandfathering, that a country with low emissions in the past would be required to have even lower emissions in future. Using this alternative method would result in a lower NDC1 budget consistent with 1.5°C (quantified below).
26. The Commission frames 36% as a "starting point" to assess the compatibility with 1.5°C and suggests that other considerations should be overlaid on this. However, even the 36% starting point is not value-neutral but already contains strong value judgements about how

<sup>2</sup> Using a subset of removals generated by forests planted after 1989, as used in gross-net target accounting.

the global effort should be distributed to reach this starting point. This paper therefore applies a range of other global equity principles to broaden the perspective on what NDC1 budgets might be considered consistent with 1.5°C.

*Key equity perspectives that can be used to determine consistency with the global effort needed*

27. Equity perspectives to inform consistency of national actions with a global goal have been widely discussed in international literature. They can be grouped into four broad categories:
- a. equality
  - b. capability
  - c. responsibility
  - d. need (the right to sustainable development).
28. These perspectives are consistent with, but not prescribed specifically by the Paris Agreement, which states that it will be *“implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances”*. Other relevant provisions relating to equity include:
- a. the recognition that peaking emissions will take longer for developing countries,
  - b. that the pursuit of net-zero global emissions should occur *“on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty”*,
  - c. that developed countries should *“continue taking the lead”* by undertaking economy-wide absolute emission reduction targets,
  - d. an encouragement for countries, as part of the adoption of the Agreement, to state *“how the Party considers that its nationally determined contribution is fair and ambitious, in the light of its national circumstances”*.

The preamble to the United Nations Framework Convention on Climate Change (UNFCCC) also notes that *“the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs”*.

## **Section 2: Application of global equity principles to mitigation efforts**

29. The principles of equality, capacity (to pay for the cost of mitigation), responsibility (for warming already caused by past emissions), and need (the right to sustainable development) can be applied to inform what emissions budget over the period 2021-2030 from New Zealand might be viewed as ‘consistent with’ 1.5°C.
30. We emphasise that there is no single way in which any given equity principle could be applied. Different approaches and data sources are possible and this can affect what NDC budget might then be considered as “consistent with” 1.5°C. The approaches outlined should merely be seen as illustrative of how each principle could be interpreted.

### **Equality**

31. Equality can be broadly interpreted as each global citizen having equal right of access to the atmosphere to dispose of greenhouse gas emissions. This is generally interpreted as meaning equal per capita emissions (an equal right to pollute). Based on this principle, New Zealand’s NDC1 would be consistent with 1.5°C if our per capita emissions are consistent with the global average per capita emissions in 1.5°C pathways.
32. This principle can be applied separately for individual gases to account for national circumstances in terms of differing emission profiles. A separate judgement is then required whether a country should have equal per capita emissions of each gas, or only in the aggregate of different gases. Since every emission of every greenhouse gas causes the

world to be warmer than it would be without this emission, higher emissions of one gas would require lower emissions of another gas for overall equality to be achieved. The relatively short lifetime of methane does not change this fundamental trade-off, although the magnitude of the trade-off depends on the exchange metric used (e.g. GWP100).

33. A critical judgement is when such equality should be achieved. The most stringent requirement would be for per capita emissions during 2021-2030 to be consistent with global average per capita emissions in 1.5°C pathways. However, given that reaching equal per capita emissions will take time for currently high emitters, an argument can be made that per capita emissions should converge with global average emissions only in 2030 or in 2050 (coinciding roughly with global peak temperature in 1.5°C pathways).
34. A later date for equal per capita emissions implies that countries with currently higher than average per capita emissions have greater access to the atmosphere in the near term than those who are currently low emitters. The reasons for this could be different geographical or climate features, or cost or social disruption from a too rapid adjustment. However, achieving global emissions consistent with 1.5°C would then require other countries to remain below global average per capita emissions for the same period.
35. The 1.5°C-consistent NDC1 budget for New Zealand can then be calculated either directly from global 1.5°C-consistent per capita emissions during 2021-2030, or by assuming a linear change in New Zealand's per capita emissions from their current levels to the time when our per capita emissions should converge with global 1.5°C-consistent emissions.
36. For context, Table 1 compares New Zealand's per capita emissions with global average per capita emissions in 2019 and in 2030 in 1.5°C-consistent emission pathways. New Zealand's current gross per capita emissions of CO<sub>2</sub> are fifty percent above the global average, and about five times the global average for methane (from all sources i.e. including fossil methane) and nitrous oxide. If only agricultural emissions are compared, New Zealand's agricultural methane emissions are nearly ten times the global average.
37. By contrast, net CO<sub>2</sub> and net long-lived greenhouse gas emissions are well below the global average, reflecting the significant on-going forestry removals in New Zealand.

