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Nationally determined contributions under the Paris Agreement

Synthesis report by the secretariat

Addendum

Additional information on the contribution of nationally determined contributions towards achieving the objective of the Convention as set out in its Article 2, and towards Article 2, paragraph 1(a), and Article 4, paragraph 1, of the Paris Agreement

Summary

This addendum provides additional information on the contribution of nationally determined contributions towards achieving the objective of the Convention as set out in its Article 2, and towards Article 2, paragraph 1(a), and Article 4, paragraph 1, of the Paris Agreement synthesized from the 48 new or updated nationally determined contributions communicated by 75 Parties in accordance with decision 1/CP.21 and recorded in the interim registry of nationally determined contributions as at 31 December 2020.

Abbreviations and acronyms

AR	Assessment Report of the Intergovernmental Panel on Climate Change
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
GHG	greenhouse gas
GWP	global warming potential
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land-use change and forestry
NDC	nationally determined contribution
SR1.5	Intergovernmental Panel on Climate Change Special Report on Global Warming of 1.5 °C
SSP	Shared Socioeconomic Pathway

I. Background

1. The ultimate objective of the Convention as defined in its Article 2 is to achieve stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

2. According to its Article 2, paragraph 1(a), the Paris Agreement, in enhancing implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development in efforts to eradicate poverty, including by holding the increase in the global average temperature to well below 2 ºC above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 ºC above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.

3. Under Article 4, paragraph 1, of the Paris Agreement, in order to achieve the long-term temperature goal set out in its Article 2, Parties aim to reach global peaking of GHG emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of the century, on the basis of equity and in the context of sustainable development and efforts to eradicate poverty.

4. The information necessary to facilitate clarity, transparency and understanding of NDCs includes information on:[1]

(a) How the NDC contributes towards achieving the objective of the Convention as set out in its Article 2;

(b) How the NDC contributes towards Article 2, paragraph 1(a), and Article 4, paragraph 1, of the Paris Agreement.

II. Contribution of nationally determined contributions towards achieving the objective of the Convention as set out in its Article 2, and towards Article 2, paragraph 1(a), and Article 4, paragraph 1, of the Paris Agreement

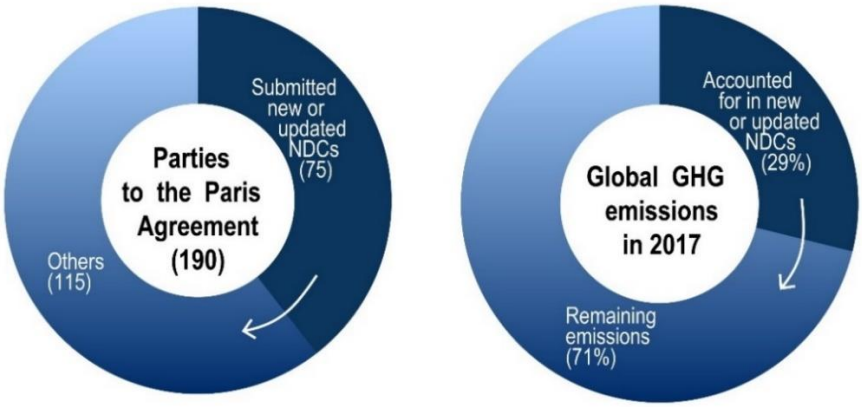
5. The new or updated NDCs considered for this report represent 39.5 per cent of the 190[2] Parties to the Paris Agreement and account for 28.8 per cent of the global GHG emissions in 2017 (see figure 1).[3]

[1] Decision 4/CMA.1, annex I, para. 7.

[2] As at 25 February 2021.

[3] Excluding emissions from forestry and other land use or LULUCF; see para. 42 for the approach to estimating the global GHG emissions in 2017.

Figure 1
Coverage of new or updated nationally determined contributions



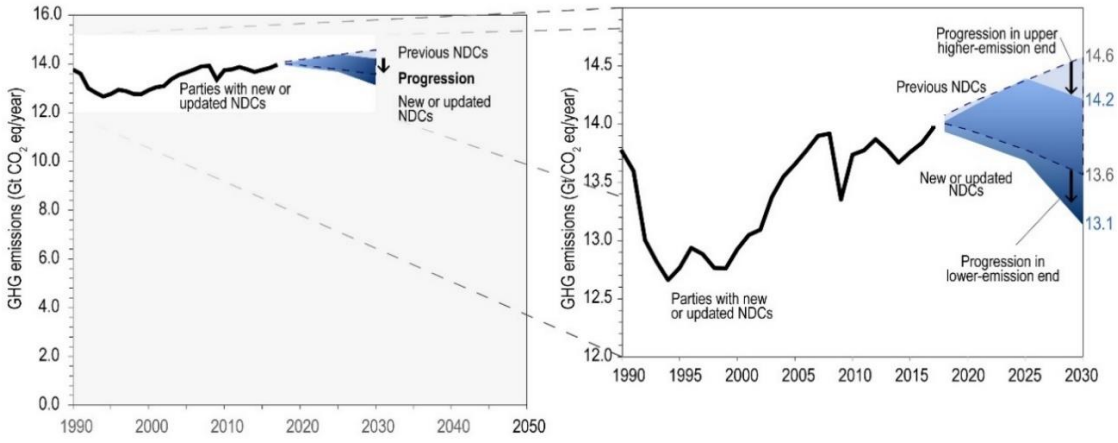
A. Total emission levels in 2025 and 2030

6. Total GHG emission levels resulting from implementation of the new or updated NDCs are estimated to be around 14.04 (13.69–14.39) Gt CO_2 eq in 2025 and 13.67 (13.13–14.21) Gt CO_2 eq in 2030[4] (see figure 2; see also chap. III for the approach and methods used for estimating the total GHG emission levels).[5]

7. Considering only the unconditional elements of the NDCs, total GHG emission levels resulting from their implementation are projected to be 14.27 (14.14–14.39) Gt CO_2 eq in 2025 and 14.04 (13.87–14.21) Gt CO_2 eq in 2030.

