# 3 The emissions gap

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## 3.1 Introduction

This chapter updates the assessment of the emissions gap for 2030. Consistent with previous Emissions Gap Reports, the emissions gap is defined as the difference between projected global greenhouse gas (GHG) emissions under full implementation of nationally determined contributions (NDCs) and emissions under least-cost pathways consistent with the Paris Agreement long-term goal of limiting global average temperature increase to well below 2°C and pursing efforts to limiting it to 1.5°C compared with pre-industrial levels (section 3.2). This chapter assesses up-to-date emissions scenarios that underlie the quantification of the emissions gap (section 3.3).

The emissions projections for the current policies and NDC scenarios published in the literature mainly predate the COVID-19 outbreak. Potential implications of COVID-19 on 2030 emissions are therefore explored based on expert knowledge and indicative calculations (section 3.4), which is consistent with the approach used in chapter 2. The implications of failing to bridge the emissions gap by 2030 and the feasibility of achieving the long-term temperature goals of the Paris Agreement are also discussed (section 3.5).

The key questions assessed in this chapter are: What is the likely emissions gap for 2030? What is the impact of the COVID-19 pandemic and associated recovery measures on emissions by 2030? What are the temperature implications? What does the 2030 emissions gap imply in a longer-term, mid-century context?

## 3.2 The 2030 emissions gap

In line with previous reports, the emissions gap for 2030 is defined as the difference between global total GHG emissions from least-cost scenarios that keep global warming to below 2°C, 1.8°C or 1.5°C with varying levels of likelihood, and the estimated global GHG emissions resulting from a full implementation of the NDCs. This section updates the gap based on estimated levels of GHG emissions in 2030 for the seven scenarios considered in this assessment and further described in section 3.3. Table 3.1 provides a full overview of 2030 emission levels for these scenarios, as well as the resulting emissions gap, while Figure 3.1 illustrates the emissions gap for 2030.

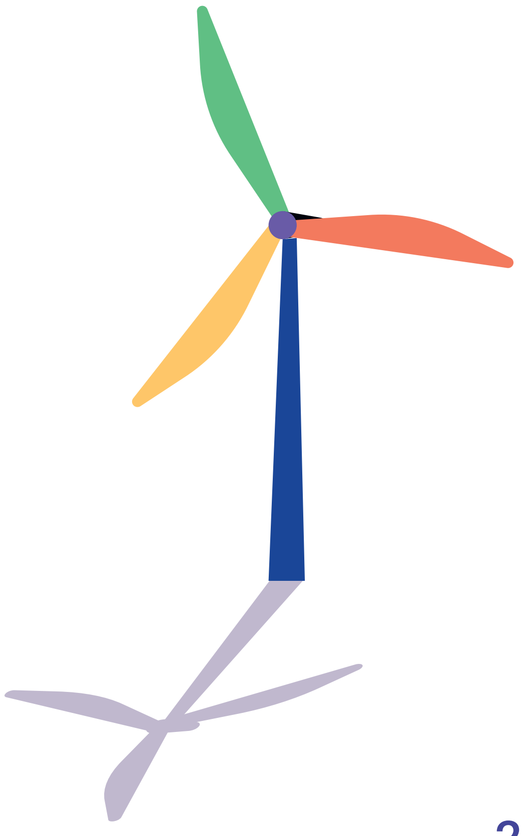
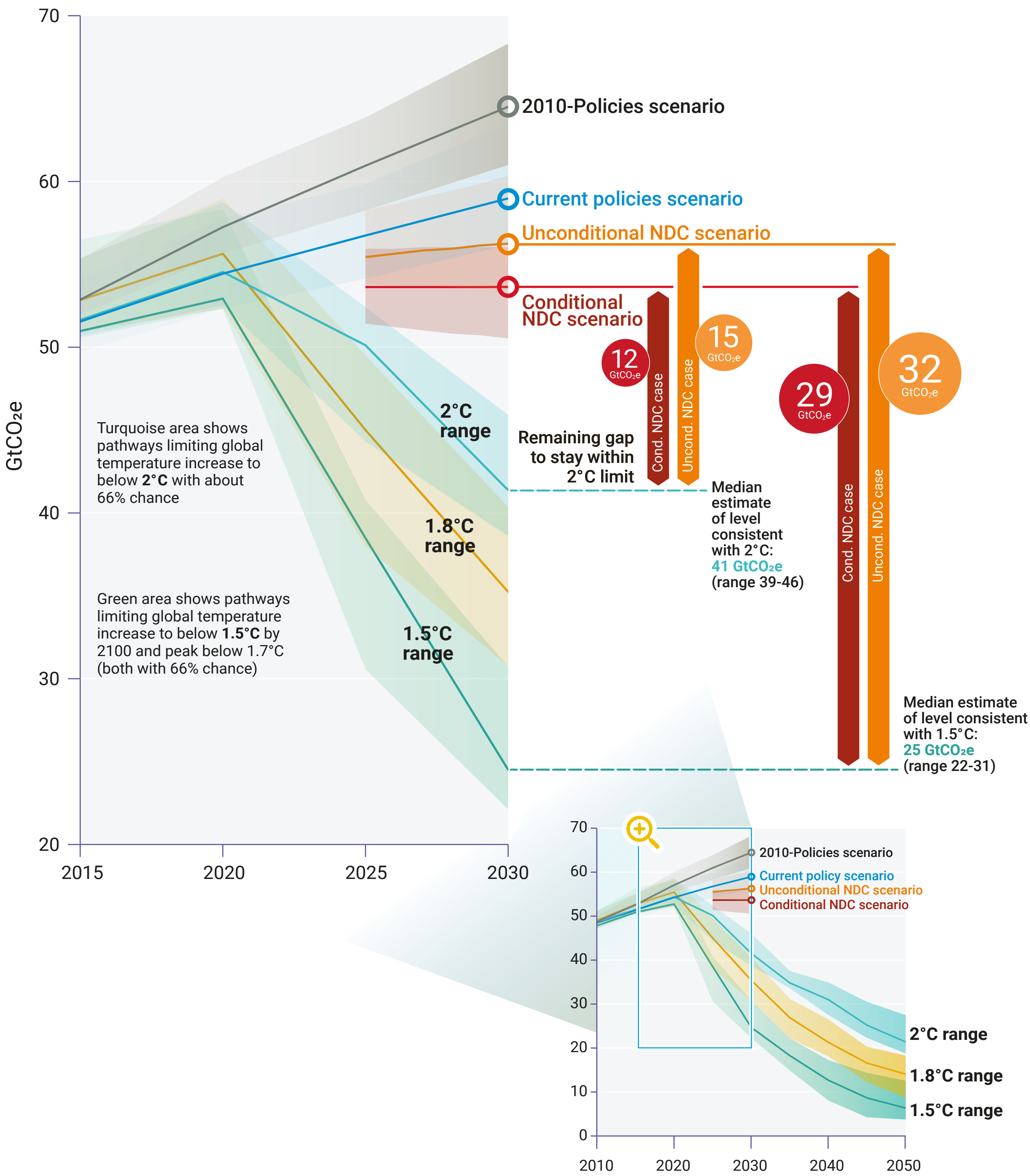