**Table 1: New Zealand and global per capita emissions**

per capita emissions	New Zealand 2019	Global 2019	Global 2030 (1.5°C)
gross all gases (tCO <sub>2</sub> -eq/capita)	16.7	6.9	3.2
net all gases (tCO <sub>2</sub> -eq/capita)	11.2	7.8	3.2
net CO <sub>2</sub> + N <sub>2</sub> O (tCO <sub>2</sub> -eq/capita)	3.7	6.2	2.7
gross CO <sub>2</sub> (tCO <sub>2</sub> /capita)	7.6	4.9	2.4
net CO <sub>2</sub> (tCO <sub>2</sub> /capita)	2.0	5.7	2.4
gross CH <sub>4</sub> (kg CH <sub>4</sub> /capita)	281	50	26
gross N <sub>2</sub> O (kg N <sub>2</sub> O/capita)	5.7	1.2	1.0

Global data for 2019 are from UNEP 2020 Emissions Gap Report, and for 2030 from SR15. New Zealand emissions for 2019 are from the 2021 emissions inventory, i.e. use inventory-based removals as this more closely resembles the way that global removals are calculated. New Zealand emissions are marked red if they are above the global average today and in 1.5°C-consistent pathways in 2030, orange if they are below currently but above the level in 2030, and green if they are below both now and in 2030.

## Capacity

38. Capacity in the context of climate change equity is generally regarded as 'capacity to pay for the cost of mitigation', and treating mitigation of emissions as a collective global task.

Based on this principle, New Zealand's NDC would be consistent with 1.5°C if our share of the *global* abatement necessary by 2030 to achieve 1.5°C-consistent emission pathways reflects our share in *global* wealth.

39. This approach assumes that countries should contribute to mitigation wherever it is possible globally, not only at home, and to determine their contribution to global mitigation based solely on their financial capacity to do so. This means that even if a country already has very low emissions domestically but is wealthy, it still has an obligation to support further emission reductions globally – simply because it is more able to do so than others who may have higher emissions but lower capacity to pay for the cost of reductions.
40. Important questions relate to how the 'capacity' to pay would be measured. A simple common metric is gross domestic product (GDP), as this can be measured reasonably consistently across countries. However, GDP does not necessarily reflect the 'capacity' to pay for mitigation. A more suitable metric reflecting capacity could be the real gross national disposable income (RGNDI), but this is not readily defined globally. A systematic shortcoming of any such aggregate metric is that they do not capture inequalities within countries, which could be exacerbated by some mitigation measures.
41. Choices also arise regarding whether countries with very low GDP or RGNDI per capita should be exempt from contributing to the cost of mitigation. Such considerations introduce significant additional judgements into how this principle is interpreted in practice.
42. Another important choice is how to describe the global abatement task. For the purpose of this advice, we use the difference over 2021-2030 between global emissions projected under current policies and in 1.5°C-consistent pathways. This difference is also often referred to as the 'emissions gap'. New Zealand's share of the global abatement task would then be given by multiplying this global mitigation task by its share in global GDP.
43. This approach would likely be regarded as unfair by countries that already have ambitious mitigation policies in place, because they are facing high costs under their own current policies already or may have already undergone transformative changes to reduce their own emissions. This could be addressed by reducing the abatement share for a country based on the cost of its existing climate policies, or based on the reductions it has already achieved. However, estimating the costs on an economy from existing policies as well as globally, or the emissions that would have occurred without any past climate policy, is highly subjective. We have therefore not used this more complex approach.
44. For context, the global emissions gap over 2021-2030 is in the range of 125-215 Gt CO<sub>2</sub>-eq based on the latest UNEP emissions gap report. These estimates reflect various assumptions of the emissions that would arise over 2021-2030 in the absence of additional policies and the global emissions consistent with limiting warming to 1.5°C.
45. New Zealand's share of global GDP (expressed in constant 2010 US dollars) is 0.23% in 2019, much greater than its current share of the global population of 0.067%. This means that under the principle of capacity to pay, New Zealand's NDC1 would have to deliver emission reductions (domestically or offshore), over and above those achieved by existing policies, between 282 and 486 Mt CO<sub>2</sub>-eq to be consistent with 1.5°C. For comparison, the 'demonstration path' in the Commission's final advice achieves a domestic reduction of 43 Mt CO<sub>2</sub>-eq across 2021-2030.

### **Responsibility**

46. The concept of responsibility means that countries are held responsible not only for the contribution of future emissions but also past emissions to future global warming. Based on this principle, New Zealand's NDC1 would be consistent with 1.5°C if the total contribution of our historical and future emissions to global warming of 1.5°C reflects our share of the global population.

