Chapter 3

# The emissions gap and its implications

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## 3.1 Introduction

The Paris Agreement aims to limit global average temperature increase to well below 2°C relative to pre-industrial levels and to pursue efforts to further limit it to 1.5°C. In 2015, almost all countries submitted national climate action plans and commitments for 2025 or 2030: their Intended Nationally Determined Contributions (INDCs). These form the foundation of the Paris Agreement, which entered into force on 4 November 2016. For the 168 countries that have to date (24 October 2017) ratified this Agreement, the INDCs have become Nationally Determined Contributions (NDCs).

This chapter provides an update on the mitigation challenge associated with the global temperature goal of the Paris Agreement, and the estimated global emission levels under various assumptions regarding the implementation of current policies and NDCs or INDCs (hereafter referred to as NDCs, unless specifically mentioned in relation to a country that has not ratified the Paris Agreement) (section 3.2 and 3.3). It also assesses the additional impact of the Kigali Amendment and the International Civil Aviation Organization (ICAO) Agreement (section 3.3), before further exploring the projected impact up to 2030 of the current policies and NDCs on emissions for each G20 member and considering how the ambition of NDCs can be compared across countries (section 3.4). Finally, the chapter provides an update on recent estimates of emission reduction potentials by subnational and non-state actor action (section 3.5).

## 3.2 Scenarios considered in the emissions gap assessment

### *3.2.1 Overview of scenarios*

In line with the 2016 Emissions Gap Report, the assessment of the emissions gap draws on six scenarios (Rogelj *et al.*, 2016). These comprise:

- Two reference scenarios:
  - *No-policy baseline scenario*, which projects global greenhouse gas emissions based on the assumption that no new climate policies are put into place from 2005 onwards.
  - *Current policy scenario*, which provides best estimates of future global emissions taking all currently adopted and implemented policies[1] into account, but assuming that no additional mitigation action is taken beyond these policies.
- Two NDC scenarios[2]:
  - *Unconditional NDC scenario*, where Parties with NDCs are assumed to implement only the portions of their targets that are without conditions, while Parties that solely have a conditional target are assumed to follow a current policy scenario.
  - *Conditional NDC scenario*, where all Parties with NDCs in addition to their unconditional targets are assumed to implement their conditional targets, and Parties that only have an unconditional target are assumed to implement that target.
- Two scenarios that limit global warming to below 2°C and 1.5°C, respectively:
  - *2°C scenario*, which is based on global emission scenarios that assume limited action until 2020 and least-cost emission reduction pathways from 2020, and are consistent with a greater than 66 percent

1 These are defined as legislative decisions, executive orders, or their equivalent.
2 In both the unconditional and conditional NDC cases, it is assumed that for any traded international offsets, each unit is counted towards the NDC of a single country only – either the buyer or the seller – to avoid issues of double counting.

chance of limiting global warming in 2100 to below 2°C above pre-industrial levels.

- *1.5°C scenario*, which is based on global emission scenarios that assume limited action until 2020 and least-cost emission reduction pathways from 2020, and are consistent with a 50-66 percent chance of limiting global warming in 2100 to below 1.5°C above pre-industrial levels.

The assessment draws on multiple individual scenarios from the published literature. Each scenario is global in scope, reflecting possible actions by all countries (for further details, see Appendix A, available online). It should be noted that the two NDC scenarios assume full implementation of the conditional and unconditional NDCs for all countries, including the United States of America, as the NDC of the United States of America has not yet been officially repealed. Section 3.3 discusses the impact of a possible withdrawal of the United States of America from the Paris Agreement.

In line with the 2016 Emissions Gap Report (UNEP, 2016) and as indicated above, the 2017 assessment mainly draws on 1.5°C scenarios that assume least-cost pathways starting from 2020 and return global warming to below 1.5°C in 2100 with a lower (50–66 percent) probability than for the 2°C scenarios (greater than 66 percent probability) (see box 3.1 for additional information about these scenarios). New studies are emerging that provide least-cost pathways from 2020 consistent with a greater than 66 percent chance of limiting global warming in 2100 to below 1.5°C. The preliminary findings of these new studies and their implications for the 2030 global emission levels are summarized in section 3.2.3. More studies are under way and will be fully integrated into the gap assessment next year, as current estimates may still change during the review process of the studies. Box 3.1 provides a discussion of the extent to which the 1.5°C and 2°C least-cost pathways are informed by the growing damages that increasingly are being attributed to early impacts of climate change.

Table 3.1 provides an overview of the projected global emission estimates under the six scenarios considered for the assessment in this report, showing the median global emission levels for 2025 and 2030 — the years countries use in their NDCs.

### Box 3.1 How are recent extreme events reflected in the 1.5°C and 2°C pathways used in the Emissions Gap Report?

With drought in Africa, floods in South Asia and repeated hurricanes in the Caribbean, 2017 will probably prove to have been a record year for the human, social and economic cost of extreme weather events. Although it would be a mistake to attribute all extreme weather events to the impact of climate change, there is growing evidence that climate change may be contributing to the their increasing frequency and severity.

It would be logical to think that the damage caused by climate change should affect the least-cost pathways that are at the core of the analysis in this report: the earlier and more severe the damage, the stronger the case for early action to reduce emissions.

Some models, such as the Dynamic Integrated Climate-Economy (DICE) model, do indeed incorporate damage functions (Nordhaus, 2017). These are a subset of Integrated Assessment Models that combine physical and economic elements and are termed 'cost-benefit Integrated Assessment Models'. These cost-benefit studies monetize the impacts of climate change and then balance the economic implications of mitigation and climate damages to identify the optimal trajectory of emissions reductions that will maximize total welfare (see box 6.1 in Clarke et al., 2014). However, since by design such scenarios do not achieve a specific climate goal, they are less directly useful as a benchmark to assess pathways towards achieving the long-term temperature goal set in Paris.

For this reason, the Emissions Gap Report makes use of a different class of Integrated Assessment Models, termed 'cost-effectiveness' models (see Weyant (2017) for a discussion of all types of Integrated Assessment Models). These models distribute the emission reductions across regions, sectors and gases in such a way that the global discounted reduction costs are minimized over time, and the climate target is achieved ( Rogelj et al., 2016; Clarke et al., 2014). In practice, the Emissions Gap Report selects pathways that aim to limit global mean temperature increase to either 1.5°C or 2°C relative to pre-industrial levels, with varying levels of probability. This means that, unless decision makers decide to make the global climate target even more ambitious, the benchmark pathways used in the Emissions Gap Report will not change in response to the impact of extreme weather events.

It does not follow that decision makers can ignore the impact of extreme weather. The events of 2017 reinforce the case for early and sustained action to reduce emissions.

**Table 3.1:** Global total greenhouse gas emissions in 2025 and 2030 under different scenarios (median and 10th to 90th percentile range).

| Emissions estimates ($GtCO_2e$/year) (rounded to the nearest gigatonne) | | | |
|---|---|---|---|
| **Scenario** | Global total emissions in 2025 | Global total emissions in 2030 | Number of scenarios in set |
| **No-policy baseline** | 61.0 (56.7–64.3) | 64.7 (59.5–69.5) | 179 |
| **Current policy trajectory** | 55.4 (53.5–56.8) | 58.9 (57.6–60.7) | 4 |
| **Unconditional NDCs** | 53.8 (50.6–55.3) | 55.2 (51.9–56.2) | 10 |
| **Conditional NDCsa** | 52.2 (49.3–54.0) | 52.8 (49.5–54.2) | 10 (6+4) |
| **2°C pathways (more than 66% chance 2°C, least-cost from 2020)[b]** | 47.7 (46.2–50.2) | 41.8 (30.6–43.5) | 10 |
| **1.5°C pathways (50- 66% chance 1.5°C, least-cost from 2020)[c]** | 44.5 (43.1–45.5)[d] | 36.5 (32–37.7)[d,e] | 6 |

Note:
Ranges are computed as described in Rogelj *et al.* (2016). In cases where estimates are based on less than 10 scenarios, the minimum-maximum range is provided. The row of "Conditional NDCs" is only provided for information, as a direct comparison with the "Unconditional NDCs" ranges is not possible, due to arbitrary model sampling differences. The emissions range for 1.5°C is smaller than for 2°C, as fewer studies for 1.5°C are available. Source: adjusted from Rogelj *et al.* (2016).

[a] Assuming full implementation of both unconditional and conditional NDCs. Six studies provided an estimate for the conditional NDC case. The median estimate of influence derived from these six studies is used to adjust the unconditional NDC estimate of the four remaining studies that did not include conditional NDC estimates. The estimated improvement of moving from the unconditional to the conditional case is in the range of 2.4 (1.2–3.0 GtCO2e/year, full range).

[b] As in UNEP (2015): greater than 66 percent probability of limiting global average temperature increase to below 2°C in 2100 (probabilities never drop below 60 percent during the entire century).

[c] As in UNEP (2016): 50 percent to 66 percent probability of limiting global average temperature increase to below 1.5°C in 2100 (allowing median global average temperature to temporarily exceed the 1.5°C limit before 2100).

[d] These numbers have been harmonized to the same 2010 emissions levels as the 2°C pathways.

[e] Forthcoming peer-reviewed research indicates that this median value is broadly consistent with results for scenarios that assume a middle-of-the-road future socio-economic development (cf. SSP2 Fricko et al., 2017). At the same time, recent research suggests that the ranges, however, could be extended further at the lower end (Rogelj et al., 2017a), that is 32-34 $GtCO_2e$/year.