8. If the NDCs are fully implemented, including all conditional elements, total GHG emission levels are projected to be 13.87 (13.69–14.04) Gt CO_2 eq in 2025 and 13.31 (13.14–13.48) Gt CO_2 eq in 2030.

Figure 2
Projected range of greenhouse gas emission levels according to nationally determined contributions



Note: The projected ranges cover the higher-emission end for unconditional elements of NDCs to the lower-emission end when also taking conditional elements of NDCs into account.

[4] Unless otherwise noted, in this report, the average of the quantification is followed by a range that represents the minimum and maximum values after aggregation for the Parties that submitted new or updated NDCs, since several presented conditional and unconditional elements of their NDCs and, in some cases, ranges of values for both.

[5] Unless otherwise noted, for this report, GHG emission levels exclude emissions from forestry and other land use or LULUCF; and GWP values with a 100-year time-horizon from the AR4 have been used. For NDCs that include estimates of GHG emissions using other GWP values (e.g. from the AR2 or AR5), a conversion has been applied.

9. The total GHG emission level in 2025 resulting from implementation of the new or updated NDCs is estimated to be around 38 Mt CO_2 eq lower (ranging from 94 Mt CO_2 eq lower to 18 Mt CO_2 eq higher) than the level according to the Parties' previous NDCs. Thus, the 2025 target emission level remains almost unchanged, with an average 0.3 per cent reduction (ranging from 0.7 per cent reduction to 0.1 per cent increase) since the previous NDCs.

10. For 2030, total GHG emissions are estimated to be 398 (362–433) Mt CO_2 eq lower than projected in the previous NDCs. The average reduction in the Parties' projected 2030 emission levels since their previous NDCs is estimated to be around 2.8 (2.5–3.2) per cent, although there is significant variation across Parties.

11. The total GHG emission level in 2025 resulting from implementation of the NDCs without taking into account conditional elements is estimated to be around 12 Mt CO_2 eq lower (ranging from 42 Mt CO_2 eq lower to 18 Mt CO_2 eq higher) than according to the previous NDCs, which is a slight reduction of 0.1 per cent (ranging from 0.3 per cent reduction to 0.1 per cent increase). Similarly, for 2030, total GHG emissions are estimated to be around 377 (362–391) Mt CO_2 eq, or 2.6 (2.5–2.7) per cent, lower than according to the previous NDCs.

12. The total GHG emission level in 2025 resulting from full implementation of the NDCs, including conditional elements, is estimated to be around 20 Mt CO_2 eq lower (ranging from 94 Mt CO_2 eq lower to 55 Mt CO_2 eq higher), or 0.1 per cent lower (ranging from 0.7 lower to 0.4 per cent higher), than according to the previous NDCs. However, total GHG emissions in 2030 are estimated to be around 430 (426–433) Mt CO_2 eq, or 3.1 (3.1–3.2) per cent, lower than previously projected.

B. Changes in total emissions in relation to the 1990, 2000, 2005, 2010, 2015 and 2017 levels

13. The total GHG emission levels in 2025 of the Parties that submitted new or updated NDCs are on average projected to be 2.0 per cent higher than in 1990 (13.77 Gt CO_2 eq), 8.6 per cent higher than in 2000 (12.93 Gt CO_2 eq), 2.8 per cent higher than in 2005 (13.66 Gt CO_2 eq), 2.2 per cent higher than in 2010 (13.74 Gt CO_2 eq), 2.0 per cent higher than in 2015 level (13.76 Gt CO_2 eq) and 0.5 per cent higher than in 2017 (13.97 Gt CO_2 eq).

14. For 2030, the Parties' total GHG emission levels are on average projected to be 0.7 per cent lower than in 1990, 5.8 per cent higher than in 2000, 0.1 per cent higher than in 2005, 0.5 per cent lower than in 2010, 0.6 per cent lower than in 2015 and 2.1 per cent lower than in 2017.

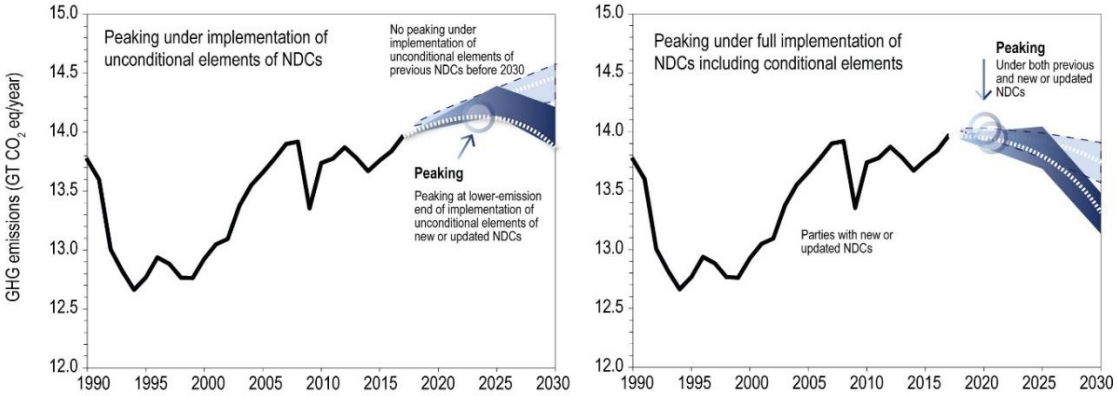
15. The average projected 2030 emission levels associated with the Parties' previous NDCs exceeded their emission levels in 1990, 2000, 2005, 2010, 2015 and 2017.