47. The absolute of warming that would constitute our fair share is necessarily very small. New Zealand's share of the global population is currently about 0.067%. This implies that New Zealand's responsibility-based contribution to global warming from its past and future emissions up to about 2050 (which is roughly when temperature would peak in 1.5°C-consistent pathways) should be no more than 0.001°C. This amount of warming would not be noticeable in practical terms on a global scale, but the same can be said for any contribution that New Zealand makes to global emissions or mitigation efforts. Collectively, small emitters contribute a relevant share to global emissions.
48. A critical decision is how far back in time the responsibility for historical emissions should stretch. The limit of 1.5°C is stated relative to pre-industrial temperature levels, but this does not imply that responsibility for past emissions must also start at that point in time.
- There is some justification in starting responsibility during the late 18<sup>th</sup> or early 19<sup>th</sup> century. Carbon dioxide emissions during that time (mostly from developed countries) are limiting the remaining emissions that can still occur globally from now until 2050 to remain below 1.5°C. The fact that developed countries did not know about climate change in the 19<sup>th</sup> century does not necessarily exempt them from taking responsibility for those emissions, especially given that those past emissions fuelled the economic development of those countries.
  - Another option is to start responsibility only in 1990, given that this marks the first IPCC report on climate change and is currently the reference year used for emissions reporting under the UNFCCC.
49. In the case of New Zealand, historical CO<sub>2</sub> emissions occurred not only from fossil fuel use, as in most developed countries, but also from significant deforestation. <sup>s 9(2)(g)(i)</sup>  
<sup>s 9(2)(g)(i)</sup> [REDACTED] Apart from resulting in large historical emissions, these periods of deforestation also influence New Zealand's emissions and mitigation options today. A key reason for the currently large CO<sub>2</sub> removal rates from forestry, and hence low net CO<sub>2</sub> emissions shown in Table 1, is that land that was deforested in the two centuries prior can now be replanted.
50. These opposing trends result in very different contributions from New Zealand's historical contribution to global warming, depending on the starting year chosen (see Table 2). New Zealand's cumulative historical net CO<sub>2</sub> emissions since 1850 are almost three times the global average. By contrast, our cumulative net CO<sub>2</sub> emissions since 1990 are less than one third of the global average over that period. Cumulative gross CO<sub>2</sub> emissions, reflecting New Zealand's high rate of fossil fuel use similar to most other developed countries, exceed the global average consistently by about two thirds over both periods.
51. Other choices relate to whether New Zealand's responsibility share of global warming should be determined its current share of global population, or the average share over historical or future time periods.

**Table 2: New Zealand and global cumulative CO<sub>2</sub> emissions since 1850 and 1990**

Cumulative CO <sub>2</sub> emissions per capita (Mt)	New Zealand	Global	ratio NZ/global
Gross, 1850-2019	357	219	1.7
Gross, 1990-2019	194	116	1.7
Net, 1850-2019	843	319	2.6
Net, 1990-2019	42	137	0.3

Emissions are expressed in per capita terms to allow a comparison with global emissions, using 2021 population estimates. Global cumulative emissions are from the Global Carbon Budget 2020. New Zealand's estimated historical net CO<sub>2</sub> emissions are derived from land cover estimates provided by Manaaki Whenua Landcare Research to the Parliamentary Commissioner for the

Environment in support of the report "Farms, forests, fossil fuels" released in 2019. There is significant uncertainty about the share of historical emissions that occurred after European arrival but before or after 1850. This can influence numbers significantly if the starting year is 1850 but would not substantially alter the overall picture.

### The right to sustainable development

52. A key aspect of equity is that only individuals that are actually similar should be treated similarly, but individuals that are different should be treated differently. The right to sustainable development seeks to give effect to this differentiation, by recognising that countries are *not* all equal now nor in 2050. For example, the ability of some countries to meet Sustainable Development Goals, in particular poverty eradication and food security, could be put at risk if their mitigation goals are set by the same principle (e.g. equal share of cost, equal rate of reduction) as for highly developed countries.
53. The general implication of this principle is that the most developed countries should take a larger share of the global burden than indicated by either of the equity dimensions of equal per capita emissions, capacity, and responsibility.
54. However, it is challenging to quantify how much the mitigation burden would shift if this principle is applied. The development needs and their implications for emissions depend on a large number of factors, including local implementation and priorities in different countries. There is no agreed metric.
55. We have therefore not attempted to quantify this principle in Section 3 below. However, New Zealand clearly is a highly developed country compared to the global average. Qualitatively therefore, this principle tends to further reduce New Zealand's 1.5°C-consistent NDC1 budget relative to budgets derived from the other three equity principles.
56. The right to sustainable development applies not only between but also within countries. Undertaking much more stringent emission reductions could have an uneven impact on specific populations even within developed countries. The extent to which this is the case will depend on details of implementation of domestic policies. The Commission noted that committing to achieving greater emission reductions than it recommends domestically, in the absence of new technologies, introduces significant risks.