## Box 3.2 The impact of uncertainties

Additional research is necessary, as the uncertainty ranges overlap for many countries and since the number of studies available for the current policy trajectory case and the NDC cases vary significantly. A recent study (Rogelj et al., 2017a) explores six dimensions that contribute to uncertainties in the assessment of emissions outcomes of NDCs. These comprise (i) variations in overall socioeconomic conditions, such as Gross Domestic Product and population growth, (ii) uncertainties in historical emission inventories, (iii) the conditionality of certain NDCs, (iv) the definition of NDC targets as ranges instead of single values, (v) the way in which renewable energy targets are expressed, and (vi) the way in which traditional biomass use is accounted for, as renewable energy or otherwise. They find that depending on assumptions in these six dimensions, NDC estimates can range from 47 to 63 $GtCO_2e$/year in 2030, which is a wider range than the 50 to 56 $GtCO_2e$/year combined unconditional and conditional NDC scenario range of this report (table 3.1). Uncertainties in socioeconomic developments are the dominant driver, accounting for more than half of the uncertainty, followed by uncertainties in the way renewable energy targets are expressed. These uncertainties are not fully accounted for in the range of this study, as this is based on the central estimates of all studies that individually make implicit or explicit assumptions on the above-mentioned uncertainties.

Another issue is the accounting of land-use-related mitigation, which has been identified as an important source of uncertainty (Forsell et al., 2016; Grassi et al., 2017; Rogelj et al., 2016), but is not explored explicitly in Rogelj *et al.* (2017a). Grassi *et al.* (2017) find a current ±3 $GtCO_2e$/year difference in global LULUCF net emissions between country reports (data submitted to UNFCCC, such as greenhouse gas inventories and national communications) and scientific studies (as reflected in Intergovernmental Panel on Climate Change (IPCC) reports). Among the many possible reasons for these differences, Grassi et al. suggest that a key factor, which deserves further analysis, relates to what is considered 'anthropogenic sink'.

Finally, there is some additional uncertainty around the impact of Global Warming Potentials. There is no consistency in the historical data and the future projections across the studies in the use of Global Warming Potentials. Some studies use the Global Warming Potentials from the IPCC Second Assessment Report (AR2) consistently for all countries, whereas others use the Global Warming Potentials from the IPCC Fourth and Fifth Assessment Reports (AR4 and AR5), depending on the NDC information. With regard to the magnitude of uncertainty related to the choice of Global Warming Potentials, global total greenhouse gas emissions for 2014 are reported to be 3 percent higher when the IPCC Fourth Assessment Report (AR4) Global Warming Potentials are used, compared to when the IPCC Second Assessment Report (AR2) Global Warming Potentials are used (Gütschow et al., 2017). The difference can be larger at a country level when, for example, the share of Methane ($CH_4$) emissions in total greenhouse gas emissions of a country is larger than the global average.

The studies from which the current policy trajectory scenario and the NDC scenario are drawn differ in a number of respects, such as their treatment of conditional versus unconditional NDCs; assumptions regarding non-covered sectors and gases; treatment of land use, land-use change and forestry (LULUCF) and surplus emission units; different bases for calculating Global Warming Potentials. These differences are further described in the 2016 Emissions Gap Report, which also provides a fuller discussion of the six scenarios. The methodological differences between the studies cannot be fully harmonized, which leads to some uncertainty as indicated in the results presented in section 3.3, where the implications of the differences between studies are also further explored (see also box 3.2).

### 3.2.2 Updates to the assessment

The emissions estimates presented in table 3.1 are based on the 2016 Emissions Gap Report (UNEP, 2016), but updates have been made in a number of cases.

There are no updates to the no-policy baseline scenario compared to the 2016 report. However, the *current policies* projections at the global level have been updated, drawing on data from the Climate Action Tracker (CAT, 2017), the Joint Research Centre (Kitous *et al.*, 2017), PBL Netherlands Environmental Assessment Agency (den Elzen *et al.*, 2016a; Kuramochi *et al.*, 2016; PBL, 2017), and the International Energy Agency (IEA, 2016).

The global emissions projections of the two *NDC scenarios* have also been updated with data from the four above-mentioned modelling studies, and with updated data from Climate Interactive (2017).

The estimates for the 2°C *pathways* with higher than 66 percent probability in 2100 remain unchanged since the 2016 Emissions Gap Report.

The estimates for the 1.5°C *pathways* with 50-66 percent probability in 2100 have been updated, resulting in 2030 global emission estimates that are around 3 $GtCO_2e$ lower than those in the 2016 Emissions Gap Report. The update is based on: (a) the inclusion of new data that have become available from scenarios generated with updated or other modelling frameworks, and (b) the harmonization of the 1.5°C pathways with the same global 2010 emissions as for the 2°C pathways. The new data considered lower the 2030 emission estimates by around 1 $GtCO_2e$ and have also expanded the emissions range. Under the assumption of continued historical socioeconomic trends, Rogelj *et al.* (2017a) find emissions in 2030 in the range of 35-37 $GtCO_2e$/year, whereas when assuming enhanced efforts to limit energy demand and a shift towards sustainable consumption patterns, cost-optimal emission levels in 2030 are estimated at 32-34 $GtCO_2e$/year.

The harmonization has been undertaken to resolve a discrepancy between the global emissions in 2010 of the 1.5°C pathways and the 2°C pathways[3]. More specifically, the global emissions in 2010 of the 1.5°C pathways included in the 2016 Emissions Gap Report were about 3 $GtCO_2e$ higher than the median 2010 levels of the 2°C pathways. This resulted in higher global emissions by 2020 for the 1.5°C pathways compared to the 2°C pathways. The harmonization brings the 2010 global emission estimates to the same level for the assessed 1.5°C pathways and 2°C pathways, and leads to comparable 2020 emission levels for the two pathways. This harmonization further affects the projected global emission levels in 2030, lowering them by around a further 2 $GtCO_2e$. The estimated global emission level is about 5 $GtCO_2e$ lower than the central estimate for the 2°C pathways, as shown in table 3.1.

### 3.2.3 Emerging studies on pathways with a greater than 66 percent chance of limiting global warming to below 1.5°C

The strengthened temperature targets of the Paris Agreement and the forthcoming 2018 Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emissions pathways by the IPCC have generated substantial interest in scenarios that assume least-cost pathways starting from 2020 and that have a higher than 66 percent probability of returning global warming to 1.5°C in 2100.

For the 2016 Emissions Gap Report, no such scenarios were available. Therefore the report focused on the least-cost pathways starting from 2020 that had a lower probability (50 percent) of returning global warming to below 1.5°C in 2100, based on a review by Rogelj *et al.* (2015) of earlier published scenarios (Luderer *et al.*, 2013; Rogelj *et al.*, 2013a; Rogelj *et al.*, 2013b).

However, new scenarios are now emerging that assume least-cost pathways starting from 2020 that can return global warming to below 1.5°C in 2100 with at least 66 percent probability. These are reported in the ADVANCE project's policy briefs (Luderer *et al.*, 2016; Vrontisi *et al.*, 2016) and its forthcoming paper (Vrontisi *et al.*, 2017). At the ninth meeting of the research dialogue at the Subsidiary Body for Scientific and Technological Advice (SBSTA) in Bonn, May 2017, Rogelj *et al.* (2017b) also presented the first draft of least-cost 1.5°C pathways starting from 2020 based on a multi-model comparison study and the framework of the Shared Socioeconomic Pathways (Riahi *et al.*, 2017)[4].

These higher probability 1.5°C scenarios have extensive implications for 2030 global emission levels. Vrontisi *et al.* (2016) reported scenarios from various models that assume least-cost pathways starting from 2020 that can return global warming to below 1.5°C in 2100 with at least 66 percent probability. Emission levels in 2030 for 1.5°C scenarios are estimated at 24 (range: 19–34) $GtCO_2e$, which is about

3 The harmonization is based on the average outcome of adopting the three harmonization methods from the literature (Rogelj *et al.*, 2011).

4 These scenarios represent an extension of the set of 'Representative Concentration Pathways' (RCPs) towards scenarios that limit end-of-century forcing to 1.9 $W/m^2$.

18 $GtCO_2e$ lower than the central estimate for the 2°C pathways (table 3.1).