16. In 2030, the total GHG emission level resulting from implementation of the NDCs without taking into account conditional elements is projected to be, on average, slightly higher than in 2017, by 0.5 per cent (ranging from 0.7 per cent lower to 1.8 per cent higher); whereas the total GHG emission level resulting from implementation of the NDCs including conditional elements is projected to be, on average, 4.7 (3.5–6.0) per cent lower than in 2017.

17. The previous NDCs (without taking into account conditional elements) indicated a continuously increasing trend in emissions up to 2030, to 2.8 (1.6–3.9) per cent above the 2017 level; whereas the new or updated NDCs (without taking into account conditional elements) indicate the possibility, at the lower end of the emission range, of the Parties' emissions peaking before 2030, with their emissions in 2030 (13.87 Gt CO_2 eq) projected to be 1.9 per cent below the lower end of the projected 2025 target level (14.14 Gt CO_2 eq) and also just below the 2017 level (13.97 Gt CO_2 eq) (see figure 3).

18. If they are fully implemented (including their conditional elements), the new or updated NDCs indicate the possibility of the Parties' emissions peaking before 2025, with the average estimate of emissions in 2025 (13.87 Gt CO_2 eq) being slightly lower than in 2017 (13.97 Gt CO_2 eq) (see figure 3).

Figure 3
Historical and projected total greenhouse gas emissions according to nationally determined contributions



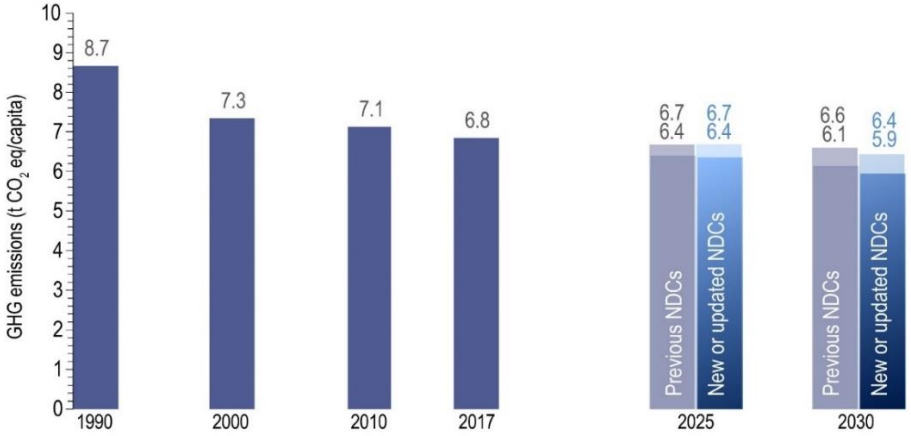
C. Per capita emissions in relation to the 1990, 2000, 2005, 2010, 2015 and 2017 levels

19. Estimated historical per capita GHG emission levels indicate a continuous downward trend. The Parties' per capita emissions were estimated to be 8.67, 7.34, 7.41, 7.13, 6.85 and 6.85 t CO_2 eq in 1990, 2000, 2005, 2010, 2015 and 2017, respectively.

20. According to their previous NDCs, per capita emissions were estimated to be lower by 4.5 (2.5–6.5) per cent in 2025 and by 7.0 (3.6–10.3) per cent in 2030 than in 2017.

21. According to the new or updated NDCs, per capita emissions were estimated at 6.52 (6.36–6.68) t CO_2 eq in 2025 and 6.19 (5.94–6.43) t CO_2 eq in 2030, which is 4.7 (2.3–7.1) per cent lower in 2025 and 9.6 (6.0–13.2) per cent lower in 2030 than in 2017 (see figure 4).

Figure 4
Estimated historical and projected per capita emission levels according to nationally determined contributions



D. Comparison with Intergovernmental Panel on Climate Change scenarios and indicators

22. According to the SR1.5,[6] to be consistent with global emission pathways with no or limited overshoot of the 1.5 °C goal, net anthropogenic CO_2 emissions need to decline by about 45 per cent below the 2010 level by 2030 (40–60 per cent interquartile range), reaching