### Section 3: Illustrative quantifications of 1.5°-consistent NDC1 budgets based on global principles of equality, capability and responsibility

57. This section calculates NDC1 budgets that could be regarded as consistent with 1.5°C, individually for each of the equity principles of equality, capability and responsibility. Certain NDC1 budgets would be more or less likely to be consistent with 1.5°C under different equity perspectives, but there is no binary yes or no answer.
58. The reason for this spread is that for any given equity principle, a relatively wide range of 1.5°C-consistent NDC budgets can be derived depending on additional choices. These include the spread across global 1.5°C-consistent emission pathways, choice of data sources, and additional value judgements such as when to start historical responsibility, or when equal per capita emissions should be achieved.
59. The choices for data sources and additional assumptions in this advice do not mean that these are necessarily the most appropriate choices and data sources. Numbers are intended only to illustrate the range of possible outcomes if a range of different principles and additional assumptions within those principles are applied.
60. Our analysis does not depend on the domestic cost of abatement or comparisons of this cost to the global cost of abatement. This is because the NDC is a responsibility target, and New Zealand has always stated that it intends to make use of offshore abatement as part of meeting its NDC target. If the cost of domestic abatement is higher than in the global average, this might motivate shifting the balance between domestic and offshore abatement, but it does not in itself change what overall level of abatement in our NDC might

be deemed consistent with 1.5°C based on those global equity lenses. We have therefore not attempted to quantify or compare the domestic cost of abatement for this analysis.

61. Where possible we have applied the equity principles to each gas individually and provide results separately to provide traceability. The overall NDC budget is then aggregated using the Global Warming Potential with a time horizon of 100 years (GWP100) as this is consistent with reporting and future accounting requirements under the Paris Agreement.
62. Alternative metric choices to aggregate the budgets for individual gases are possible, but these would affect both the NDC budget and the way we account for it to ensure New Zealand's *effort* reflects the burden sharing implied by each equity principle. Different metric choices would therefore not necessarily change the actions required by New Zealand to meet its NDC, even if the budgets are expressed differently.

### Equal per capita emissions

63. 1.5°C-consistent NDC budgets based on equal per capita emissions are calculated for three different assumptions of when our per capita emissions should match the global average: during 2021-2030, by 2030, and by 2050.
64. Global per capita emissions are taken from 1.5°C-consistent global emissions pathways in the SR15 and calculated separately for net-CO<sub>2</sub>, biogenic methane and nitrous oxide. Additional estimates are made for the interquartile range across different economic models, but the choice of target year for convergence of per capita emissions has a much larger impact on the results than the range across different economic models.
65. The 1.5°C-consistent NDC budget is then calculated either directly from the global per capita emissions during 2021-2030, or by a linear extrapolation between New Zealand's projected emissions of each gas in 2021 and 1.5°C-consistent per capita emissions in 2030 or in 2050, and adding up the emissions of each gas over 2021-2030.
66. We apply per capita calculations separately for biogenic methane, and for all gases other than biogenic methane, consistent with the separation of gases in domestic 2050 targets. Other methods are possible (e.g. counting all methane rather than only biogenic methane). This would change the resulting aggregate budgets but would be unlikely to change the overall picture.
67. Based on this approach, the following NDC budgets would be consistent with 1.5°C, depending on when equal per capita emissions would be achieved (numbers in brackets indicate the range across the interquartile range of SR15 1.5°C-consistent pathways):
  - a. during 2021-2030: **257 (232-265) Mt CO<sub>2</sub>-eq**, comprised of 224 Mt CO<sub>2</sub>-eq for all greenhouse gases other than and 33 Mt CO<sub>2</sub>-eq for biogenic methane
  - b. in 2030: **387 (372-398) Mt CO<sub>2</sub>-eq**, comprised of a budget of 205 Mt CO<sub>2</sub>-eq for long-lived greenhouse gases and 182 Mt CO<sub>2</sub>-eq for biogenic methane
  - c. in 2050: **513 (511-516) Mt CO<sub>2</sub>-eq**, comprised of a budget of 228 Mt CO<sub>2</sub>-eq for long-lived greenhouse gases and 286 Mt CO<sub>2</sub>-eq for biogenic methane
68. A per capita approach is challenging for methane, given that New Zealand's biogenic methane emissions per capita are currently almost ten times the global average, and five times the global average even if global fossil methane emissions are included. The budgets are larger the later the year in which per capita emissions converge with the global average.
69. The specific budgets use the greenhouse gas inventory to infer New Zealand's current net emissions, which is more consistent with the way that global per capita emissions are expressed. These budgets can be translated into target accounting budgets to ensure the same outcome to the atmosphere. This is done in Section 4 of this paper.

### Capacity to pay

70. As noted above, New Zealand's share of the global abatement task (i.e. the gap between emissions under current policies and emissions consistent with 1.5°C) based on New Zealand's share of global GDP is estimated between 282 and 486 Mt CO<sub>2</sub>-eq.
71. The 1.5°C-consistent NDC1 budget can then be calculated by subtracting New Zealand's share of the global abatement task from its estimated emissions over 2021-2030. As the global emissions gap is estimated based on all emissions and removals, we use projected emissions based on New Zealand's emissions inventory for this rather than projected emissions using net target accounting. Based on 2020 projections but using the most recent inventory data, total net emissions over 2021-2030 from New Zealand under current policies are estimated to be 664 Mt CO<sub>2</sub>-eq.
72. Based on this approach, a 1.5°-consistent NDC1 would be **280 (178-382) Mt CO<sub>2</sub>-eq.**
73. As for the principle of equal per capita emissions, this budget is based on inventory-based emissions and removals, as this is more similar to how the global emissions gap is expressed. These budgets can be translated into target accounting budgets to ensure the same outcome to the atmosphere. This is done in Section 4 of this paper.