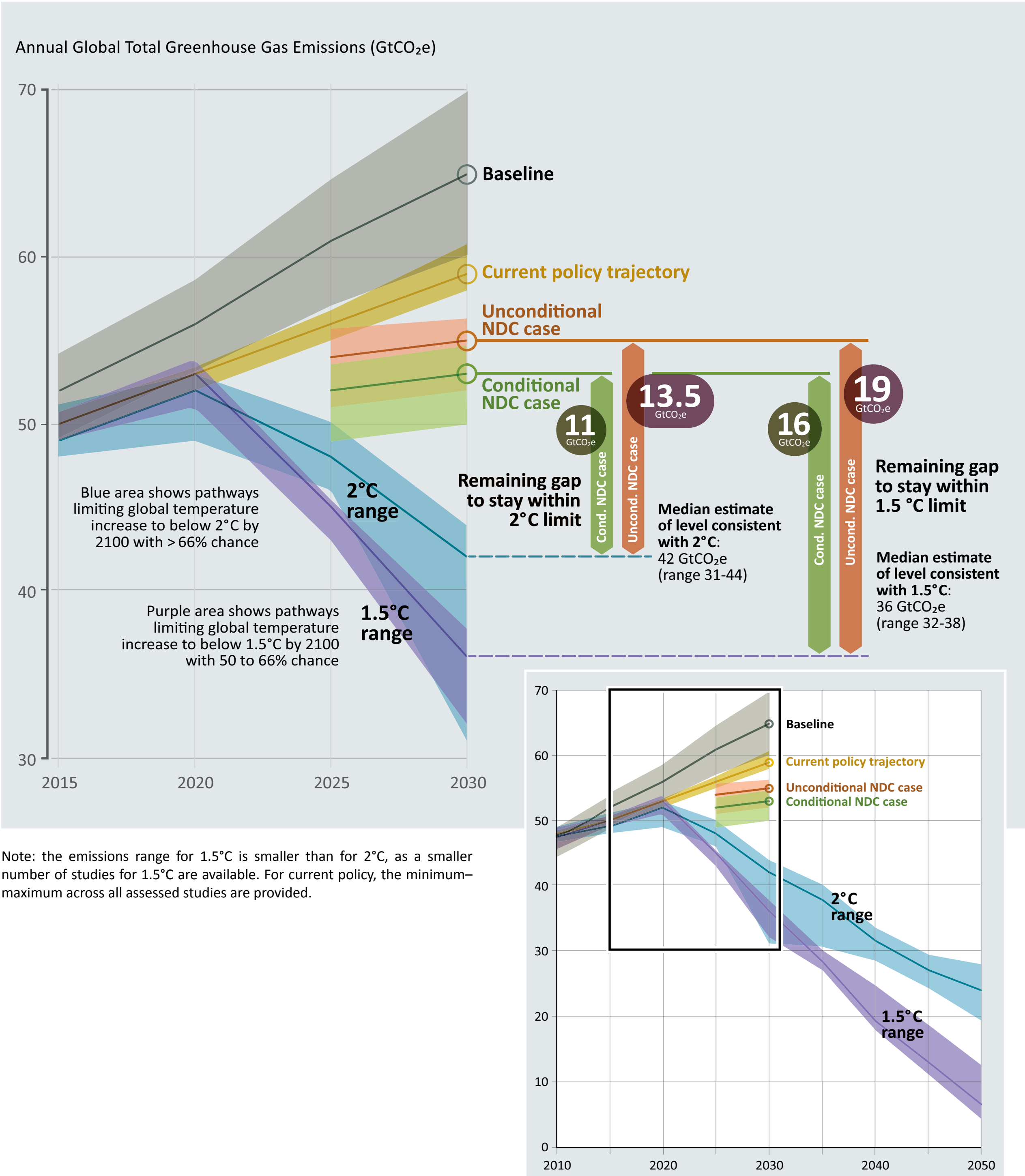
## 3.3 The emissions gap in 2030 and urgency of action

This section updates the 2030 emissions gap from previous reports (section 3.3.1) and examines the implications of the estimated emission levels associated with the NDC scenarios for peaking of emissions, depletion of the carbon budget and global average temperature increase by the end of the century (section 3.3.2). It then assesses the potential positive effects on the 2030 emissions gap of two important agreements outside the UNFCCC: the Kigali Amendment and the International Civil Aviation Organization Agreement.

### *3.3.1 The effect of NDCs on global greenhouse gas emissions and the resulting emissions gap*

This section presents the emissions gap for 2030, drawing on the estimated global total greenhouse gas emission levels in 2030 under the six scenarios described in section 3.2 and provided in table 3.1. As in previous reports, the emissions gap in 2030 is defined as the difference between global total greenhouse gas emissions from least-cost scenarios that are consistent with the below 2°C and 1.5°C temperature target

**Figure 3.1:** Global greenhouse gas emissions under different scenarios and the emissions gap in 2030 (median estimate and 10th to 90th percentile range).




Note: the emissions range for 1.5°C is smaller than for 2°C, as a smaller number of studies for 1.5°C are available. For current policy, the minimum–maximum across all assessed studies are provided.

and the expected global total greenhouse gas emissions implied if NDCs are fully implemented. Findings regarding the aggregate effect of full implementation of the NDCs on global total greenhouse gas emissions in 2025 and 2030 are also compared to the emissions implied by the no-policy baseline scenario and the current policy scenario.

The results are illustrated in figure 3.1, which shows that the emissions gap in 2030, compared with least-cost pathways limiting global warming to below 2°C with a greater than 66 percent chance, ranges from 11-13.5 $GtCO_2e$ for the full implementation of the conditional and the unconditional NDCs respectively. These estimates are slightly lower than those made in 2016 (12-14 $GtCO_2e$), due to updated information from five global studies resulting in lower emission projections for the NDCs. The emissions gap in the case of least-cost pathways limiting global warming to below 1.5°C with 50–66 percent chance is 16-19 $GtCO_2e$ for conditional and unconditional NDCs respectively. This is higher than the estimates made in 2016 (15-17 $GtCO_2e$) due to the updated 1.5°C pathways (see section 3.2). As indicated by the emerging new studies, the gap would be significantly larger if a higher probability (>66 percent) of limiting global temperature increase to 1.5°C in 2100 was considered.

It is apparent from figure 3.1 that current policies lead to emissions that are markedly lower than the baseline, which assumes that no additional climate policies are put in place from 2005. This indicates that the baseline will become increasingly less useful as a reference case. The current policies projections have lowered by about 1 $GtCO_2e$ compared with the estimate made in 2016, mainly due to lower current policy projections from China.

Figure 3.1 shows that full implementation of the **unconditional NDCs** will reduce annual global greenhouse gas emissions in 2030 by 9 $GtCO_2e$[5] (range: 8–13) relative to the median no-policy baseline, and by 4 $GtCO_2e$ (range: 2–7) relative to the median current policy trajectory. Comparing these cost-optimal 2°C and 1.5°C scenarios with the unconditional NDC projections shows a large discrepancy. More specifically, there is a gap in 2030 of 13.5 $GtCO_2e$ (range: 10–15) between the unconditional NDC scenario and the median 2°C scenario. Comparing the unconditional NDC scenario with the median global emissions pathway consistent with meeting 1.5°C with a 50–66 percent chance leads to a gap of 19 $GtCO_2e$ (range: 15-21), which is 2 $GtCO_2e$ higher than the gap in the 2016 report, due to the lower 1.5°C emissions pathways.

In comparison, if countries were to also fully implement the **conditional NDCs**, estimated global greenhouse gas emissions would be about 2.4 $GtCO_2e$ (range: 1.2–3.0) lower in 2030 compared with the unconditional NDC scenario case. This leaves a gap in 2030 of 11 (range 8–12) $GtCO_2e$ between the conditional NDC scenario and the median cost-optimal 2°C scenario. Comparing the conditional NDC scenario with the median 1.5°C scenarios (50–66 percent chance) increases the gap to 16 $GtCO_2e$ (range: 13–18).

It should be noted that the two NDC scenarios assume full implementation of the conditional and unconditional NDCs submitted by all countries. Considering the announcement of the United States of America regarding its withdrawal from the Paris Agreement and policy changes in the United States of America, section 3.4 also discusses recent studies estimating possible effects on the United States of America's emissions.

The gap calculations assume that there is no double counting of reductions. In other words, transferred reductions are only counted towards the achievement of one country's NDC, not towards both the country buying and selling. The Paris Agreement provides for voluntary use of "international transferred mitigation outcomes", such as trading of offset credits, on the basis that parties shall avoid double counting. If, in a theoretical scenario, all Parties were to freely double count (contrary to the provisions of the Paris Agreement), this could increase the global emissions by 2030 by 0.8 $GtCO_2e$ in the case of both unconditional and conditional NDCs[6].

### 3.3.2 The implications on peaking, carbon budget and temperature

Global total greenhouse gas emissions (covering all sectors and gases) are expected to increase and not peak before 2030 under both the NDC scenarios and the current policy scenario. New actions would be necessary to change this. In contrast, the 2°C and 1.5°C least-cost pathways assume that global total greenhouse gas emissions peak no later than in 2020. This stresses the urgency of strengthening mitigation action as well as NDCs before 2020, as Chapter 2 also concludes.