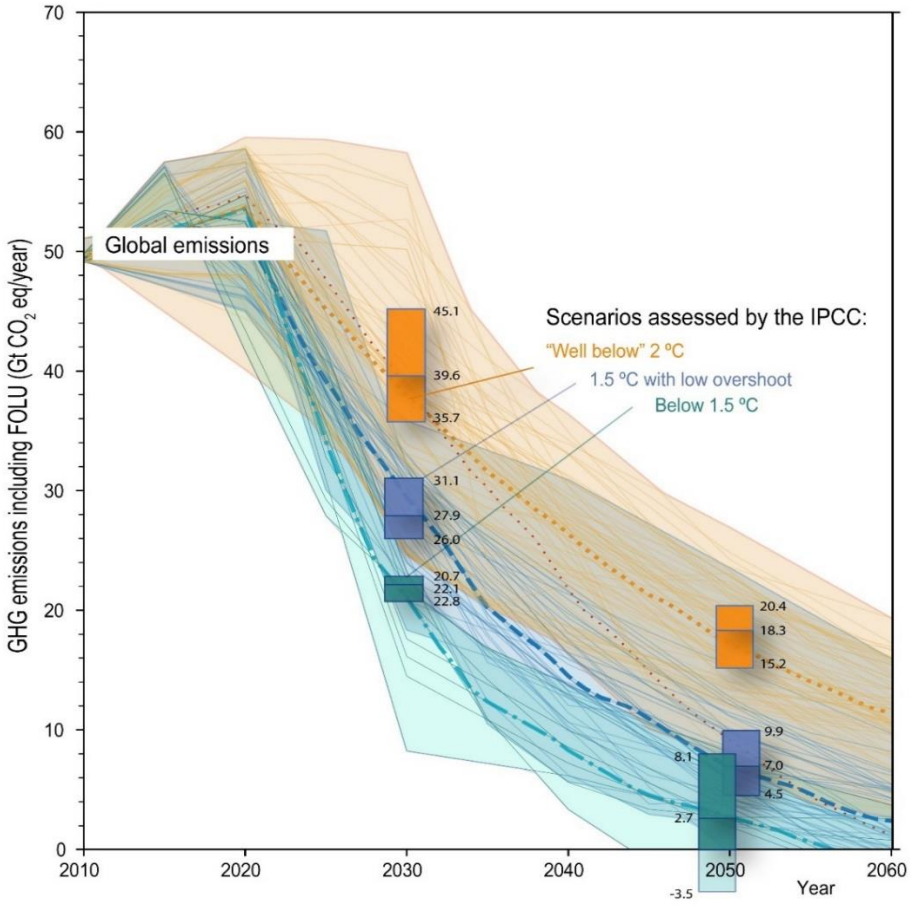
[6] IPCC. 2018. *IPCC Special Report on the Impacts of Global Warming of 1.5 °C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. V Masson-Delmotte, P Zhai, H-O Pörtner, et al. (eds.). Geneva: World Meteorological Organization. Available at https://www.ipcc.ch/sr15/.

net zero around 2050 (2045–2055 interquartile range); and for limiting global warming to below 2 °C, CO_2 emissions need to decline by about 25 per cent from the 2010 level by 2030 on most pathways (10–30 per cent interquartile range) and reach net zero around 2070 (2065–2080 interquartile range). Deep reductions are required for non-CO_2 emissions as well.[7]

23. With their GHG emissions in 2030 on average projected to be 0.5 per cent below the 2010 level (see para. 14 above), the scale of the total emission reduction expected to be achieved by the represented Parties (noting that this is only about 40 per cent of the Parties to the Paris Agreement) through implementation of the new or updated NDCs falls far short of what is necessary according to the IPCC ranges referred to in paragraph 22 above.

24. In order to provide a clear picture of the combined contribution of all NDCs towards achieving the objective of the Convention as set out in its Article 2, and towards Article 2, paragraph 1(a), and Article 4, paragraph 1, of the Paris Agreement, the final version of the NDC synthesis report will include a comparison of the projected total emission levels resulting from implementation of all NDCs with different mitigation scenarios and indicators assessed by the IPCC. It will also include a comparison with remaining cumulative emissions towards the 1.5 and 2 ºC goals as assessed by the IPCC (see figure 5). Providing such information in this initial report was not possible because of the limited number of the NDCs included in the report.

Figure 5
Global emissions scenarios assessed by the Intergovernmental Panel on Climate Change



Note: The assessed 2030 and 2050 global emission ranges (including forestry and other land use) for the IPCC scenarios provided in the SR1.5 (table 2.4) are shown with interquartile ranges, except for the below 1.5 ºC scenario, for which minimum–maximum ranges are shown. The median (red dotted) line, which shows the 1.5 ºC with high overshoot scenario, suggests that emission levels in 2030 will be approximately equivalent to those under the below 2 ºC scenario and that emission levels in 2050 will be in line with the 1.5 °C with low overshoot scenario before transitioning to net negative emissions in the latter half of the century.

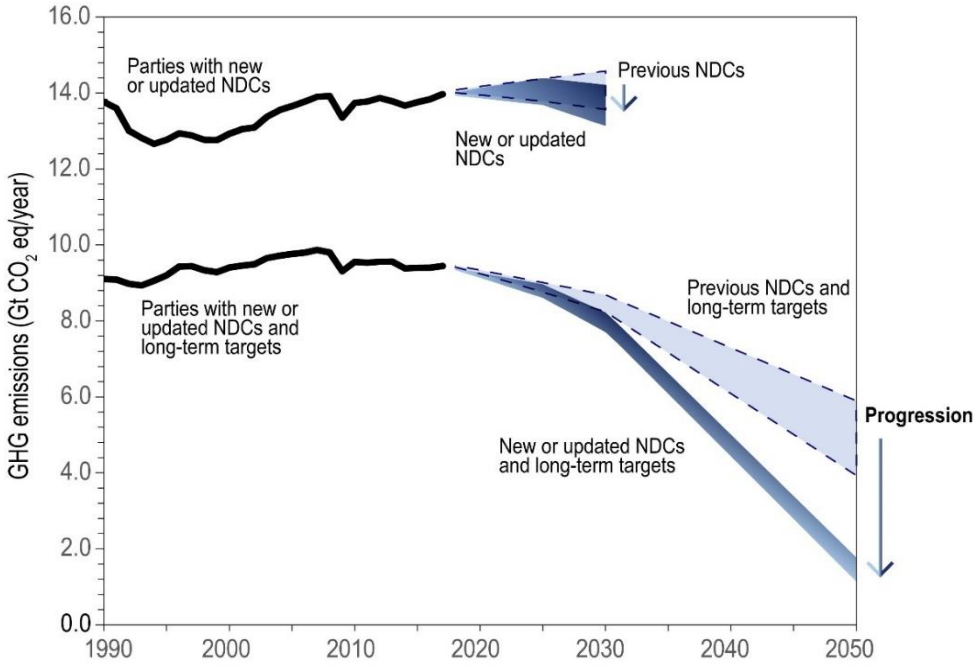
[7] Further information on all IPCC scenarios is available at https://data.ene.iiasa.ac.at/iamc-1.5c-explorer/.