**Table 3.1.** Global total GHG emissions in 2030 under different scenarios (median and 10th to 90th percentile range), temperature implications, and the resulting emissions gap (based on the pre-COVID-19 current policies scenario)

| Scenario (rounded to the nearest gigaton) | Number of scenarios in set | Global total emissions in 2030 [$GtCO_2e$] | Estimated temperature outcomes | | | Closest corresponding IPCC SR1.5 scenario class | Emissions Gap in 2030 [$GtCO_2e$] | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 50% probability | 66% probability | 90% probability | | Below 2.0°C | Below 1.8°C | Below 1.5°C in 2100 |
| **2010 policies** | 6 | 64 (60–68) | | | | | | | |
| **Current policies** | 8 | 59 (56–65) | | | | | 17 (15–22) | 24 (21–28) | 34 (31–39) |
| **Unconditional NDCs** | 11 | 56 (54–60) | | | | | 15 (12–19) | 21 (18–25) | 32 (29–36) |
| **Conditional NDCs** | 12 | 53 (51–56) | | | | | 12 (9–15) | 18 (15–21) | 29 (26–31) |
| **Below 2.0°C (66% probability)** | 29 | 41 (39–46) | Peak: 1.7–1.8°C In 2100: 1.6–1.7°C | **Peak: 1.9–2.1°C In 2100: 1.8–1.9°C** | Peak: 2.4–2.6°C In 2100: 2.3–2.5°C | Higher 2°C pathways | | | |
| **Below 1.8°C (66% probability)** | 43 | 35 (31–41) | Peak: 1.6–1.7°C In 2100: 1.3–1.6°C | **Peak: 1.7–1.8°C In 2100: 1.5–1.7°C** | Peak: 2.1–2.3°C In 2100: 1.9–2.2°C | Lower 2°C pathways | | | |
| **Below 1.5°C in 2100 and peak below 1.7°C (both with 66% probability)** | 13 | 25 (22–31) | Peak: 1.5–1.6°C In 2100: 1.2–1.3°C | **Peak: 1.6–1.7°C In 2100: 1.4–1.5°C** | Peak: 2.0–2.1°C In 2100: 1.8–1.9°C | 1.5°C with no or limited overshoot | | | |

*Note:* The gap numbers and ranges are calculated based on the original numbers (without rounding), which may differ from the rounded numbers (third column) in the table. Numbers are rounded to full $GtCO_2e$. GHG emissions have been aggregated with 100-year global warming potentials (GWP) values of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) (to be consistent with table 2.4 of the IPCC Special Report on Global Warming of 1.5°C (SR1.5), whereas the United Nations Environment Programme (UNEP) Emissions Gap Report 2018 used GWP values of the IPCC Second Assessment Report (SAR)). The NDC and current policies emissions projections are updated from the presented numbers in cross-chapter box 11 of the IPCC SR1.5 (Bertoldi *et al.* 2018), with new studies that were published after the IPCC literature cut-off date. Pathways were grouped in three categories depending on whether their maximum cumulative $CO_2$ emissions were less than 600 $GtCO_2$, between 600 and 900 $GtCO_2$, or between 900 and 1,300 $GtCO_2$, respectively, from 2018 onwards until net-zero $CO_2$ emissions are reached, or until the end of the century if the net-zero point is not reached before. The estimated temperature outcomes represent estimates of global average surface air temperature (GSAT), most consistent with the impact assessment of the IPCC Fifth Assessment Report (AR5). Pathways assume limited action until 2020 and cost-optimal mitigation thereafter. Estimated temperature outcomes are based on the IPCC AR5 method (Meinshausen *et al.* 2011; Clarke *et al.* 2014).

**Figure 3.1.** Global GHG emissions under different scenarios and the emissions gap in 2030 (median and 10th to 90th percentile range; based on the pre-COVID-19 current policies scenario)




*Note*: This figure shows total GHG emissions. The inset shows how 1.5°C, 1.8°C and 2.0°C scenarios continue to 2050. In contrast to $CO_2$ emissions, total GHG emissions do not reach net zero by 2050 in the 1.5°C scenario, but about 10–20 years later (table 2.4 in Rogelj *et al.* 2018 and section 3.5).

As figure 3.1 shows, the gap between the unconditional NDC scenario (56 $GtCO_2e$ in 2030) and least-cost pathways limiting warming to below 2°C in 2100 with limited overshoot (41 $GtCO_2e$ in 2030) is 15 $GtCO_2e$ (range: 12–19 $GtCO_2e$), whereas the gap between the unconditional NDCs scenario and least-cost pathways limiting warming to below 1.5°C in 2100 with limited overshoot (25 $GtCO_2e$ in 2030) is 32 $GtCO_2e$ (range: 29–36 $GtCO_2e$). The full implementation of both unconditional and conditional NDCs would reduce each of these gaps by around 3 $GtCO_2e$.

The emissions gap is unchanged compared with 2019, meaning that countries need to strengthen their NDC ambitions dramatically, specifically threefold to achieve a 2°C goal and more than fivefold to achieve the 1.5°C goal.

There are two reasons why the gap has not changed. First, adjustments to the NDC scenarios have been very minor: as at November 2020, none of the major emitters had submitted new or updated NDCs with stronger NDC targets for 2030. Overall, any NDC target updates from 2019 are expected to reduce total 2030 emissions by less than 1 per cent (section 3.2.2). Second, no new 1.5°C, 1.8°C and 2.0°C scenarios have been added to the assessment since 2019.