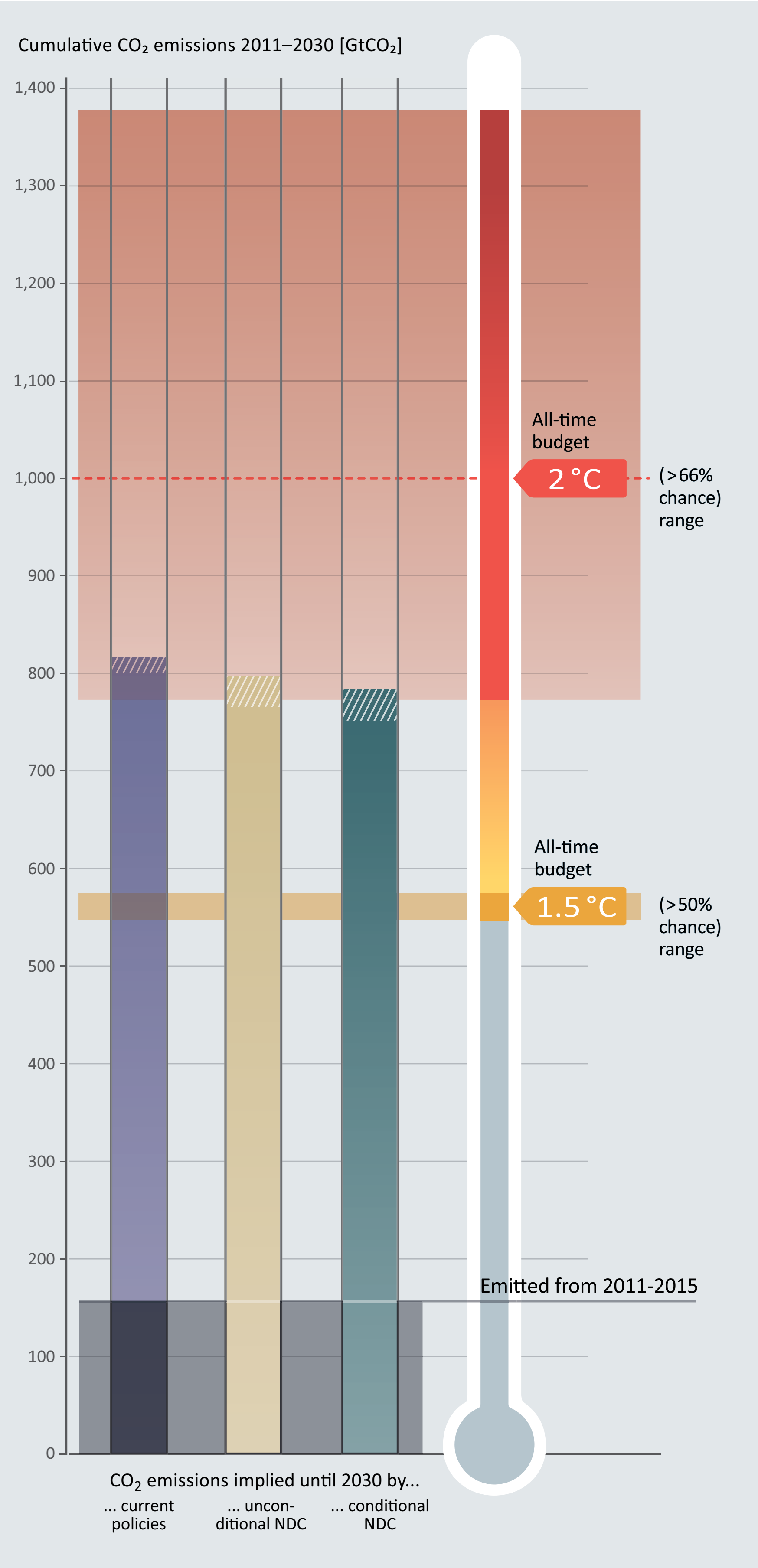
Another indication of the urgency of action concerns the implications of projected global total $CO_2$ emissions for the carbon dioxide ($CO_2$) budget. The $CO_2$ budget indicates the total cumulative $CO_2$ emissions that can be emitted for temperatures to stay below 2°C and 1.5°C[7]. If the NDCs are fully implemented, they will result in cumulative emissions of 750-800 $GtCO_2$ during the 2011–2030 period, which is about 80 percent of the remaining $CO_2$ budget of 1,000 $GtCO_2$ (range: 750-1,400) for limiting global warming to below 2°C with more than 66 percent probability. The available global carbon budget for 1.5°C with 50-66 percent probability will already be well depleted by 2030. A recently published paper (Millar *et al.*, 2017) suggests that the available budget for 1.5°C

5 The gap numbers and ranges in the text are rounded to the nearest Gt.

6 Consistent with the earlier analysis of double counting in the UN Environment 2014 Emissions Gap Report, for the NDC cases it is assumed that international emission offsets could account for 33 percent of the difference between current policies trajectory and emission levels for the NDC cases by 2030 for the OECD countries. This is an arbitrary, conservative estimate, as many parties have yet to specify any limits on the use of transferable units.

7 Box 2-1 (UNEP, 2014) explains how cumulative $CO_2$ emissions are influenced by various factors, such as the transient climate response to cumulative carbon emissions and non-$CO_2$ greenhouse gases.

**Figure 3.2:** Comparison of projected emissions by 2030 and all-time 1.5°C and 2°C carbon budgets.




Note: The figure shows cumulative global total $CO_2$ emissions for the conditional NDC case, the unconditional NDC case and the current policies scenario, and carbon budgets from the Fifth Assessment Report of the IPCC (IPCC AR5) (IPCC, 2014a). The carbon budget ranges show the values based on the range of scenarios assessed by Working Group III (IPCC, 2014b). The solid horizontal line at 1,000 $GtCO_2$ shows the estimate based on complex Earth-System Models, assessed by Working Group I (IPCC, 2014a). Historical emissions until 2015 are based on Le Quéré *et al.* (2015).

might be bigger. However, criticism on the study points to the fact that using different global average temperature data sets in the calculations would not lead to higher budgets[8].

Finally, the urgency of action and enhanced ambition becomes unquestionable when the global average temperature implications of the NDCs are taken into consideration. Estimates of the level of global average temperature increase associated with the implementation of the NDCs depend on the assumptions made about what will happen after 2030, and the probability assigned to the global average temperature increase. Previous Emissions Gap Reports adopt the approach of Rogelj *et al.* (2016), which assumes that, as a minimum, the level of climate mitigation effort implied by the NDCs is continued after 2030, until the end of the century. As reported in the 2016 Emissions Gap Report, full implementation of unconditional NDCs and comparable action afterwards is consistent with a global average temperature increase of about 3.2°C (median, range: 2.9–3.4°C) relative to pre-industrial levels with greater than 66 percent probability by 2100. Full implementation of the conditional NDCs would lower the projection by about 0.2°C by 2100.

### 3.3.3 Impact of the Kigali Amendment

The Kigali Amendment to the Montreal Protocol aims to phase down production and imports of hydrofluorocarbons (HFCs), thereby reducing hydrofluorocarbon emissions, which is in the spirit of the Paris Agreement to reduce greenhouse gas emissions to net zero. It solidifies the international efforts and provides more certainty that national measures to reduce these emissions will be implemented. Against a no-action baseline, the reductions could be in the order of 0.7 $GtCO_2e$/year in 2030 (Höglund-Isaksson *et al.*, 2017).

The Kigali Amendment may have a lower *additional* impact against the NDCs, but one that is uncertain as countries are not clear about the extent to which such reductions are already covered by the NDCs. Most countries set targets for all greenhouse gases including the hydrofluorocarbons. For them, implementing the commitments of the Kigali Amendment will not necessarily lead to lower hydrofluorocarbon emissions than implementing the NDC. Some, most notably China, have not included these emissions in their NDC. For them, the implementation of the Kigali Amendment would lead to lower emissions than implementing the NDC and would, therefore, narrow the emissions gap.

The long-term impact of the Kigali Amendment is assessed in Chapter 6, which shows that it can be substantial.

8 https://www.carbonbrief.org/factcheck-climate-models-have-not-exaggerated-global-warming ; http://www.realclimate.org/index.php/archives/2017/09/is-there-really-still-a-chance-for-staying-below-1-5-c-global-warming/

### 3.3.4 Impact of the International Civil Aviation Organization Agreement

The International Civil Aviation Organization is the United Nations body responsible for international civil aviation emissions of $CO_2$ under Article 2.2 of the Kyoto Protocol. Although international aviation is not explicitly identified under the Paris Agreement, it is assumed that the International Civil Aviation Organization will continue to take responsibility for international emissions.

The International Civil Aviation Organization adopted a target of 'Carbon Neutral Growth from 2020', that is no increase of international aviation emissions of $CO_2$ from 2020 onwards. In order to achieve this, the International Civil Aviation Organization agreed a global market-based measure, the 'Carbon Offsetting and Reduction Scheme for International Aviation' (CORSIA) at the 39th International Civil Aviation Organization Assembly (Resolution A39-3) in 2016. The Carbon Offsetting and Reduction Scheme for International Aviation relies on emissions offsetting and work is currently ongoing on agreeing a monitoring, reporting and verification system and defining the emissions units and registries to be used. In addition, the International Civil Aviation Organization is working on implementing technical measures to increase efficiency or the use of sustainably sourced low-carbon fuels to also contribute to the target of 'Carbon Neutral Growth from 2020'.

As of 2015, total emissions of aviation $CO_2$ are estimated to be of the order of 0.9 $GtCO_2e$ (International Energy Agency data)[9], around 62 percent of which are international. Domestic emissions fall under the reporting and reduction plans of States. International aviation emissions are expected to grow from 0.5 $GtCO_2e$ in 2017 to around 1.1 $GtCO_2e$ in 2030 with increasing traffic demand over the coming decades, despite emission reductions from operational improvements, aircraft technology and utilization of sustainable alternative fuels. If growth after 2020 is compensated by offsets, emissions of the order of 0.3 $GtCO_2e$/year in 2030 could be saved over the reference development. This is consistent with the International Civil Aviation Organization's own estimate[10].

Given that participation in the first phases of the Carbon Offsetting and Reduction Scheme for International Aviation is voluntary, that certain developing countries are permanently exempt, and that its actual effectiveness depends on its implementation by States, the impact of the Carbon Offsetting and Reduction Scheme for International Aviation is still uncertain. So far, around 70 States have declared their commitment to join the Carbon Offsetting and Reduction Scheme for International Aviation.

9 Here, aviation $CO_2e$ emissions are effectively $CO_2$ emissions alone, the sector having no significant emissions of methane, Nitrous Oxide ($N_2O$) etc. Aviation does have non-$CO_2$ impacts, however, from emissions of particles, Nitrogen Oxides (NOx) and water vapour that impact on Ozone ($O_3$), reduce methane, and affect cloudiness but these are not estimated in $CO_2e$ since the scientific uncertainty of doing so in terms of Global Warming Potential100 is still rather large (Fuglestvedt *et al.*, 2010; Lee *et al.*, 2009; Lee *et al.*, 2010).