E. Long-term mitigation visions, strategies and targets

25. Many[8] Parties provided information on long-term mitigation visions, strategies and targets for up to and beyond 2050 that either have already been formulated or are under preparation, or have been communicated through a long-term low-emission development strategy. Most of the long-term goals refer to climate neutrality, carbon neutrality, GHG neutrality or net zero emissions by 2050, 2060 or mid-century. Compared with the previous NDCs, some 25 per cent more Parties referred to such long-term goals in their new or updated NDCs.

26. These Parties' total GHG emission level in 2017 was estimated at 9.29 Gt CO_2 eq. On the basis of the information provided on long-term mitigation visions, strategies and targets in the NDCs, their total emissions in 2050 were estimated at 0.7–1.2 Gt CO_2 eq. Mindful of the inherent uncertainties surrounding such long-term estimates, this represents a GHG emission reduction of about 87–93 per cent below the 2017 level by 2050 (see figure 6).

Figure 6
Estimated greenhouse gas emission levels in 2050 resulting from implementation of long-term mitigation visions, strategies and targets communicated in nationally determined contributions

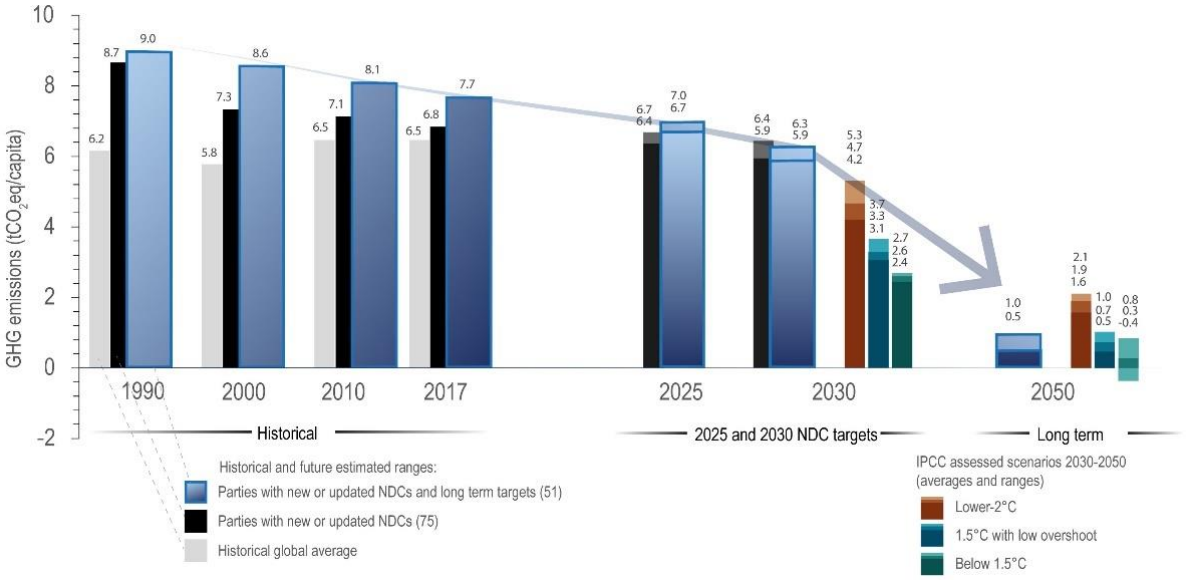


27. For the Parties that provided information on long-term mitigation visions, strategies and targets, average per capita emission levels resulting from their implementation were estimated at 0.5–1.0 t CO_2 eq for 2050. This is an 87–93 per cent reduction compared with the 2017 level and suggests that by 2050 the Parties' per capita emissions will be within the range implied in the 2 ºC and 1.5 ºC with low overshoot scenarios in the SR1.5 (see figure 7).

[8] That is, 41–70 per cent of the Parties represented.

Figure 7

Projected per capita emission levels until 2050 resulting from implementation of long-term mitigation visions, strategies and targets communicated in nationally determined contributions



Note: For comparison, the per capita emissions of all Parties with new or updated NDCs (including those without long-term targets indicated) are shown; as well as the global emission levels associated with the 1.5 and 2 ºC mitigation scenarios assessed in the SR1.5, converted from absolute emission levels using United Nations medium global population projections.