### Responsibility for warming from past and future emissions

74. Applying the principle of responsibility, and allocating an emission budget that would be consistent with 1.5°C, relies on estimating the total contributions to global warming from all of New Zealand's emissions since a given date up to 2050.
75. For long-lived gases, the total warming from historical and future emissions is determined largely by their cumulative emissions over that time. For short-lived gases, their contribution to warming is determined largely by their current rate of emissions.
76. Simulations with a simple climate model used in IPCC assessments show that if the start year for historical responsibility is 1850, historical emissions of carbon dioxide and nitrous oxide alone have caused warming of more than twice New Zealand's population-based share of global warming of 1.5°C. Methane emissions are adding another roughly one and a half times New Zealand's population-based share of global warming of 1.5°C.
77. This means New Zealand's contribution to global warming from emissions since 1850 is well over three times its population-based responsibility share of 1.5°C. Given the persistence of warming from long-lived gases, New Zealand's NDC1 budget would therefore have to be well below zero to be consistent with 1.5°C while taking responsibility for warming from all emissions since 1850.
78. The picture is different if New Zealand takes responsibility only for the warming caused by emissions since 1990. The 1.5°C-consistent budget can be calculated as follows:
  - a. Globally, a finite amount of long-lived gases (carbon dioxide and nitrous oxide) can be emitted between 1990 and 2050 for warming to be limited to 1.5°C. New Zealand's share of those cumulative global net emissions is then given by its share of the global population.
  - b. Global emissions of methane and fluorinated gases have to be reduced considerably at the same time. Since the warming caused by short-lived gases depends largely on their rate of emissions, New Zealand's responsibility share of emissions of those gases during 2021-2030 is given by its share of the global population applied to global emissions of those gases during 2021-2030.<sup>3</sup>

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<sup>3</sup> Not all fluorinated gases are short-lived. However, given their relatively small share of overall warming and limited data on their future emissions in 1.5°C-consistent pathways, we treat them as if they were short-lived gases for the purpose of this illustrative analysis.

79. Based on this approach, New Zealand's NDC1 budget taking responsibility for the contribution to global warming of its net emissions since 1990 is **453 Mt CO<sub>2</sub>-eq**, but with a large uncertainty from **394 to 557 Mt CO<sub>2</sub>-eq**.
80. In this approach, the budget allowed for long-lived gases is about 400 Mt CO<sub>2</sub>-eq, which is greater than the projected emissions even under current policies. This is because if responsibility starts only in 1990, New Zealand's low net carbon dioxide emissions since 1990 leave a relatively large remaining budget for long-lived gases between now and 2050. By contrast, the budget for methane is only about 50 Mt CO<sub>2</sub>-eq, since global methane emissions per capita in 1.5°C-consistent pathways are much lower than in New Zealand.

### Equal percentage rate of reductions – gross/net and net/net approaches

81. As noted in paragraphs 24-25, the Commission used a gross-net approach to determine an equal percentage rate of reductions. I.e. consistency of New Zealand's rate of CO<sub>2</sub> reductions was determined by *net* CO<sub>2</sub> emissions in 2030 being below *gross* CO<sub>2</sub> emissions in 2010 by the same percentage as *net* CO<sub>2</sub> emissions globally in 2030 would be below *net* CO<sub>2</sub> emissions globally in 2010. The Commission used *net target* accounting (which excludes removals from pre-1990 forests) to calculate New Zealand's net emissions in 2030 as this was considered more consistent with this consideration.
82. An alternative approach would be to apply the global net-net reductions between 2010 and 2030 in 1.5°C-consistent pathways equally to New Zealand's net emissions, i.e. to require net CO<sub>2</sub> emissions in 2030 to be reduced below net CO<sub>2</sub> emissions in 2010. For this approach, using inventory-based emissions and removals would be more appropriate since this is more similar to how emissions in global emission pathways are described (i.e. those pathways do not exclude removals from pre-1990 forests).
83. Using otherwise the same methodology as in the Commission's final advice, the following NDC budgets could therefore be considered as consistent with 1.5°C, updated based on the latest (2021) emissions inventory (interquartile ranges shown in brackets):
- 568 (527-608) Mt CO<sub>2</sub>-eq** using a gross-net approach and net target accounting
  - 484 (458-510) Mt CO<sub>2</sub>-eq** using a net-net approach and inventory-based removals
84. These two budgets are not directly comparable since they differ not only in their use of gross-net or net-net approaches, but the former excludes removals from pre-1990 forests, whereas the latter includes emissions and removals regardless of planting date.
85. As for the other equity principles, the results can be made comparable by translating the inventory-based budget into a net target accounting based budget that would ensure the same effort, i.e. the same actual emissions and removals over the 2021-2030 period. This conversion is done in a separate section below.