10 https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ3.aspx estimates range from 0.288-0.376 $GtCO_2$ per year in 2030.

Whether the offsetting under the Carbon Offsetting and Reduction Scheme for International Aviation reduces the emissions gap (between the NDCs and what is needed for the Paris Agreement long-term goals) also depends on the quality of the offsets that are allowed under the Carbon Offsetting and Reduction Scheme for International Aviation regime. The gap (as defined in this report) would be narrowed if only offsets that reduce emissions beyond the NDC of the country that was selling the offsets were allowed. The gap would not be narrowed if credits were allowed that were already counted towards meeting the countries' NDCs. This would be the case, for example, for Clean Development Mechanism (CDM) projects initiated several years ago that keep operating regardless of whether or not the Clean Development Mechanism credits are sold, and whose reductions are included in the current emission trajectory of the country selling the offsets (Schneider *et al.*, 2017). Whether the offsetting under the Carbon Offsetting and Reduction Scheme for International Aviation reduces the emissions gap also depends on the level of participation.

Hence, the International Civil Aviation Organization Agreement to reduce greenhouse gas emissions from aviation may have an impact of between 0 and 0.3 $GtCO_2e$ on closing the emissions gap in 2030.

## 3.4 Understanding the current emission trends of G20 members

### *3.4.1 A comparison of current emission trends of G20 members*

This section presents a comparison of country-specific findings for the G20 members. To assess these, figure 3.3 shows the projected impact up to 2030 of the NDCs and current policies on greenhouse gas emissions for each G20 member. As mentioned in Chapter 2, these economies collectively generate around three quarters of global greenhouse gas emissions. Therefore their success in implementing (or exceeding) their NDCs will have a major impact on the achievement of global climate goals.

NDCs are not static or one-off commitments; countries have the obligation to strengthen them regularly. The assessment conducted in this section is on current NDCs, acknowledging that they can be revised in the future.

For each of the G20 members, median emission projections resulting from the current policies and full implementation of the NDCs is calculated. As described in box 2.2 in Chapter 2, current policies projections from independent analyses presented in Chapter 2 cover the main energy and climate policies implemented as of a recent cut-off date and do not consider prospective policies that are being debated or planned.

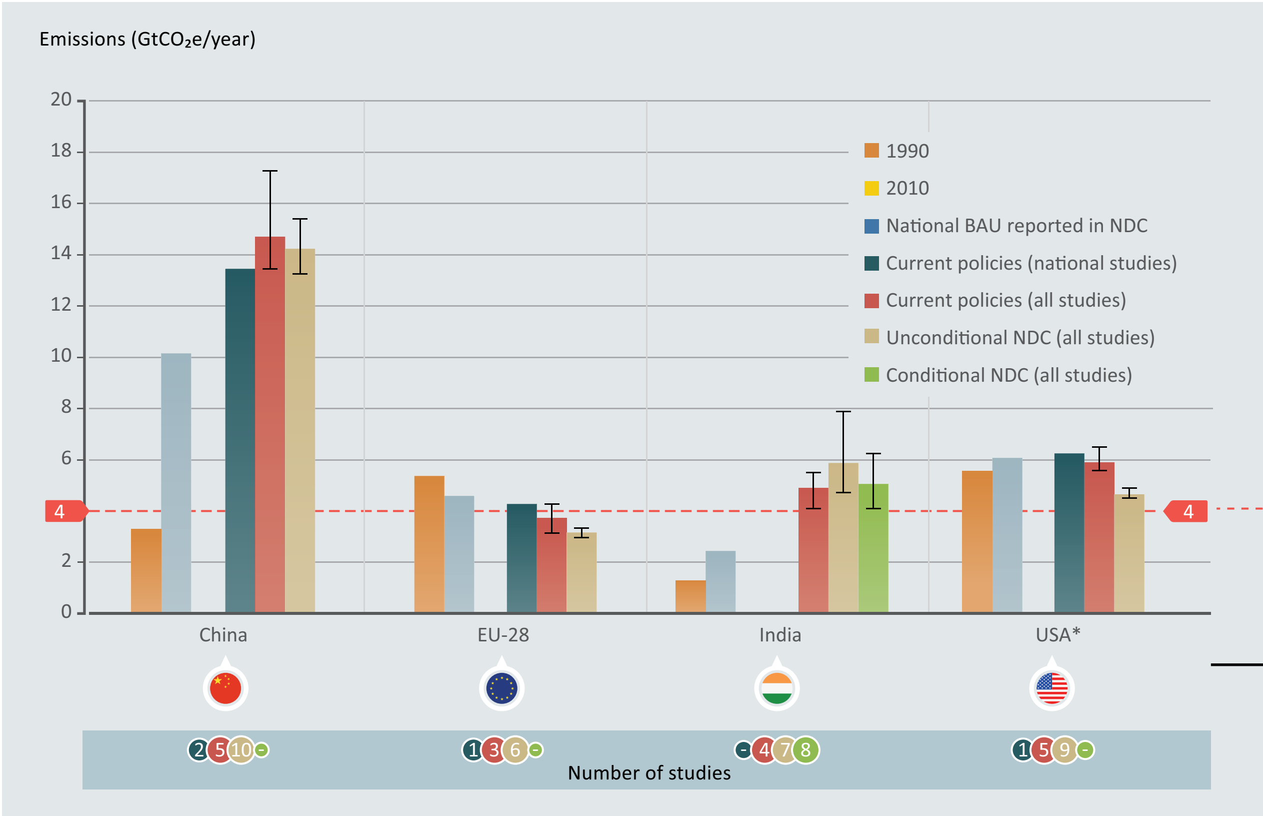
The calculation is based on the same data as the 2016 Emissions Gap Report was (UNEP, 2016), but updates have been used for: the current policies and the NDC projections from the Climate Action Tracker (CAT, 2017); the International Energy Agency (IEA, 2016); the Joint Research Centre (Kitous *et al.*, 2017); PBL Netherlands Environmental Assessment Agency (den Elzen *et al.*, 2016a; Kuramochi *et al.*, 2016; PBL, 2017); updated NDC projections from Climate Interactive (2017); and some updated national and official studies (Reputex, 2016; Sha *et al.*, 2017) (see Appendix A available online). More specifically, the data is sourced from: (i) the official estimates included in the NDCs (UNFCCC, 2015a); (ii) calculations based on the NDCs and on other documents submitted by countries to the UNFCCC (such as national greenhouse gas inventories, national communications, biennial reports, and biennial update reports); (iii) estimates published in country-specific studies; and (iv) eight independent global analyses[11]. These are described in further detail in Appendix A, which is available online.

The results of this assessment are presented for all G20 members in figure 3.3 (with the 28 European Union members represented collectively instead of by the four Member States, who are individual G20 members), noting that data are not available for all countries for all studies. By comparing the current policy scenarios and the NDC scenarios, the figure provides an indication of whether or not a country needs to implement policies additional to the current policy trajectory to meet its NDC target. The figure does not indicate the level of ambition of the NDC targets. Box 3.3 considers possible principles for assessing and comparing the ambition of NDCs across countries. It is also important to note that the current policy trajectory scenarios, which attempt to reflect the most recent mitigation policies, differ from the baseline or 'business as usual' (BAU) scenarios employed by some countries, which typically assume that no new policies are adopted or implemented after a given cut-off year.

11 The UNFCCC synthesis report and the Danish Energy Agency (DEA) study are excluded here, as these studies do not provide national estimates.

**Figure 3.3: Greenhouse gas emissions (all gases and sectors) of the G20 members by 2030.**

**Figure 3.3 a**




* For the US, the unconditional NDC is for 2025.

Note: Greenhouse gas emissions (all gases and sectors) of the G20 members by 2030 for the BAU emissions projection from the NDC submission (third bar), for the current policies scenario from official and national studies (fourth bar), from all studies, including official, national and global model studies (fifth bar), for the unconditional NDC scenario (sixth bar), and for the conditional NDC scenario (seventh bar). For current-policy and NDC scenarios respectively, the minimum–maximum and 10th–90th-percentile range across all assessed studies are provided. The uncertainty ranges are explained in the main text. For reporting reasons, the emissions projections for China, European Union, India and United States of America are shown in panel (a), and the other countries in panel (b), with different vertical axis. The figure also shows the number of studies underlying the estimate (if available) for the last four bars: current policies (national studies), current policies (all studies) and the unconditional NDC and conditional NDC (all studies).

Figure 3.3 shows that for many countries the implementation of their NDC would lead to lower emissions than the current policies scenario, or in other words that additional policies would have to be implemented to meet the NDC target. For some countries the NDC is above the current policies scenario, indicating that it should be possible to enhance ambition quite easily. For eight G20 members, the NDC is above 2010 emission levels.