III. Approach and methods for estimating emission levels resulting from implementation of nationally determined contributions[9]

A. Approach

28. The estimated total GHG emission levels of Parties in 2025, 2030 and 2050 resulting from implementation of their new or updated NDCs are discussed in this report in relation to:

(a) The estimated levels of emissions for those years according to the Parties' previous NDCs;

(b) Historical levels of emissions in 1990, 2000, 2005, 2010, 2015 and 2017;

(c) The global emission levels corresponding to scenarios consistent with limiting the global average temperature rise to well below 2 °C above pre-industrial levels;

(d) The global emission levels corresponding to scenarios consistent with holding the global average temperature rise to below 1.5 °C above pre-industrial levels by 2100 with no or limited overshoot;

(e) Per capita emission levels calculated on the basis of the most recent United Nations population data, historical estimates and the medium forecast.[10]

29. For the purpose of this report:

(a) The information communicated by Parties in their new or updated NDCs was considered. The use of any additional information is described in chapter B below;

[9] Unless otherwise noted, the approach and methods described in document FCCC/CP/2016/2, chap. II.C, were applied.

[10] See https://population.un.org/wpp/.

(b) The synthesis is focused on the targets, sectors and gases covered by the NDCs. GHG emissions that do not fall within the scope of the NDCs were assessed for Parties taken together as a group, as explained in paragraph 31(b) below;

(c) Information is presented for all the represented Parties taken together;

(d) It was assumed that Parties will achieve the conditional and unconditional emission levels projected in the NDCs; no assumptions were made on the likelihood of the NDCs not being fully implemented or exceeded.

B. Methods

30. For the purpose of this report:

(a) The total emission levels of Parties in 2025, 2030 and 2050 resulting from implementation of the new or updated NDCs were estimated;

(b) The levels of the emissions not covered by the NDCs in 2025, 2030 and 2050 were estimated using IPCC reference scenarios.[11]

31. The total GHG emission levels in 2025, 2030 and 2050 resulting from implementation of the new or updated NDCs were estimated by summing the expected levels of emissions for the same year communicated in each NDC. The resulting emission levels are expressed as average values and minimum–maximum ranges owing to the uncertainties underlying the aggregation and the ranges and conditions expressed in the NDCs.

32. The estimates of total GHG emission levels in 2025 and 2030 are provided as follows:

(a) For the full implementation of both the unconditional and conditional elements of the NDCs;[12]

(b) For implementation of only the unconditional elements of the NDCs. For Parties that have conditional targets only, 'business as usual' was taken into account;

(c) For implementation of the conditional elements of the NDCs, with Parties assumed to fully implement the unconditional and, if any, conditional elements of their NDCs.

33. Unless otherwise noted, the discussion of total GHG emission levels resulting from implementation of the NDCs is premised on the implementation of both the unconditional and conditional elements of the NDCs, as described in paragraph 32(b) above.

34. Where a Party included in its NDC an expected absolute level of emissions for 2025, 2030 or later, that figure was used in the calculation of the total emission level.[13] Otherwise, the method used for quantifying the estimated level of emissions in the target year (2025 or 2030) depended on the type of target:

(a) For absolute emission reduction targets relative to a base year, it was calculated by subtracting the percentage emission reduction or limitation specified by the Party for the target year from the base-year level of the emissions covered by the NDC;

[11] Such estimates are based on emission figures for 2025, 2030 and 2050 for the countries, sectors and gases not covered by the NDCs derived from scenarios assessed by the IPCC in the SSP scenario database at https://tntcat.iiasa.ac.at/SspDb/dsd. (See also Gütschow J, Jeffery ML, Günther A, et al. 2020. *Country resolved combined emission and socio-economic pathways based on the RCP and SSP scenarios (Version 1.0)*. Zenodo. Available at http://doi.org/10.5281/zenodo.3638137.) The SSP1 reference scenario developed using the Integrated Model to Assess the Greenhouse Effect was used for the sector-, gas-, country- and region-specific growth rates of emissions until 2025 and 2030.

[12] Where Parties stated ranges of emissions for conditional or unconditional targets, for the purpose of calculating the total sum of emissions the ranges were assumed to cover the lower-emission end of the range that assumes full implementation of the NDCs, including conditional elements, to the higher-emission end of the unconditional range.

[13] If necessary, a conversion was applied using GWP values with a 100-year time-horizon from the AR4.

(b) For emission reductions below a 'business as usual' or reference level, it was calculated by subtracting the emissions corresponding to the percentage reduction specified by the Party from the stated level of emissions in the target year;

(c) For cumulative emission reductions or cumulative emission levels, a constant reduction or emission level was assumed over the stated target period; except where the target period started around 2020, in which case annual reductions were assumed to increase linearly. If both cumulative and absolute target levels for a specific year were specified, the latter figure was used;

(d) Net zero emission or climate- and carbon-neutrality targets were assumed to cover the same sectors and gases as the Party's NDC targets for 2030, unless otherwise noted in the NDC:

(i) For net zero emissions it is assumed that the sum, weighted by GWP values with a 100-year time-horizon from the AR4, of the covered emissions in the target year equals zero;

(ii) Carbon-neutrality targets are implemented with an emission range in the target year unless otherwise specified, ranging from only covering CO_2 emissions and keeping non-CO_2 emissions constant at the 2030 level to assuming zero emissions of all GHGs by the target year;

(iii) Climate-neutrality targets are implemented as net zero emission targets;

(e) For Parties that communicated a combination of any of these targets, resulting in some cases in potential overlaps between covered sectors and/or gases, expected levels of emissions in 2025 and 2030 were estimated individually for each target;

(f) For other types of target, including in relation to mitigation co-benefits of adaptation actions and policies and measures or intensity targets, the effects were not quantified in this report unless estimates of resulting emission levels in 2025 and 2030 were provided in the NDCs.