Furthermore, the 2020 gap assessment is unaffected by the COVID-19 pandemic. As noted in figure 3.1, this gap assessment is still based on scenarios that do not specifically consider the implications of COVID-19 and related rescue and recovery measures. COVID-19 will only affect the gap assessment if the NDC scenarios and/or the 1.5°C, 1.8°C and 2.0°C long-term scenarios are affected. In turn, NDC estimates will only be affected by COVID-19 and related measures if NDCs are updated in response to the pandemic or if projections of NDC emissions from countries with intensity targets are revised. At present, there are no studies available that quantify this, but at the global scale it is expected to be only a second-order effect. Similarly, COVID-19 and associated rescue and recovery measures will only affect long-term pathways to keep global warming to 1.5°C or well below 2°C if they result in a structural shift of the economy. Although COVID-19 lockdown measures have resulted in a sharp temporary decline in global fossil fuel carbon dioxide ($CO_2$) emissions in 2020 (see chapter 2), there is currently no firm scientific evidence to confirm a structural shift of the economy towards higher or lower emissions in the long term. The gap assessment between NDCs and least-cost pathways thus remains unaffected by the COVID-19 pandemic, although current policy projections could be impacted (section 3.3).

## 3.3 Scenarios considered for the 2030 gap assessment

This section updates the scenarios considered for the 2030 emissions gap assessment. These scenarios comprise reference scenarios, NDC scenarios and least-cost mitigation scenarios starting in 2020 and consistent with specific temperature targets.

### 3.3.1 Reference scenarios and updates

Reference scenarios are used as benchmarks to track progress in emission reductions. Two reference scenarios are considered: the 2010 policies scenario and the current policies scenario.

The 2010 policies scenario projects global GHG emissions assuming no new climate policies have been put in place from 2010 onwards. Similar to the Emissions Gap Report 2019, the data for this scenario are based on the baseline projections of Shared Socioeconomic Pathway (SSP2: middle of the road) scenarios from six modelling studies that also underpin the current policies scenario projections as of 2019 (the CD-LINKS Scenario Database, version 1.0) (McCollum *et al.* 2018; Roelfsema *et al.* 2020). This scenario database has not changed for SSP2 compared with 2019.

The current policies scenario projects global GHG emissions assuming all currently adopted and implemented policies (defined as legislative decisions, executive orders, or equivalent) are realized and that no additional measures are undertaken. The data for this scenario are updated and based on the current policies projections (cut-off year for policies: 2019) of the Climate Action Tracker (2019), International Energy Agency (IEA 2019) World Energy Outlook 2019, Joint Research Centre (Prospective Outlook on Long-term Energy Systems (POLES) model) (Keramidas *et al.* 2020), and PBL Netherlands Environmental Assessment Agency (Integrated Model to Assess the Global Environment (IMAGE)) (den Elzen *et al.* 2019; Kuramochi *et al.* 2019; PBL 2020). Four international modelling groups that were also included in the 2019 report provided updated projections in Roelfsema *et al.* (2020): the International Institute for Applied Systems Analysis (IIASA, using the MESSAGE–GLOBIOM model) (Fricko *et al.* 2017); the National Institute for Environmental Studies (NIES, using the AIM model) (Fujimori *et al.* 2017); the Potsdam Institute for Climate Impact Research (PIK, using the REMIND–MAgPIE model) (Luderer *et al.* 2015); Resources for the Future Euro-Mediterranean Center on Climate Change (RFF-CMCC) European Institute on Economics and the Environment (using the World Induced Technical Change Hybrid (WITCH) model) (Emmerling *et al.* 2016). One additional modelling group was also included from Roelfsema *et al.*, the Computable Framework for Energy and the Environment (COFFEE) model of the Graduate School of Engineering (COPPE) of Universidade Federal do Rio de Janeiro (Rochedo *et al.* 2018). It should be noted that the latter five current policy projections from Roelfsema *et al.* (2020) originally use 31 December 2016 as their cut-off date for current policies. Post-2016 policies, rollback of policies since 2017, or planned policies to be implemented are not included. Policies are also assumed to be realized (Roelfsema *et al.* 2020). To ensure comparability, these latter five current policy projections have been adjusted to reflect changes to 2019. The influence of moving the policy cut-off date from 2016 to 2019 was analysed by comparing the results of the four modelling studies that provide estimates for both cut-off dates (United Nations Environment Programme [UNEP] 2017), which gave an estimated reduction of 1.5 $GtCO_2e$ (range: -0.4 to -3.0). The emissions projections of the last five modelling studies are adjusted accordingly to reflect the best estimate of the most recent current policies. Overall, this only has a small impact on the globally aggregated emissions projections for which the uncertainty ranges are large. The median estimate of global GHG emissions by 2030 for the **current policies scenario** is 59 $GtCO_2e$ (range: 56–65 $GtCO_2e$) (for comparison, 2019 emissions were 54 $GtCO_2e$), which is

1 $GtCO_2e$ lower than the median estimate of the Emissions Gap Report 2019 of 60 $GtCO_2e$ (range: 58–64 $GtCO_2e$). The change in projections varies across model studies, ranging from -0.5 to -3 $GtCO_2e$.

The current policies scenario does not take implications of COVID-19 and related rescue and recovery measures into account. These are explored in section 3.4.

**Box 3.1. Comparing emission estimates across chapters**

The historical estimates in chapter 2 are independent and should not be directly compared to the estimates in chapter 3. Under the current policies scenario used to assess the emissions gap, global 2019 GHG emissions are estimated to be about 53.6 $GtCO_2e$, which is lower than the 2019 estimate of 59.1 $GtCO_2e$ reported in chapter 2. The estimate provided in chapter 2 is derived from land-use change (LUC) emissions of 6.8 $GtCO_2e$, which differs to LUC emissions of 3.8 $GtCO_2e$ as calculated by most models used in chapter 3 (similar to Houghton and Nassikas 2017). The difference to be considered is therefore 56.7 $GtCO_2e$ against 53.6 $GtCO_2e$, which is relatively small and well within the certainty range of the emissions estimates. Both estimates show a similar increase of around 12 per cent compared with 2010 levels. There could be multiple reasons why the median emissions projections of the models (used in chapter 3) are lower than the independent historical emission estimates (used in chapter 2). For example, models may be calibrated to an earlier database (in contrast to the yearly updates of historical data), calibrations may be based on other emissions databases (such as IEA, PRIMAP or earlier versions of EDGAR), or models may not include all emission sources. The nine global models used for the current policies scenario cover a wide range of global GHG emissions for 2010 (47–50 $GtCO_2e$), whereas the historical emissions database has an estimate of 50 $GtCO_2e$.