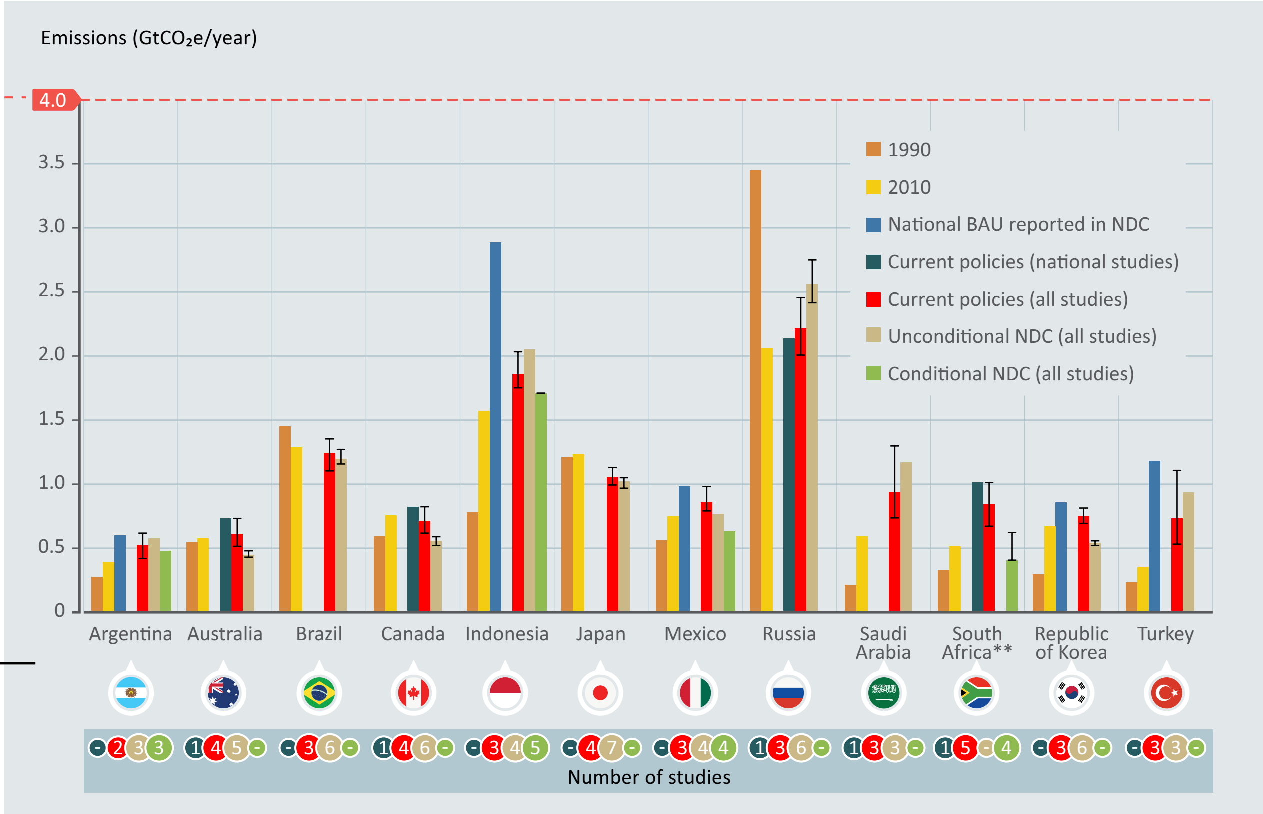
Recent studies suggest that Brazil, China, India and Russia are likely to – or are roughly on track to – (over)achieve their (unconditional) 2030 targets through their currently implemented policies.

Argentina, Australia, Canada, the European Union, Indonesia, Japan, Mexico, South Africa, Republic of Korea and the United States of America are likely to require further action in order to meet their NDCs, according to government and independent estimates.

From the existing studies, it is not possible to determine whether Saudi Arabia and Turkey are on track to meet their NDCs.

Figure 3.3 furthermore illustrates that the progress on cutting down greenhouse gas emissions varies across the G20 countries. For 11 of the 16 G20 members (counting the 28 European Union members as one), emission projections based on current policies are higher than their 2010 emission levels. More specifically, for some non-OECD Member States (Argentina, China, India and Saudi Arabia) as well as for some OECD Member States (Australia, Mexico, Republic of Korea and Turkey), currently implemented policies do not stop annual emissions from increasing until 2030. Annual emissions in other countries are projected to remain stable at about 2010 levels (including in Canada, Russia and the United States of America), or to decrease further (such as in the European Union with a 7–32 percent reduction compared to 2010 levels), under current policies. The following section provides more detail on each of the G20 members.

**Figure 3.3 b**




** South Africa's INDC is based on an emissions trajectory with an emissions range of 398–614 $MtCO_2e$ including LULUCF over the period 2025-2030.

## Box 3.3 Comparing the ambition of countries' NDCs

When countries put forward their NDCs for the Paris Agreement, they were asked to explain why these are ambitious. These explanations can be used to derive metrics to compare countries' actions.

The literature on assessing the ambition of NDCs is growing. It compares different energy and climate indicators between countries and analyses what would be necessary in terms of national ambition to be compatible with the Paris Agreement (Aldy *et al.,* 2016; Climate Transparency, 2017; Höhne et al., 2017). Höhne *et al.* (2017) argue that only a comprehensive approach that covers all perspectives can be used to assess the ambition of national climate policy. Many principles could be used by countries to assess ambition, including (based on Höhne et al. 2017):

- **A country's reduction of emissions since 1990 (or any other base-year):** the standard perspective for developed countries used since 1992, also used in the Kyoto Protocol – the metric used by the European Union, for example.
- **Change in recent trend in emissions:** a country would do more than before – the main argument in the proposal by the United States of America. This can also be measured as a deviation from a BAU scenario.
- **Time and level of peaking emissions per capita:** countries go through different levels of development with first rising, then peaking and then declining emissions – the metric chosen by China.
- **Comparison with equity-based effort-sharing calculations:** There is a long history of scientific studies that use 'effort-sharing' principles to calculate 'fair' emission targets for countries. The principles include responsibility (for example those who emitted more in the past now have to reduce more) or capability (for example those with higher per capita income levels should do more), equality (that is equal emission rights per capita), cost-effectiveness (total abatement cost per Gross Domestic Product), as well as combinations.
- **Comparison with benchmarks of decarbonization indicators:** A number of indicators can be used to describe countries' circumstances and developments, for example at the national level, emissions per Gross Domestic Product, emissions per capita, energy use per capita or the energy mix. At the sectoral level it could be emissions per kilometre travelled or per tonne of cement or steel produced. Indicators can measure activity (for example vehicle kilometres travelled) or intensity (emissions per vehicle kilometre) (see also the data portal of the Climate Action Tracker).
- **In line with globally cost-effective model pathways:** Modelling exercises can identify the country reductions required to minimize the aggregated global costs of emission reductions. As a result, reductions are required in those sectors and countries where they are least-cost from a global perspective.
- **Comparison with best practice policy package or policy menu:** A comparison can be made on the extent to which a country has implemented supporting policies, addresses barriers, or has counterproductive policies in place. A contribution can be regarded as ambitious if it includes many policies that are considered good practice, while it would be less ambitious if the country were not to implement the policies that most of its peers had already successfully implemented (see also climate policy database[12], Climate Transparency 2017).

Comprehensive studies that evaluate diverse metrics are not yet available. However, their inclusion would be very useful in future Emissions Gap Reports, as well as for the further processes under the UNFCCC, including the Facilitative Dialogue in 2018 and the global stocktake in 2023.

### *3.4.2 NDCs and emission trends of individual G20 members*

**China's** NDC includes four major targets: (1) an intention to peak $CO_2$ emissions around 2030, making best efforts to peak earlier, (2) to reduce the carbon intensity of Gross Domestic Product by 60–65 percent from 2005 levels by 2030, (3) to increase the share of non-fossil fuels in primary energy consumption to around 20 percent by 2030, and (4) to increase the forest stock volume by around 4.5 billion $m^3$ from 2005 levels by 2030. For the first two targets, the NDC does not clarify which sectors are covered (Damassa *et al.*, 2015). Recent independent studies (Climate Action Tracker, 2017a; den Elzen *et al.*, 2016b; IEA, 2016; Sha *et al.*, 2015) suggest that China's emissions under currently implemented policies would roughly be in line with what the NDC targets would mean for overall emissions, but do not provide strong indication that $CO_2$ emissions would peak before 2030[13]. Total greenhouse gas emissions are projected to keep on growing up to 2030, albeit at a much lower rate than previously observed, which is also concluded in the analysis of Jiang *et al.* (2017). Several studies have revised their projection for 2030 downward compared to last year's projection.

Driven by air pollution control action policies (State Council, 2013), China started to control coal use and promote clean energy use in 2012. Together with economic structural

12 www.climatepolicydatabase.org, https://newclimate.org/2015/12/01/good-practice-policies/

13 Some analysts have argued that structural shifts in the economy in recent years make likely much steeper reductions in the $CO_2$ intensity of Gross Domestic Product. Fergus and Stern (2017) include an illustrative pathway wherein intensity is halved from 2005 to 2020, and the result is a peak in $CO_2$ emissions between 2020 and 2025.

changes, this resulted in a slowdown of most energy-intensive production, a peak in coal consumption in 2013 in physical unit and in 2014 in standard coal equivalents, and continued decline from 2014. Coal consumption reduced by 4.7 percent in 2015, and 3.7 percent in 2016 (China Statistic Year Book, 2017). Due to the increase in natural gas and petroleum production, the total $CO_2$ emissions have started to decline after 2014. Based on the energy use data, energy related $CO_2$ emissions are around 450 $MtCO_2$ lower in 2016 than in 2014, which amounts to 5 percent of total $CO_2$ emissions from energy activities. Despite a small increase in emissions from clinker manufacture, $CO_2$ emissions in 2016 are still 430 $MtCO_2$/year lower than in 2015 (China Statistic Year Book, 2017).

In the last two years, newly installed capacity on wind power, solar power, and hydropower has increased to more than 120 GW, which together with 11 GW newly installed capacity for nuclear has dominated the global newly installed capacity for low-carbon power. Low-carbon power accounts for more than 40 percent of global newly installed capacity in the last two years (CEC, 2017; REN21, 2017).