### Combinations of equity principles

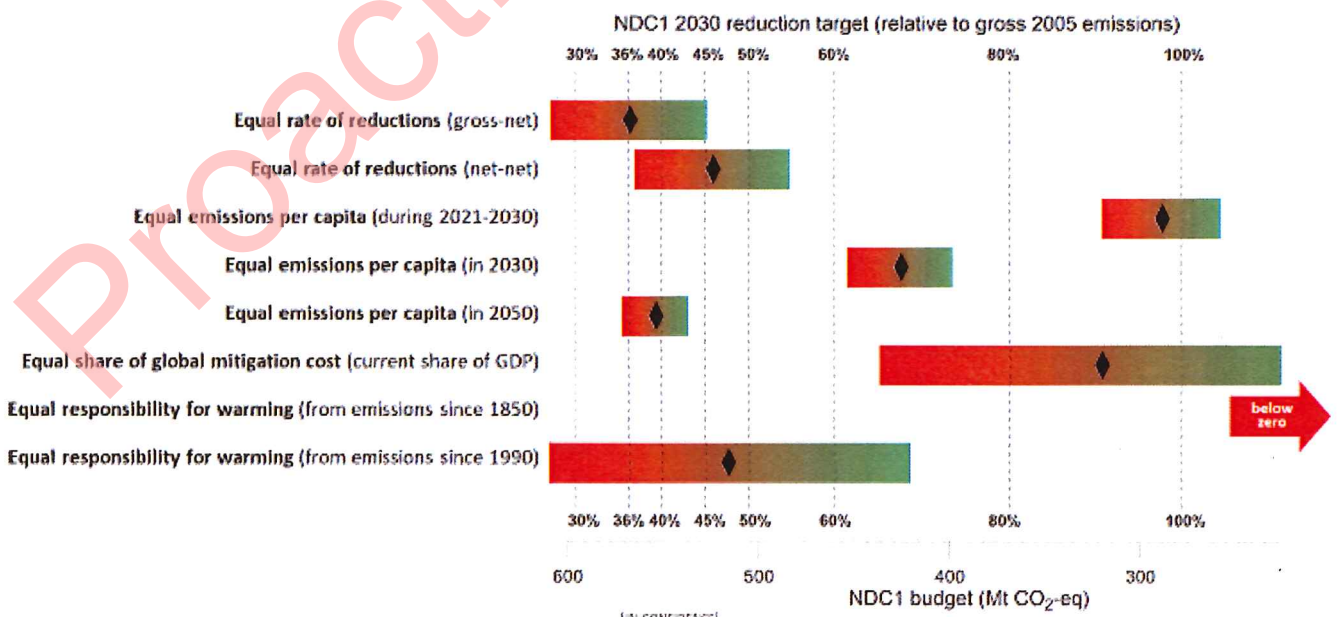
86. Each of the above equity principles, with the exception of the right to sustainable development, provides only one specific lens through which consistency of our NDC budget with 1.5°C could be viewed and determined quantitatively. However, those equity principles are not alternatives; some could plausibly be combined, e.g. we could expect our per capita to be *at least* consistent with global average per capita emissions by a certain date, *and* that our capacity to pay should nudge us towards even greater reductions.
87. However, reductions indicated by each individual equity principle are not additive; i.e. if one equity principle indicates that our NDC should reduce emissions by 100 Mt CO<sub>2</sub>-eq over 2021-2030, and another equity principle also indicates a reduction of 100 Mt CO<sub>2</sub>-eq, it does not follow that the reduction consistent with both equity principles would be 200 Mt CO<sub>2</sub>-eq. This is because e.g. reducing per capita emissions to be consistent with the global average would also draw on our capacity to pay for those reductions.

- 88. Not all equity principles can be combined in a meaningful way. In particular, it would be contradictory for our NDC1 to aim for an equal rate of reduction (which implies permanently *unequal* emissions per capita) as well as consistency based on equal access to the atmosphere (which assumes *equal* emissions per capita).
- 89. For these reasons, we have not produced results for combinations of equity principles. Instead, the results for individual principles simply illustrate NDC budgets that might be considered consistent with certain specific global equity perspectives.