### 3.3.2 NDC scenarios and updates

The NDC scenarios estimate the levels of GHG emissions projected as a result of the implementation of the mitigation actions pledged by countries in their NDCs. In line with previous Emissions Gap Reports, two NDC scenarios are considered: the unconditional and conditional NDC scenarios. The NDC scenarios of the 2020 report are based on the same data sources as the current policies scenario and are provided by the same 10 modelling groups as cited above, with updates for the Joint Research Centre, PBL and the Climate Action Tracker. PBL and the Climate Action Tracker have also analysed the impact of NDC target updates on global emissions by 2030 (last update 20 September 2020), which is estimated to be limited, resulting in reductions in total emissions by 2030 of less than 1 per cent compared with NDC scenarios without target updates reported since the Emissions Gap Report 2019.

The effect of the COVID-19 pandemic on projected emissions under the NDC scenarios is limited so far, as NDC targets of major emitting countries, such as the G20 economies, have not changed at this point. For countries, whose reduction targets are defined per unit of gross domestic product (GDP), in particular China and India with intensity targets, the pandemic may likely affect the NDC emissions projections due to its impact on GDP growth, though information at this level is not yet available.

### 3.3.3 Mitigation scenarios consistent with the Paris Agreement

GHG emissions by 2030 that are consistent with a least-cost pathway towards limiting global warming below 2°C, 1.8°C and 1.5°C are estimated in the same way as for the 2019 report and calculated from the scenarios underlying the IPCC Special Report on Global Warming of 1.5°C (SR1.5) (Huppmann *et al.* 2018a; Huppmann *et al.* 2018b; Rogelj *et al.* 2018). Maximum cumulative $CO_2$ emissions from 2018 onwards are used to classify scenario groups, which is consistent with the approach of the IPCC SR1.5, which groups scenarios based on their maximum temperature outcome (Intergovernmental Panel on Climate Change [IPCC] 2018; Rogelj *et al.* 2018). This approach enables a close mapping of scenarios to the maximum temperature increase they would cause and thus informs various possible interpretations of the Paris Agreement long-term temperature goal (United Nations Framework Convention on Climate Change [UNFCCC] 2015; Schleussner *et al.* 2016). A comparison with the IPCC SR1.5 approach is provided in box 3.2.

The three temperature scenario groups represent various degrees of ambition that range from limiting warming to around 2°C, to interpretations of limiting warming to well below 2°C, to pursuing to limit warming to 1.5°C (see table 3.1). Each scenario considers a least-cost climate change mitigation pathway that starts long-term reductions from 2020.

- **Below 2.0°C scenario:** This scenario limits maximum cumulative $CO_2$ emissions from 2018 until the time net-zero $CO_2$ emissions are reached (or until 2100 if net-zero emissions are not reached before)[1] to between 900 and 1,300 $GtCO_2$, and cumulative 2018–2100 emissions to at most 1,200 $GtCO_2$, when net negative $CO_2$ emissions in the second half of the century are included. It is consistent with limiting warming below 2.0°C with about 66 per cent probability, both at the time of peak global warming and at the end of the century. The median estimate of 2030 GHG emissions for this scenario is 41 $GtCO_2e$, which falls in the middle of the 36–45 $GtCO_2e$ range estimated for the lower 2°C scenario category of the IPCC SR1.5 (see table 2.4 in Rogelj *et al.* 2018).

- **Below 1.8°C scenario:** This scenario limits maximum cumulative $CO_2$ emissions from 2018 until the time net-zero $CO_2$ emissions are reached (or until 2100 if net-zero emissions are not reached before) to between 600 and 900 $GtCO_2$, and cumulative 2018–2100 emissions to at most 900 $GtCO_2$. It is consistent with limiting warming over the course and at the end of the century to below 1.8°C with about 66 per cent or greater probability. The median estimate of 2030 emissions for this scenario is 35 $GtCO_2e$. This scenario is included to provide more granular information on how emissions reduction requirements for 2030 change with gradually increasing stringency of global mitigation action.

- **Below 1.5°C in 2100 scenario:** This scenario limits maximum cumulative $CO_2$ emissions from 2018 until the time net-zero $CO_2$ emissions are reached (or until 2100 if net-zero emissions are not reached before) to 600 $GtCO_2$, and cumulative 2018–2100 to at most 380 $GtCO_2$, when net negative $CO_2$ emissions in the second half of the century are included.[2] It is consistent with limiting global warming to below 1.5°C in 2100 with about 66 per cent probability, while limiting peak global warming during the twenty-first century to about 1.6–1.7°C with about 66 per cent or greater probability. This class of scenarios is consistent with the scenarios in IPCC SR1.5°C that limit warming to 1.5°C with no or limited overshoot (explained in box 3.2; see also characteristics in table 3.1). The median estimate of 2030 emissions of 25 $GtCO_2e$ falls well within the range of 22–28 $GtCO_2e$ of the IPCC SR1.5 1.5°C scenarios with no or limited overshoot (see table 2.4 in Rogelj *et al.* 2018).

1 Potential net negative emissions that some scenarios achieve in the second half of the century are not counted towards the maximum cumulative $CO_2$ emissions used here. If a scenario does not achieve net-zero $CO_2$ emissions before 2100 but still limits warming to below a specific temperature threshold, it is assumed that global $CO_2$ emissions reach net zero immediately or shortly after 2100.

2 The 380 $GtCO_2$ value represents the highest value of cumulative $CO_2$ emissions over the 2018–2100 period found in the scenarios available for this report's analysis. In theory, a 420 $GtCO_2$ cut-off would suffice for a scenario to be included in this category based on the IPCC SR1.5 (Rogelj *et al.* 2018).