Due to structural change in the industry sector, energy demand increase is projected to be quite low, with energy demand by 2020 much lower than that projected in government planning. Based on scenario analysis, the increase in energy demand in the near future could be provided by renewable energy, nuclear and natural gas. Given the recent trends, coal decline could continue. Taking into account these recent developments, $CO_2$ emissions may already have peaked, or may not increase in the future (Green and Stern, 2017), a development that is not yet included in the studies cited above and may be visible in future Emissions Gap Reports.

Meanwhile, the **European Union's** NDC contains a commitment of a 40 percent reduction in domestic emissions by 2030 compared to 1990. Recent independent studies (CAT, 2017; Kitous *et al.*, 2016) and the European Environment Agency (EEA) Trends report (EEA, 2016) suggest that the European Union will fall slightly short of its NDC target under existing policies.

**India's** NDC commits to, by 2030, reduce its emissions intensity of Gross Domestic Product by 33–35 percent below 2005 levels, increase the share of non-fossil energy in total power generation capacity to 40 percent, and create an additional cumulative carbon sink of 2.5–3 $GtCO_2e$ through additional forest and tree cover. In figure 3.3, unconditional NDCs assume either current policies or only the intensity target, while conditional NDCs assume full implementation of the NDC, including the non-fossil fuel target. Independent studies project that the emission level under the intensity target would be overachieved, but it is uncertain what emission level would be reached under all three targets combined (Climate Action Tracker, 2017a; Mitra *et al.*, 2017; PBL, 2017). Recent policy developments include the Draft Electricity Plan published in December 2016 (Central Electricity Authority, 2016). Although this is currently not an official policy and is in a draft stage, the analysis in the document forecasts that no new coal-fired power capacity would be required during the period 2022–2027, in contrast to around 50 GW of additional capacity expected for the period 2017–2022 (Central Electricity Authority, 2016). As a result, the share of renewables in total installed capacity in this scenario is projected to increase to around 43 percent in 2027 (Central Electricity Authority, 2016). Overall, the assessment suggests that the positive development provides ample room for India to strengthen its NDC.

The INDC communicated by the **United States of America** in 2015 indicated an intent to reduce greenhouse gas emissions by between 26 and 28 percent below 2005 levels in 2025, which translates to 4.6-4.8 $GtCO_2e$/year (national estimate, in the IPCC Fourth Assessment Report (AR4) Global Warming Potential terms). In June 2017, President Donald Trump announced that the United States of America intended to withdraw from the Paris Agreement and would cease implementation of the NDC. The United States of America subsequently communicated its intent to the United Nations Secretary-General (The Representative of the United States of America to the United Nations, 2017). The earliest that United States of America withdrawal can take effect is in 2020, four years after the Paris Agreement entered into force. Seven studies to date estimate that 2025 emissions under the new Administration's policies will range from 5.7-6.8 $GtCO_2e$/year, in contrast to 5.0-6.6 $GtCO_2e$/year under the previous Administration's policies (Chai *et al.*, 2017; Climate Action Tracker, 2017a; Climate Advisers, 2017; ClimateInteractive, 2017; Hafstead, 2017; Rhodium Group, 2017a, b). The impact of current and upcoming action by subnational and non-state actors may also be significant (Kuramochi *et al.*, 2017).

**Argentina** presented a revised NDC at the COP 22 in November 2016 (Government of Argentina, 2016). This new NDC includes an unconditional absolute emissions target of 483 $MtCO_2e$/year by 2030 and a conditional target of 369 $MtCO_2e$ by 2030, both including LULUCF. The revised NDC is significantly more ambitious than the previous one in terms of absolute emissions (about 190 $MtCO_2e$/year lower for the unconditional target), which is partially attributable to the revised methodology for quantifying the historical emissions data. The Climate Action Tracker concludes in its latest analysis (Climate Action Tracker, 2017b) that the 2030 emissions projections, previously assessed to be on track to meet the unconditional target (Kuramochi *et al.*, 2016), would not reach the revised NDC targets.

**Australia** committed to a 26–28 percent reduction of greenhouse gas emissions by 2030 below 2005 levels, including LULUCF. Government projections indicate that emissions are expected to reach 592 $MtCO_2e$/year in 2030 (Government of Australia, 2016), in contrast to the targeted range of 429-440 $MtCO_2e$/year. Independent analyses (Kuramochi *et al.*, 2016; Reputex, 2016) confirm that the emissions are set to far exceed its Paris Agreement NDC target for 2030. The Emissions Reduction Fund, which the Government of Australia considers to be a key policy measure to reduce emissions alongside other measures such as the National Energy Productivity Plan and targets for the reduction of hydrofluorocarbons (85 percent by 2036), does not set Australia on a path to meeting its targets.

**Brazil** has put forward an absolute emissions reduction target, committing to reduce emissions to 1.3 $GtCO_2e$/year by 2025 and 1.2 $GtCO_2e$/year by 2030, which is equivalent to 37 percent and 43 percent below 2005 emissions levels including LULUCF. Recent independent studies suggest current policy projections to be in line with the NDC targets (CAT, 2017; Kuramochi *et al.*, 2016; PBL, 2017). Uncertainty nevertheless remains about the future of emissions growth; for example, the LULUCF emissions reduced by 86 percent between 2005 and 2012 (Ministry of Science and Technology of Brazil, 2016), but recent data and analyses suggest that the decreasing trend on deforestation and the resulting emissions reductions have slowed down or even stopped (SEEG, 2017).

**Canada's** NDC commits to emissions reductions of 30 percent from the 2005 level by 2030. Government projections indicate that emissions are expected to reach 742 $MtCO_2e$/year in 2030, in contrast to the targeted level of 523 $MtCO_2e$/year (excluding LULUCF) (Environment and Climate Change Canada, 2017). Independent studies (Climate Action Tracker, 2017h; PBL, 2017) also agree that Canada will miss its NDC target under current policies by a large margin (610–820 $MtCO_2e$/year compared to the NDC target of 510–580 $MtCO_2e$/year in 2030).

**Indonesia's** NDC includes an unconditional target of 29 percent below BAU and a conditional 41 percent reduction below BAU with sufficient international support by 2030, both including LULUCF. The NDC includes emissions due to deforestation and peat land destruction, which are the country's largest sources of greenhouse gas emissions. Studies covered in figure 3.3 show that Indonesia is close to being on track to achieving its unconditional NDC, which is based on new independent analyses (CAT, 2017; Kuramochi *et al.*, 2016; PBL, 2017) that show a range of emission projections under current policies for 2030, although the upper end of the projection range is not expected to achieve the unconditional NDC target.

**Japan** aims to reduce its greenhouse gas emissions by 26 percent below 2013 levels by 2030 under its NDC. Recent analyses (CAT, 2017; PBL, 2017) show that the target could possibly be reached with currently implemented policies, although there is still a great deal of uncertainty regarding the future role of nuclear and coal power. It is worth noting that the government has started the process to formulate a new Basic Energy Plan, in which a revised future electricity mix target for 2030 and subsequent years would be laid out.

**Mexico** aims, in its NDC, to reduce its greenhouse gas emissions by between 22 percent (unconditional) and 36 percent (conditional) from BAU by 2030. Under its current policies, Mexico is not on track to meet its NDC target. Independent studies (Climate Action Tracker, 2017c; PBL, 2017) agree that Mexico will fall short of its unconditional NDC target (759 $MtCO_2e$/year) by 20–160 $MtCO_2$/year under its current policies.

**The Republic of Korea** committed under its NDC to reduce its greenhouse gas emissions by 37 percent below BAU by 2030. Recent independent analyses (CAT, 2017; PBL, 2017) indicated that the emissions projections under current policies would fall short of the NDC emission level. However, it should be noted that the new President Moon Jae-in recently announced that the Republic of Korea will reduce its dependency on coal-fired and nuclear power generation (Cheong Wa Dae, 2017; MOTIE-MOE-MOLIT, 2017), while increasing renewable electricity. No official government document has been published.

**Russia's** INDC aims to limit its greenhouse gas emissions to 70–75 percent of 1990 levels by 2030. Independent estimates on the INDC emission level vary significantly (2.4–2.7 $GtCO_2e$/year including LULUCF), mainly due to different interpretations on the accounting of LULUCF emissions (Government of Russia, 2014). The emission levels under current policies projected by independent analyses are approximately 2.0–2.4 $GtCO_2e$/year (including LULUCF) in 2030 and reach the lower end of Russia's INDC range (Kuramochi *et al.*, 2016). The latest current policies projections for 2030 excluding LULUCF by the Climate Action Tracker (Climate Action Tracker, 2017d) have been revised downward by 0.2–0.3 $GtCO_2e$/year compared to the 2016 assessment. Our assessment suggests that there is ample room for Russia to strengthen its NDC.

**Saudi Arabia's** NDC aims to achieve mitigation co-benefits of up to 130 $MtCO_2e$ avoided annually by 2030 through actions and plans outlined to contribute to economic diversification and adaptation. The country has not yet defined a baseline, which the NDC states will be determined based on differently weighted combinations of two scenarios, which differ in terms of their assumptions on the allocation of oil: produced for either domestic consumption or export. Among independent studies, PBL Netherlands Environmental Assessment Agency and the European Commission's Joint Research Centre project that Saudi Arabia will achieve its NDC (Kitous *et al.*, 2017), whereas Climate Action Tracker projects it to miss the NDC target (Climate Action Tracker, 2017e).