35. If a Party did not indicate a target for 2025, the level of emissions in 2025 was estimated using linear interpolation between the latest historical emission level available and the estimated level of emissions in 2030 resulting from implementation of its NDC. Similarly, for long-term strategies that indicated emission targets for years other than 2050, linear interpolation between the latest quantified emission level and the estimated emission level in the long-term target year was undertaken to obtain an estimate for 2050.

36. If a Party had previously communicated a target with a time frame of up to 2020 (e.g. in the context of pre-2020 action), the level of expected emissions in 2020 associated with that target was used.

37. If a Party did not indicate a target for 2030, the emissions trajectory between the latest historical emission level available and 2025 was assumed to continue at the same rate after 2025.

38. In order to show the progression of Parties' long-term targets for up to 2050, if the previous NDC did not indicate a long-term or 2050 target, the emissions trajectory for 2025–2030 was assumed to continue at the same rate after 2030.

39. The targets communicated by Parties in the new or updated NDCs were used in the estimations for this report, but that information was complemented, as necessary, by data contained in the latest GHG inventories, national communications, biennial update reports and biennial reports, with any remaining data gaps filled using scientific global data sets.[14]

[14] To ensure consistent aggregation of emissions, a gas-by-gas data basis was used to perform conversions from different metrics, such as GWP values from the AR2 or AR5 into GWP values from the AR4, which were used consistently for the aggregation presented in this report. Therefore, in some cases, it was necessary to use complementary data sets for estimating the total level of emissions associated with implementation of the NDCs. The primary complementary sources of gas-by-gas and sectoral data on the emissions of Parties were composite databases, including official

40. In order to quantify the difference in estimated emissions compared with previous NDCs, the information in the previous NDCs and the total level of emissions for the covered sectors and gases for all Parties were complemented by information on non-covered sectors and gases. Similarly, non-covered sectors and gases were added at the total level to the sum of covered gases and sectors for the new or updated NDCs. Also, the previous NDCs were assessed using the same set of updated reported historical emission data as the new or updated NDCs, unless the previous NDCs referred to specific absolute emission or reference levels, in which case those were used.

41. The long-term strategies were quantified as stated in the NDCs, or as stated in the long-term strategies officially reported[15] by Parties with their new or updated NDCs.

42. Global total GHG emissions for 2017 were estimated by summing the GHG emission data for individual Parties contained in the latest GHG inventories, national communications, biennial update reports and biennial reports, complemented by other data from global data sets to address any remaining data gaps.[16] Since emissions from international transport were not included in the sum of emissions for Parties with new or updated NDCs, but in the global totals, for this report the historical CO_2 emissions related to aviation and maritime transport were used to complement the country data to arrive at the global total emission estimate.[17]

43. As regards the use of international market-based mechanisms, for this report it was assumed that any international offset will lead to additional emission reductions in other countries. In other words, it was assumed that emission reductions in the context of the implementation of one NDC are not double counted in the context of implementing another.

44. Per capita emission estimates were derived using the medium fertility variant scenarios projected in the 2019 revision of the World Population Prospects by the Population Division of the United Nations Department of Economic and Social Affairs.[18]

45. The analysis took into account the specific GWP values that Parties indicated, namely GWP values over a 100-year time-horizon from the AR2, AR4 or AR5. In line with most Parties' current GHG reporting, GWP values over a 100-year time-horizon from the AR4 were used to sum the GHGs covered in the NDCs. Where necessary, summed emissions were converted using 100-year time-horizon GWP values from the AR4 on the basis of Parties' historical CO_2, methane, nitrous oxide and other GHG emissions. For comparison purposes, the projected emission levels for 2030, and their progression in comparison with those in the previous NDCs, were also estimated for the 100-year time-horizon GWP values from the AR2 and AR5.

C. Key challenges and approaches to addressing them

46. A number of uncertainties and challenges are involved in these approaches and methods linked to target specification and data availability and quality.

47. One key challenge relates to the different ways in which Parties expressed their NDC targets in terms of time frame, reference year and sectors and gases covered. Compared with those in the previous NDCs, the targets in the new or updated NDCs were generally more clearly defined in quantitative terms, with substantially fewer targets expressed in terms of

submissions to the UNFCCC and GHG inventory submissions, with data gaps filled using sources such as the Food and Agriculture Organization of the United Nations and the Emission Database for Global Atmospheric Research.

[15] See https://unfccc.int/process/the-paris-agreement/long-term-strategies.

[16] To fill sectoral and gas-by-gas data gaps, growth rates from international scientific databases with global coverage were used, as compiled in Gütschow J, Jeffery ML, Gieseke R, et al. 2019. *The PRIMAP-hist national historical emissions time series (1850-2017)*. GFZ Data Services. Available at https://doi.org/10.5880/PIK.2019.018.

[17] In 2017, according to IEA, CO_2 emissions from international aviation bunker fuel combustion (579 Mt CO_2) accounted for 1.2 per cent of global GHG emissions and those from international shipping bunker fuel combustion (702 Mt CO_2) accounted for 1.4 per cent. See IEA. 2020. *CO_2 Emissions from Fuel Combustion: Overview*. Paris: IEA. Available at https://www.iea.org/reports/co2-emissions-from-fuel-combustion-overview.