**Box 3.2. Technical comparison with the IPCC Special Report on Global Warming of 1.5°C**

The analysis included in this chapter is consistent with the latest assessment of the IPCC SR1.5 (2018). The range of Kyoto-GHG emissions in 2030 consistent with limiting warming to 1.5°C used in this report (24 $GtCO_2e$/year with a range of 22–30 $GtCO_2e$/year) closely matches the 25–30 $GtCO_2e$/year range reported in IPCC SR1.5 (2018) for scenarios limiting global warming to 1.5°C with no or limited overshoot. Differences are attributed to the exclusive use of scenarios that start emissions reductions from 2020 onwards in this report, compared with the wider set used in IPCC SR1.5. Overall, these minor changes do not affect the assessment of the adequacy of current NDCs for limiting warming to 1.5°C or well below 2°C.

Cumulative $CO_2$ emissions from 2018 onward never exceed 600 $GtCO_2$ in the below 1.5°C by 2100 scenario. This broadly corresponds to the remaining carbon budget for limiting warming to 1.5°C with 50 per cent probability (580 $GtCO_2$ from 2018 until net-zero emissions are reached) of IPCC SR1.5, suggesting that temperature overshoot is limited to less than 0.1°C with 50 per cent probability, and to 1.6–1.7°C with 66 per cent probability. Cumulative $CO_2$ emissions from 2018 until the end of the century are at most 380 $GtCO_2$ in the available scenarios, which is less than the IPCC SR1.5 remaining carbon budget of 420 $GtCO_2$ for limiting warming to 1.5°C with 66 per cent probability. Cumulative $CO_2$ emissions from 2018 onward never exceed 900 $GtCO_2$ in the below 1.8°C scenario. Using the IPCC SR1.5 assessment, this 900 $GtCO_2$ equates to a 66 per cent probability of limiting warming to about 1.8°C, and also corresponds to about a 50 per cent probability of limiting warming to 1.7°C. For the below 2°C scenario, maximum cumulative $CO_2$ emissions from 2018 never exceed 1,300 $GtCO_2$ and from 2018 to 2100 are 1,200 $GtCO_2$ when accounting for net negative emissions in the second half of the century. Using the IPCC SR1.5 assessment, this 1,200 $GtCO_2$ equates to limiting warming to below 2°C with at least 66 per cent probability by 2100, though there is a slightly lower probability at peak warming during the century. This suggest that the probability of limiting warming to 1.9°C is about 50 per cent.

*Source*: Adapted based on box 3.2 of the Emissions Gap Report 2018 (Luderer *et al.* 2018)

## 3.4 Implications of the COVID-19 pandemic and associated rescue and recovery measures on GHG emissions by 2030

The COVID-19 pandemic and associated rescue and recovery measures impact global GHG emissions. This section analyses how they impact current policy projections under different assumptions. Due to the high uncertainty surrounding how the pandemic will develop and impact $CO_2$ emissions in particular, only explorative calculations are presented. As indicated in chapter 2, 2020 global $CO_2$ emissions may drop 7 per cent (range: 2–12 per cent) below 2019 levels depending on how national epidemics and lockdowns develop over time. Almost all the emissions reductions are due to a temporary drop in activity resulting from lockdown measures, which include, for example, the transport sector, with people requested to stay home and halt travelling, as well as economic activity. Since these emissions reductions are not the result of structural changes, they may quickly reverse once lockdown measures are lifted (Forster *et al.* 2020; Le Quéré *et al.* 2020). This means that a pronounced short-term dip in energy- and industry-related $CO_2$ emissions is anticipated, after which emissions may follow the pre-2020 growth trend.

Implications of the COVID-19 pandemic and associated rescue and recovery measures on 2030 emissions and global emissions pathways towards meeting the temperature goals of the Paris Agreement were assessed in a recent study (Dafnomilis *et al.* 2020), which presents 'what if' scenarios based on explorative calculations and using sources available before June 2020. This methodology is used here, with some adjustments made to the GDP data. Using the short-term GDP projections of the Organisation for Economic Co-operation and Development (OECD) single-hit and second-hit scenarios for 2020 and 2021[3] (Organisation for Economic Co-operation and Development [OECD] 2020a; OECD 2020b), two post-COVID-19 economic growth scenarios are calculated. These economic projections are combined with two scenarios for future decarbonization rates (i.e. change in fossil $CO_2$ emissions per unit of GDP): one based on the pre-COVID-19 current policies scenario from the original model studies (labelled current trends), and one based on a post-COVID-19 scenario with lower decarbonization rates due to the rollback of current policies in countries (see chapter 2) and possible delays in climate

3 The projected GDP growth rates for 2020 and 2021 are -6 per cent and 5.2 per cent in the OECD single-hit scenario and -7.6 per cent and 2.8 per cent in the OECD second-hit scenario.

policy implementation (labelled rebound to fossil fuels). The rationale behind the second scenario is that several countries have announced emissions-intensive policies to stimulate economic recovery, therefore putting climate policies at risk of being rolled back (Climate Action Tracker 2020a; Miosio *et al.* 2020; Vivid Economics 2020). This impact is quantified by applying a decarbonization rate that is 50 per cent lower than the rate of the original model study for 2021–2024 (Dafnomilis *et al.* 2020).

The total energy and industry $CO_2$ emissions for 2021–2024 are calculated using a Kaya decomposition (Kaya 1990). For 2025–2030, fossil $CO_2$ emissions follow the same growth trend as suggested by the original model projections. The non-$CO_2$ GHG emissions and $CO_2$ land-use-related emissions for 2020–2030 are identical to the original pre-COVID-19 projections. However, preliminary data suggest that there may be an expansion of farming and livestock activities due to COVID-19-related consumption changes and market disruptions (Food and Agriculture Organization of the United Nations [FAO] 2020), which could lead to increased methane ($CH_4$) and nitrous oxide ($N_2O$) emissions. Deforestation rates in South American and Asian regions are also expected to increase due to a lack of regulatory measures, limited budgets and weak enforcement of adopted legislation to protect native ecosystems (Amador-Jimenez *et al.* 2020; Azevedo 2020; López-Feldman *et al.* 2020; Rondeau *et al.* 2020).