**Section 4: Converting equity-derived budgets to a target-accounting basis**

- 90. The various 1.5°C-consistent NDC1 budgets derived above are not directly comparable to the existing NDC1 budget or the Commission’s benchmark reduction of 36%, as they are expressed using differing accounting approaches.
- 91. A given level of ambition/effort (i.e. same set of actual emissions, removals, and international purchases) translates into a different budget quantity for net emissions during 2021-2030 depending on the NDC accounting approach. A net target accounting approach (i.e. based on a gross-net target) recognises about 26-55 Mt CO<sub>2</sub> fewer removals over 2021-2030 than the full national greenhouse gas emissions inventory removals.
- 92. This difference means that if the level of ambition for NDC1 is determined based on an inventory approach (as it has been for most of the analyses above), the NDC1 budget should be increased by 26-55 Mt CO<sub>2</sub> if we then account towards achievement of our NDC1 using a net target accounting approach.
- 93. Figure 1 summarises the NDC budgets that could be considered with 1.5°C from the different equity perspectives, expressed consistently on a net target accounting basis. The ranges shown for each equity principle reflect the spread across different global emission scenarios consistent with 1.5°C and specific uncertainties in the data sources used for this quantitative analysis, but do not reflect the impact of alternative methodologies.

**Figure 1: Illustrative ranges of NDC1 budgets and 2030 reduction targets that would be consistent with 1.5°C based on different equity principles.**



Note: NDC1 budgets and 2030 reduction targets are expressed using the same methodology as for the current NDC1 and used in the Commission’s final advice, including Global Warming Potentials from the IPCC AR4.

## Section 5: Stakeholder views and other issues related to 1.5°C consistency

94. The Commission reports that submitters responding to its draft advice generally agreed that the current NDC1 was not compatible with 1.5°C. However, the Commission also reports that submitters were split on the level of ambition, with some wanting much deeper emissions reductions and some wanting less action on climate change overall. However, only few submitters engaged on the specific approach taken by the Commission to assess compatibility with contributing to the global effort.
95. Many of the submitters who commented on the NDC1 expressed concern about the use of offshore mitigation. Some submitters argued that the target accounting approach used to account for the NDC is misleading and that we should account for all emissions and removals reported in the national greenhouse gas inventory.
96. The options and challenges for meeting an enhanced NDC1, and accounting approaches to track progress towards achieving our NDC, are discussed in separate briefings building on the advice of the Commission on those matters.
97. Our global equity analysis is broadly consistent with results obtained by using existing equity calculators and with analysis conducted by Oxfam New Zealand. However, we have not attempted to compare specific numbers given that methodologies and data sources are not necessarily identical. Different international equity calculators treat carbon dioxide removals via forest sinks in different ways, which can have a large impact on overall results. In addition, international equity calculators tend to apply a combination of equity indicators to arrive at an overall equity-based reduction target. Given the additional choices that this entails, we have not provided an aggregate measure of equity in this advice.
98. We are aware of some stakeholder concerns that the simple measures of global equity as assessed in this analysis do not reflect our national circumstances, and that doing so could substantially alter what is regarded as New Zealand's fair share as part of a global effort. Examples include:
- a. There may be good reasons why a country's per capita emissions are currently different from the global average, relating e.g. to its climatic conditions (affecting heating and cooling requirements), population density and the structure of its economy based on its natural resources.
  - b. Imports and exports mean that greenhouse gas emissions related to a country's consumption may differ from those reported in its national emissions inventory and used to calculate equity-based shares of global emissions.
  - c. Even if the capacity to pay for a given country is high overall, some populations within this country might bear a disproportionate burden from a large increase in mitigation efforts. Simple metrics such as GDP are unable to recognise such inequities within countries. This risk has also been noted by the Commission. While the right to sustainable development is generally applied to less developed countries, it could also be applied to populations within developed countries.
  - d. There are differing interpretations of what it means to take responsibility for warming from past emissions, and how the burden related to past emissions should be shared across future emitters. For short-lived gases, some stakeholders argue that current emissions should only be counted for the additional warming they cause relative to a given reference year. This latter issue is discussed from a range of global equity perspectives in Box 2 below.
99. While all these points have some merit, they need to be considered in the context that global emissions consistent with 1.5°C are a zero-sum problem. If one country has higher emissions than indicated by any given equity metric, another country will need to have even lower emissions than indicated by the same equity metric. Both countries would need to be able to agree, at least in principle, that this is fair for both.

100. New Zealand's specific national circumstances and other considerations that can inform what might constitute New Zealand's highest possible ambition for its NDC1, consistent with the expectations set out in the Paris Agreement, also need to be taken into consideration when considering an updated NDC1.