[18] See https://population.un.org/wpp/.

emission and gross domestic product ratios (intensity targets) and NDCs expressed solely in terms of policies and measures. A larger share of targets relative to a historical base year or quantified future reference level was communicated in the new or updated NDCs, as well as more other target types that present fewer quantification challenges, such as targets specified in terms of absolute future emission levels, cumulative emission budgets and net zero emissions.

48. Further challenges relate to the methodologies used for estimating and projecting GHG emissions as well as to the quality, clarity and completeness of the data used, including missing information on metrics, such as which GWP values were applied (although more Parties specified the chosen GWP values in their new and updated NDCs); lack of gas-by-gas emission data for summing emissions using consistent metrics; missing or incomplete data on the 'business as usual' or reference scenario and on expected future gross domestic product or population (although this was less of a challenge with fewer Parties communicating intensity targets); lack of clarity on approaches to LULUCF accounting; missing information in relation to the application of conditions in the target year; and lack of information on the use of international market-based mechanisms and how double counting was avoided.

49. A consistent approach to addressing these challenges was applied:

(a) Uncertainties arising from the different ways of expressing targets were addressed by applying the method described in paragraph 34 above;

(b) As noted in paragraph 39 above, the synthesis was based on data in the new or updated NDCs and challenges related to missing data were addressed as described in paragraphs 34–40 above;

(c) Differences in the coverage of sectors and gases were addressed by limiting the Party-level analysis to the GHG emissions covered by the NDCs;

(d) Uncertainties linked to conditions specified by Parties in their NDCs were addressed by separately estimating unconditional and conditional, and only unconditional, emission reduction levels and expressing the result as a range. Also, any uncertainties in relation to unconditional elements of the NDCs or any ranges of conditional reductions provided were taken into account as separate ranges. These ranges were used in estimating the overall ranges of projected emission levels resulting from implementation of the unconditional elements of NDCs, as well as the effect of the implementation of both unconditional and conditional NDC elements (see para. 33 above).

50. A major area of uncertainty relates to the approaches used for estimating, projecting and accounting for LULUCF emissions and removals. The results presented in this report are subject to the high sensitivity of the methods used for estimating global emissions to how emissions and removals from the LULUCF sector were considered. For example, some Parties intend to follow specific LULUCF accounting rules, while others will pursue a full carbon accounting approach (i.e. include LULUCF net emissions or removals in the same way as emissions from any other sector).[19]

51. For this report, the divergent treatments of the LULUCF sector were taken into account in estimating the total emission levels. For example, an approach using a relative target below a historical base-year level was applied to the total national emissions including LULUCF if the Party stated its intention to account for the LULUCF sector as any other sector. To the extent quantifiable with the available data sources, exceptions were taken into account; for example, reported wildfire-related (and approximate estimates for insect-related) emissions were subtracted for the base year if emissions related to natural disturbances were intended not to be counted up to 2025 or 2030. In the absence of other methods for estimating LULUCF-related accounting for some Parties, a (discounted) continuation of credits or debits from the first commitment period of the Kyoto Protocol was assumed, where applicable. Where available, reported projections 'with existing measures' formed the basis for estimating future LULUCF emissions and removals, unless the Party provided LULUCF projections in its NDC. Alternatively, the latest available historical data points were assumed

[19] A few Parties specified how natural disturbances and harvested wood products are to be accounted for.

to remain constant; or, where appropriate, a range of constant and projected LULUCF projections was assumed to reflect the inherent uncertainty of the quantification.

52. There is a difference in definitions between the estimation of anthropogenic GHG emissions and removals from the LULUCF sector under the UNFCCC, and the estimation of emissions related to land-use change as part of the global emission estimates of the IPCC[20] and the scenarios in the AR5 and SR1.5 scenarios database. To enable a comparison between estimated total emission levels and estimates from the SR1.5 in the final version of the NDC synthesis report, the underlying calculations for estimating total emissions for 2025 and 2030 will take into account LULUCF emission and removal estimates provided by Parties. In order to estimate total emissions consistently with the global emission estimates of the IPCC, a range of global land-use change emissions scenarios in line with the targets and IPCC-assessed scenarios will be assumed for up to 2030 and 2050. This will enable the total emission estimates to be presented in the report to be comparable with the emission levels provided by the IPCC.

53. It should be noted that, in addition to the conditions stated by Parties in their NDCs, the uncertainty related to the accounting and projections of LULUCF emissions and/or removals contributes to the need to express the estimated total emissions in 2025 and 2030 as a range. According to the previous NDCs, the change in the total LULUCF emissions and projections was within the range of the change in land-use change emissions from current levels to 2025 and 2030 in the AR5 reference scenarios.[21] This qualitatively supports the need to maintain the approach described in paragraph 51 above to presenting the global emission estimates in the final version of the NDC synthesis report in order to be consistent with the global emissions scenarios assessed by the IPCC.

54. Parties communicated different target years in their NDCs, primarily 2030 but also 2025. In order to estimate the global emission level for 2025, emissions for Parties with targets for 2030 only were interpolated linearly using the latest available historical emission data. In order to estimate the global emission level for 2030, emissions for Parties that did not communicate an emission level for 2030 were derived through linear extrapolation of the difference between their 2020 and 2025 emission levels.

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[20] See, for example, figure SPM.1 in IPCC. 2014. Summary for Policymakers. *In*: O Edenhofer, R Pichs-Madruga, Y Sokona, et al. (eds.). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press. Available at https://www.ipcc.ch/report/ar5/wg3/.

[21] See https://unfccc.int/files/focus/indc_portal/application/pdf/technical_annex_-_synthesis_report.pdf, chap. E.