**Figure 3.2.** Global total GHG emissions by 2030 under the original current policies scenario based on pre-COVID-19 studies and various 'what if' scenarios using explorative calculations (post-COVID-19) (median and 10th to 90th percentile range)

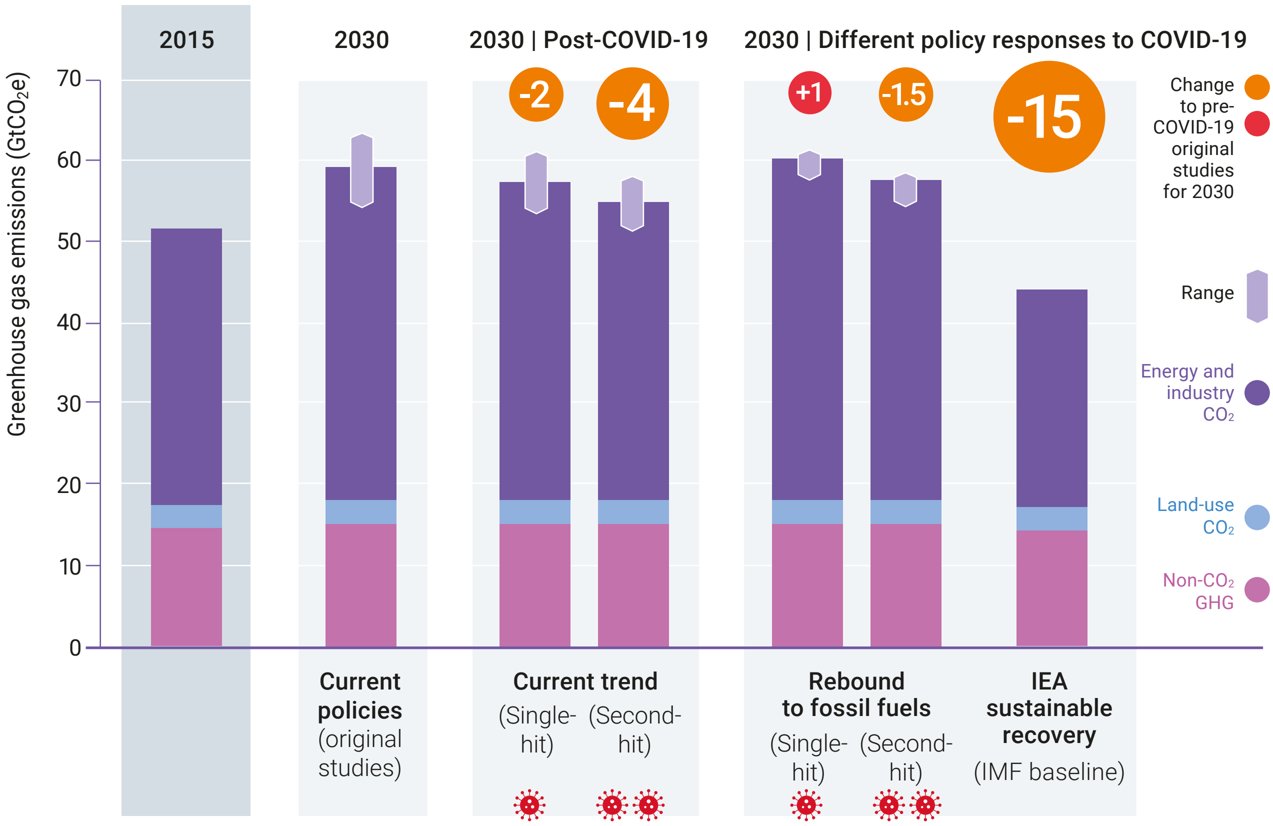



Figure 3.2 shows projected GHG emissions by 2030 under each of these scenarios. The impact of the general slowdown of the economy due to the COVID-19 pandemic and its associated policy responses (figure 3.2 – current trend) would lead to a **reduction** in global GHG emissions by 2030 **of about 2–4 $GtCO_2e$** (equivalent to 3–7 per cent) compared with the pre-COVID-19 estimates for OECD's single-hit and second-hit scenarios. This assumes a pronounced short-term dip in $CO_2$ emissions, after which emissions follow pre-2020 growth trends. The Climate Action Tracker (2020a) finds a similar difference of about 2–4 $GtCO_2e$ between the post- and pre-COVID-19 current policies projections by 2030. Comparing the IEA's World Energy Outlook 2020 (IEA 2020b) post-COVID-19 global energy and industry $CO_2$ emissions projections for their stated policies scenario[4] (estimates published in 2019) suggests a similar difference

4 No directly comparable figures could be obtained for the IEA World Energy Outlook 2020 (2020c) because the 2020 edition does not provide current policies scenario projections. The following are used instead: i) the stated policies scenario, in which COVID-19 is gradually brought under control and the global economy return to pre-crisis levels the same year (this scenario reflects all current announced policy intentions and targets); ii) the delayed recovery scenario, which is designed with the same policy assumptions as the stated policies scenario, but shows lasting damage to economic prospects following a prolonged pandemic (IEA 2020c).

of about 1.5–4 $GtCO_2e$ between the post- and pre-COVID-19 stated policies projections by 2030.

If the initial short-term dip in $CO_2$ emissions is followed by growth trends with lower decarbonization rates due to countries' potential rollback of climate policies as part of COVID-19 responses, the decrease in global emissions by 2030 is **projected to be significantly smaller at around 1.5 $GtCO_2e$** (instead of 4 $GtCO_2e$) and may actually **increase by around 1 $GtCO_2e$** (instead of -2 $GtCO_2e$) (figure 3.2 – rebound to fossil fuels second-hit and single-hit scenarios, respectively) compared with the pre-COVID-19 current policies scenario.

Around the world, countries are launching economic rescue and recovery measures to cushion the impacts of the COVID-19 pandemic. Future global GHG emissions depend critically on the extent to which recovery measures are green (low carbon), which at present is difficult to evaluate comprehensively (see chapter 4). At the global level, the impact of 'green recovery' responses can be estimated based on the IEA's (2020a) Sustainable Recovery Plan and its associated global energy and industry $CO_2$ emissions projections under the IEA (2020b) sustainable recovery scenario. For the GHG emissions projections in figure 3.2, the IEA's energy and industry $CO_2$ emissions were supplemented with land-use $CO_2$ and non-$CO_2$ emissions projections under current policies of the model studies underlying the original current policies scenario. The emissions projections in figure 3.2 also adopted the IEA's (2020b) assumption of a 0.8 $GtCO_2e$ emissions reduction following investments to tackle $CH_4$ leakages from oil and gas operations by 2024, and kept this reduction constant to 2030. Figure 3.2 shows that 2030 emissions are only projected to be significantly reduced if COVID-19 economic recovery is used as an opportunity to pursue strong decarbonization. The sustainable recovery scenario results in global GHG emissions of 44 $GtCO_2e$ by 2030, which is a **reduction of 15 $GtCO_2e$** (just over 25 per cent) compared with the original current policies scenario used for the emissions gap assessment, and would bring 2030 emissions within the range consistent with least-cost pathways that limit global warming to below 2°C (table 3.1). More dedicated attention would be required to reach levels consistent with limiting global warming to below 1.8°C or 1.5°C.