**South Africa's** NDC consists of a peak, plateau and decline in the greenhouse gas emissions trajectory range, which gives a range of 398–614 $MtCO_2e$/year between 2025 and 2030, reaching a peak between 2020 and 2025 and a plateau for the following decade, before starting to fall. All studies (Climate Action Tracker, 2017f; Kitous *et al.*, 2017; PBL, 2017) agree that South Africa will not achieve its NDC range under current policies by a margin of 50 $MtCO_2e$/year to nearly 400 $MtCO_2e$/year in 2030.

**Turkey's** NDC sets an economy-wide greenhouse gas emission reduction target of up to 21 percent below BAU in 2030. Among independent studies, PBL Netherlands

Environmental Assessment Agency and the European Commission's Joint Research Centre project that Turkey will overachieve its NDC considerably by 370–410 $MtCO_2e$/year (Kitous *et al.*, 2017; PBL, 2017; van Vuuren *et al.*, 2017; Vandyck *et al.*, 2016) while Climate Action Tracker projects it to miss the NDC target, based on the government projection (Climate Action Tracker, 2017g).

## 3.5 Subnational and non-state actions to narrow the gap

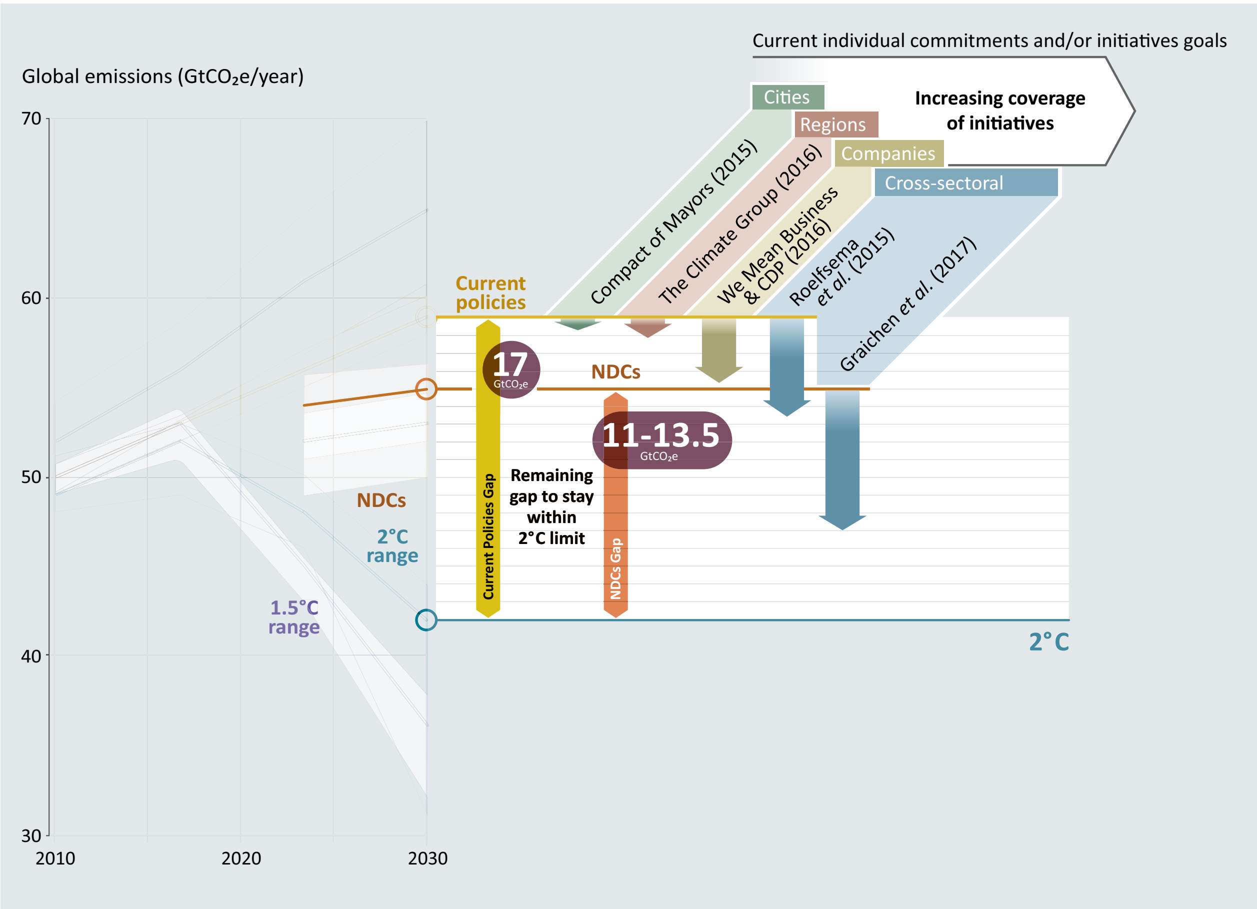
In line with previous Emissions Gap Reports, this report finds that subnational and non-state actions could possibly make a significant contribution to narrowing the gap (figure 3.4). The aggregate impact of the initiatives could be in the order of a few $GtCO_2e$ in 2030 beyond the current NDCs, if the initiatives reach their stated goals and if these reductions do not displace actions elsewhere. Since the 2016 report, only updates on earlier studies (Compact of Mayors 2015; CDP and We Mean Business, 2016; The Climate Group, 2016; Graichen *et al.*, 2017), but no significantly new aggregation reports, have become available.

Analysis of the extent to which individual subnational and non-state actors or initiatives meet their stated objectives is still scarce. Chan *et al.* (2016) find that not all initiatives deliver on their promises. Graichen *et al.* (2017) provide a preliminary assessment of the actual emission reductions of an initiative compared to its potential. Based on such analysis, several studies (Graichen *et al.*, 2016; Michaelowa and Michaelowa, 2017) have identified criteria for initiatives to be effective:

- Permanent funding and secretarial support
- Inclusion of Non-Govermental Organizations in the design and implementation of the initiative
- Definition of mitigation targets including baseline
- Regular monitoring, reporting and verification

The process around and following the COP 21 in Paris in 2015 has brought about much higher recognition and institutionalization of the role of non-state actors in the intergovernmental climate change process. This process continued at COP 22 in Marrakech in 2016, where the Marrakech Partnership for Global Climate Action was

**Figure 3.4:** Illustration of the potential impact of international cooperative initiatives in 2030.




Note: The arrows showing the emission reductions potential start at different levels because the individual studies use different baselines (the last study explicitly estimated the impact additional to NDCs).

launched[14]. It provides guidance on how the UNFCCC process will catalyse and support climate action by Parties and non-Party stakeholders in the period up to 2020, in line with the arrangements of the Paris Agreement. It also promotes an assessment of the compatibility of commitments with regard to the long-term objectives of the Paris Agreement, and seeks to increase the coherence with the Sustainable Development Goals.

A number of new cooperative initiatives involving non-state actors were launched at COP 22 in Marrakech. The '2050 Pathways' platform intends to build a bridge to long-term decarbonization scenarios and strategies and brings together both state and non-state actors[15]. The Global South was well represented in new initiatives such as the Marrakech Investment Committee for Adaptation Fund, the Initiative for Renewable Island Energy and the Marrakech Pledge for Fostering Green Capital Markets in Africa. A host of other initiatives were launched in various areas, including forests, water, energy, human settlements, oceans, transport and agriculture[16]. However, there was little information on the progress regarding the non-state initiatives launched in Paris.

The number of non-state commitments and actions included in the Non-State Actor Zone for Climate Action[17] platform, where the UNFCCC captures and recognizes climate commitments from non-state actors, continued to grow to over 12,000 (mostly individual) commitments in 2016, compared to 10,000 in 2015. The Non-State Actor Zone for Climate Action also aims to assess the progress in these commitments, but so far there is little data available. UN Environment's Climate Initiatives Platform[18], which provides the Non-State Actor Zone for Climate Action with data on important cooperative non-state climate initiatives, has also started collecting this information.

Actions by subnational and non-state actors have the potential to reinforce each other (Andonova *et al.*, 2017) and could make the Paris Agreement more robust. Even if Parties announce the withdrawal of their support from implementing the Paris Agreement, other actors in the same country could step in to reaffirm their commitment. For example, following the announcement of the Trump Administration to withdraw from the Paris Agreement, the United States of America has seen a number of new initiatives driven by subnational and non-state actors, such as America's Pledge on Climate[19], We Are Still In[20], Climate Mayors[21] and the US Climate Alliance[22]. If backed by action, these initiatives have the potential to make up for the withdrawal (Kuramochi *et al.*, 2017).

Jerry Brown, governor of California, announced[23] in July 2017 that the State of California will convene representatives from subnational governments, businesses, investors and civil society in San Francisco, California, in September 2018 for a Global Climate Action Summit[24]. The meeting aims to demonstrate the groundswell of innovative, ambitious climate action, highlight the economic and environmental transition already under way and spur deeper commitment from all parties, including national governments.

14 http://unfccc.int/files/paris_agreement/application/pdf/marrakech_partnership_for_global_climate_action.pdf
15 http://newsroom.unfccc.int/unfccc-newsroom/high-level-climate-champions-launch-2050-pathways-platform/
16 http://newsroom.unfccc.int/climate-action/non-state-actors-partner-with-governments-to-boost-climate-action/
17 http://climateaction.unfccc.int/
18 http://climateinitiativesplatform.org/
19 https://www.americaspledgeonclimate.com
20 http://www.wearestillin.com
21 http://www.climatemayors.org
22 https://www.usclimatealliance.org
23 https://www.gov.ca.gov/news.php?id=19866
24 https://globalclimateactionsummit.org/