**Box 2: The different contributions of long- and short-lived gases to global warming**

- Some stakeholders express the view that a goal of not adding further warming, or halting our contribution to global warming, would be a simple and appropriate level of ambition for New Zealand.
- This appears as an intuitively attractive position that seems to align readily with a goal of limiting global warming to 1.5°C. However, it does not reflect any of the global equity principles considered in this paper:
  - a. It does not take into account responsibility for overall warming. A country whose contribution to global warming already exceeds its fair share (based on population or any other criteria) would potentially continue to exceed its fair share if all it does is to stabilise its contribution to warming at that level.
  - b. It does not take into account capacity to pay. From a capacity perspective, countries should contribute to the global abatement task based on their financial capacity to do so, even if it means that their contribution to global warming reduces over time; doing otherwise would mean poorer countries have to shoulder a greater share of the global abatement task.
  - c. It does not take into account the right to sustainable development. The warming caused by some countries will have to increase over time to allow them to achieve essential development goals; this implies that the warming caused by other countries may need to reduce over time for the world to remain within an overall warming limit.
  - d. It does not result in equal per capita emissions and would give countries with currently high emissions greater access to the atmosphere and a greater right to contribute to global warming in future. There are different reasons for this for long-lived and short-lived gases:
    - i. For long-lived gases, not causing additional warming requires roughly net-zero, which implies equal per capita emissions. However, every emission until net-zero emissions are reached will cause additional warming. Countries starting at high emissions per capita will add more warming until they reach net zero than countries starting with low emissions per capita.
    - ii. For short-lived gases, not causing additional warming implies emissions continue at a nearly constant rate. This would allow countries with very high current emissions to continue with very high emissions in future, while countries with low current emissions would have to maintain low emissions in future. As the warming from short-lived greenhouse gases is determined largely by their future rate of emissions, this would imply a greater future right to cause warming for countries that have high emissions at present.
- In conclusion, we consider that not adding further warming can be a useful and important milestone for countries and it is clearly a key objective for the world as a whole. However, it does not in itself ensure that the distribution of effort across countries is consistent with global equity perspectives.

## What do the different equity approaches tell us about updating NDC1?

101. Equity perspectives can tell us what would be New Zealand's "fair share" of global emissions consistent with limiting warming to 1.5°C, for the budget period 2021-2030.
102. There is no single measure of equity. Differing interpretations of equality, capacity and responsibility give a wide range of New Zealand's NDC1 budgets that could be described as being consistent with 1.5°C.
103. All global equity perspectives indicate that our NDC1 budget should be below, and in some cases by several hundred million tonnes below the current NDC1 budget. This tells us that we should do as much as is feasibly possible to reduce our emissions, including through increasing abatement globally, during this decade and in future.
104. Our analysis builds on the advice from the Commission that our NDC1 would need to be much below 36% below gross 2005 emissions by 2030 to be compatible with 1.5°C. It strengthens this advice by indicating how much below, depending on the equity principle or principles we wish our efforts to be consistent with.
105. However, the global equity approaches used in this analysis represent only a very simple lens on equity and fairness. What is possible will also depend on our specific national circumstances, including our current emissions profile, policy architecture and the availability and integrity of offshore abatement.
106. The equity analysis in this paper therefore constitutes only one contributing factor to the overall decision of what constitutes New Zealand's highest possible ambition for NDC1, and must be considered alongside these other factors.
107. Based on individual global equity principles only, taking the mid-range of global emissions pathways consistent with 1.5°C as reference point, our NDC1 would need to be:
  - a. below 568 Mt CO<sub>2</sub>-eq (-36%), but ideally below 524 Mt CO<sub>2</sub>-eq (-46%), if we wanted our emissions to reduce at the same rate as those emissions reduce globally
  - b. below 554 Mt CO<sub>2</sub>-eq (-39%) if we wanted our aggregate per capita emissions to align with global per capita emissions by 2050; and below 426 Mt CO<sub>2</sub>-eq (-67%) for our per capita emissions to be aligned with the global average by 2030
  - c. below 320 Mt CO<sub>2</sub>-eq (-90%) if we wanted our mitigation efforts to be consistent with our relative wealth expressed as our current share of global GDP
  - d. below 516 Mt CO<sub>2</sub>-eq (about -47%) if we wanted to take responsibility for how much our emissions since 1990 have contributed to overall warming; if we wanted to take responsibility for emissions caused by deforestation during the 19<sup>th</sup> century, our budget would be well below zero.

## Consultation and Collaboration

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108. The following agencies were consulted in the preparation of this advice: Ministry for Primary Industries, Ministry of Business, Innovation and Employment, the Treasury, Ministry of Foreign Affairs and Trade, Department of Prime Minister and Cabinet. Their views have helped shaped MfE's advice presented in this paper.

## Risks and mitigations

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109. The quantitative calculations presented in this paper have not been subject to external peer review. Alternative methodologies and data sources are possible and could change specific numbers while still being consistent with the general equity principles discussed in this

paper. The ranges shown in the quantitative analysis only partially reflect the range of possible choices.

110. Further revisions to specific numbers are likely as updated projections become available, as the international literature evolves, and as New Zealand's greenhouse gas emissions inventory is updated and improved every year.
111. In addition, translating equity-based NDC1 budgets into target accounting budgets, and the way that our NDC1 is expressed as a 2021-2030 budget, further makes it difficult to directly compare results in this paper with other studies.
112. While these changes are unlikely to alter the overall picture fundamentally, we emphasise that the quantitative results should be seen as illustrative rather a formal and final determination of NDC1 budgets or headline 2030 reduction targets that could be described as being 'consistent with' global efforts to limit warming to 1.5°C based on global equity principles.

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