As noted in the beginning of this section, the emissions projections for the post-COVID-19 policy scenarios are highly indicative. They are based on simple calculations compared to the model-based pre-COVID projections and are driven by a wide range of GDP estimates for 2020 and 2021 from the OECD single-hit and second-hit scenarios published in June 2020 (OECD 2020a; OECD 2020b). The more recent GDP estimates of the IMF (2020) (June) and the OECD (2020c) Economic Outlook (September) are both within the projected GDP range of the OECD June estimates. Applying the more recent GDP estimates would result in GHG emissions projections for 2030 that are closer to those of the current trends scenario (figure 3.2 – single-hit). It should be noted that the post-COVID-19 projections do not yet include information based on announcements of specific economic recovery measures (Miosio *et al.* 2020; Vivid Economics 2020). GHG emissions projections greatly depend on the starting point of calculations, in this case, the impact of COVID-19 on 2020 $CO_2$ emissions, and are therefore likely to change in the coming months as the pandemic evolves and a vaccine becomes available worldwide. At present, it is unclear how temporary changes in international trade, consumption and mobility in urban areas will evolve in the medium term. Once countries lift lockdown measures, patterns are expected to return to pre-COVID-19 levels. Similarly, it is uncertain how oil market prices will evolve and how oil exporters and producers will adapt to price changes of fossil resources. The projections reported in this chapter are therefore highly preliminary and primarily provide an indication of the magnitude of the direct effect of COVID-19 and related measures.

## 3.5 Implications of the emissions gap for the feasibility of achieving the long-term temperature goal of the Paris Agreement

The previous sections clearly show that current NDCs remain insufficient to bridge the emissions gap by 2030 and that the size of the gap is as large as the 2019 assessment's estimate. They also indicate that emissions continue to rise under the (pre-COVID-19) current policies scenario and that COVID-19 is only likely to significantly reduce total GHG emissions by 2030 if used as an opening for economic recovery that fosters strong decarbonization. This section examines the implications of inadequate and delayed short-term action in achieving the long-term temperature goals of the Paris Agreement.

### 3.5.1 Implications of postponing action in the context of long-term zero emissions goals

Achieving the long-term temperature goals of the Paris Agreement to limit global warming to well below 2°C and pursue 1.5°C depends strongly on implementing mitigation action by 2030. Taking a longer-term perspective illustrates how the low-carbon transition challenge until 2050 depends critically on this near-term action.

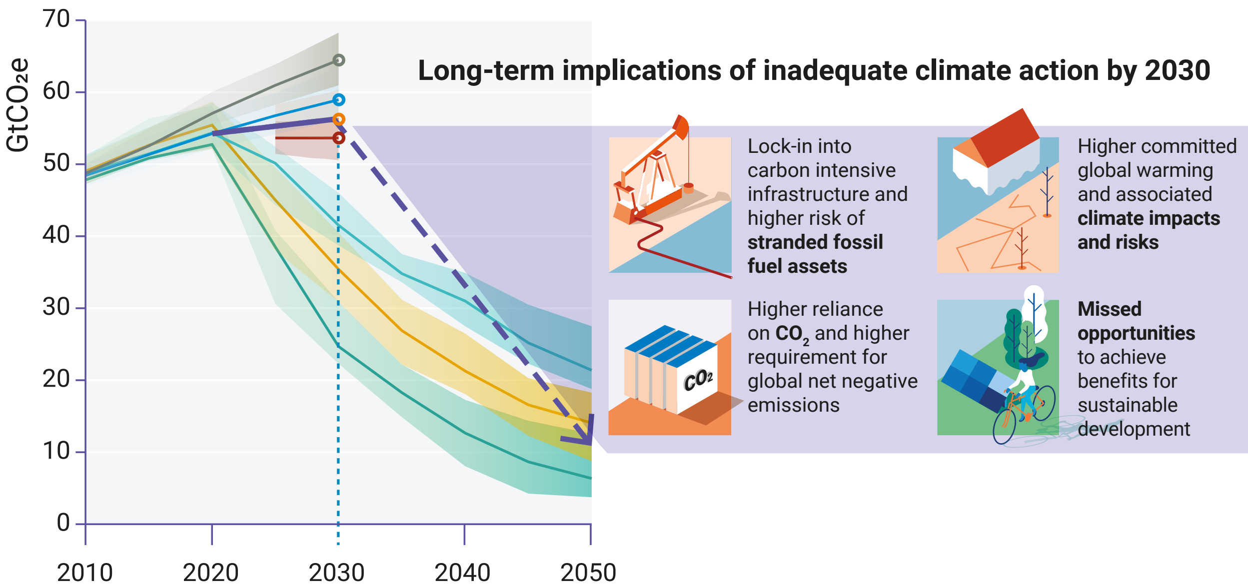
The Paris Agreement aims to reach net-zero GHG emissions in the second half of this century, which means that any remaining $CO_2$ and non-$CO_2$ emissions are balanced with net $CO_2$ removal or negative emissions. When calculated using the 100-year global warming potentials (GWPs) typically applied by the United Nations Framework Convention on Climate Change (UNFCCC) to compare different GHGs, global warming will peak and then gradually decline thereafter. The timing of global net-zero $CO_2$ and GHG emissions provides milestones for pathways that are consistent with the Paris Agreement and can be estimated from long-term emissions scenarios. According to the IPCC SR1.5, limiting warming to 1.5°C with no or limited overshoot requires global $CO_2$

and GHG emissions to reach net zero around 2050 (range: 2046–2055) and 2067 (range: 2061–2084), respectively. For temperature limits higher than 1.5°C, the timing would be later (see table 2.4 in Rogelj *et al.* 2018). It should be noted that these net-zero target years are for the global pathways and therefore need to be achieved collectively. Setting net-zero targets for individual countries involves considerations of equity and fairness, which means that national net-zero targets do not necessarily have to coincide with the net-zero years and global pathways.

Previous Emissions Gap Reports have highlighted the key implications of postponing mitigation action and failing to bridge the 2030 emissions gap (Luderer *et al.* 2018), which are summarized in figure 3.3. Furthermore, the implications of postponed action are apparent when looking across the Emissions Gap Reports produced to date (UNEP 2019; Höhne *et al.* 2020). The global average emissions reductions required per year to meet 2030 emission levels that are consistent with the 2°C and 1.5°C scenarios are by now approximately quadruple and more than double, respectively, what they would have been had serious collective climate action started in 2010. This remarkable increase in annual emission reduction rates due to the lack of sufficient action add significantly to the challenge of meeting the Paris Agreement.

The conclusion is clear: postponing ambitious climate action, thereby delaying the path towards reaching net-zero emissions, will make it impossible to achieve the Paris Agreement temperature goal of limiting global warming to 1.5°C. Greater climate action is therefore needed by 2030 to make reducing global GHG emissions to levels consistent with 1.5°C pathways feasible.

**Figure 3.3.** Long-term implications of not closing the emissions gap by 2030




To illustrate, the six 1.5°C pathways available from the literature that limit the availability of biomass with carbon capture and storage (CCS) and that aim to maximize synergies with sustainable development all have GHG emission levels of at most 25 $GtCO_2e$ by 2030 (Bauer *et al.* 2018; Bertram *et al.* 2018; Grübler *et al.* 2018; Holz *et al.* 2018; Huppmann *et al.* 2018b; Kriegler *et al.* 2018; Rogelj *et al.* 2018; van Vuuren *et al.* 2018).

Similar insights can be drawn for limiting warming to well below 2°C. In the absence of significant climate action by 2030, the daunting challenge that lies beyond 2030 suggests that limiting global warming to even slightly higher levels than 1.5°C would effectively be out of reach – a conclusion that is also highlighted in the IPCC SR1.5 (Rogelj *et al.* 2018).

### 3.5.2 Global warming implications

Emissions until 2030 do not fully determine the levels of warming by the end of the century. However, the trend until 2030 can be used to estimate the projected warming based on the assumption that this trend will continue until 2100. The method used in previous Emissions Gap Reports has been followed to link 2030 GHG emissions and their continuation until 2100[5] to projected warming throughout the twenty-first century (Rogelj *et al.* 2016). This approach results in global warming estimates that are consistent

5 Since most scenarios that are used to inform the extension of emissions after 2030 assume exponentially increasing carbon prices throughout the century, the method applied here also implicitly assumes that climate action continues to be strengthened until 2100.

with temperature outcomes found in the wider integrated scenario literature (Jeffery *et al.* 2018).

Since current policies and NDC scenarios have not changed since the 2019 report, the estimated temperature implications remain the same. The unconditional NDCs are consistent with limiting warming to no more than 3.2°C (range: 3.0–3.5°C) by the end of the century (with 66 per cent probability). Full implementation of both conditional and unconditional NDCs would lower this estimate by about 0.2°C. In contrast, the current policies scenario (pre-COVID-19) results in greater emissions by 2030, which if continued until the end of the century would result in a global mean temperature rise of 3.5°C by 2100 (range: 3.4–3.9°C, 66 per cent probability). In all cases, global warming would not be stabilized by 2100 and would continue to increase thereafter.

These global warming ranges do not consider the growing number of announced net-zero emission goals, such as China's 2060 announced net-zero carbon goal, the European Union's 2050 net-zero GHG emissions goal, the United Kingdom's legally enshrined 2050 net-zero GHG emissions goal, and South Africa's aspirational 2050 net-zero carbon emissions goal. Japan and the Republic of Korea have also announced similar goals. Although detailed studies of the temperature outcomes of these targets are not yet available, a preliminary estimate carried out for this report suggests that, collectively, these targets could further lower the temperature projections consistent with unconditional NDCs by about half a degree Celsius to around 2.7°C. If the United States of America were to also adopt a net-zero GHG emissions target by 2050, as suggested in the Biden-Harris climate plan, the combined effect of all net-zero targets would be further strengthened. In that case, projections until the end of the century are estimated to be 2.5–2.6°C, which is 0.6–0.7°C lower than the global warming estimate for current unconditional NDCs. This is consistent with other preliminary analyses (Climate Action Tracker 2020c). Once countries submit their announced net-zero targets as long-term low GHG emission development strategies to the UNFCCC, temperature projections can more formally reflect these intentions.

The 2020 analysis makes it clear that neither NDCs nor current policies are adequate to limit warming below the temperature limits included in the Paris Agreement. This inadequacy is even further emphasized when considering the cumulative $CO_2$ emissions by 2030 as implied by current NDCs. Starting from the 2018 level of global $CO_2$ emissions of 41.6 $GtCO_2$ (Le Quéré *et al.* 2018) and assuming a straight trajectory to 2030, the current unconditional NDC scenario implies cumulative emissions of about 510 $GtCO_2$ (range: 495–528 $GtCO_2$) until 2030. Meanwhile, the IPCC SR1.5 estimated that the remaining carbon budget starting from 2018 and consistent with limiting warming to 1.5°C (with 50–66 per cent probability) amounts to around 320–480 $GtCO_2$, which rises to 700 $GtCO_2$ and 1,070 $GtCO_2$ for limiting warming to 1.75°C and 2°C (with 66 per cent probability), respectively.[6] Current NDCs therefore fully deplete the carbon budget consistent with limiting warming to 1.5°C and strongly reduce the remaining budgets for limiting warming to well below 2°C, without making any progress towards bringing global $CO_2$ emissions closer to net zero.

Finally, COVID-19 containment measures have resulted in a marked but temporary reduction in global GHG emissions in 2020. However, unless economic recovery is used as an opportunity to foster a low-carbon transition, this temporary blip in global GHG emissions is estimated to result in no more than a 0.01°C reduction of global warming by 2050, which by then is expected to have exceeded 1.5°C (IPCC 2018; Forster *et al.* 2020). NDCs to date fail to reverse the long-term upward trend in emissions, which leaves no doubt that the current NDCs are completely inadequate to achieve the climate goals of the Paris Agreement.

6 These values consider the impact of Earth system feedbacks such as permafrost thaw, as assessed in the IPCC SR1.5.