Executive summary

1. The strengthened long-term objectives of the Paris Agreement require even stronger actions than previously identified, calling for accelerated efforts pre-2020, as well as increasing the ambition of the Nationally Determined Contributions

The Paris Agreement has very specific language about the long-term goals and how to get there, including:

- A long-term goal of keeping the increase in global average temperature to well below 2 degrees Celsius (°C) above pre-industrial levels.
- An aim to limit the temperature increase to 1.5°C, as this would signi cantly reduce the risks and impacts of climate change.
- The need for global emissions to peak as soon as possible, followed by a rapid decline – recognising that this will take longer for developing countries.

Compared to the 2°C goal that was the reference point of earlier Emissions Gap Reports, these new objecti es require stronger short-term action and deeper cuts in the medium and longer term, as the remaining carbon dioxide budget is now considerably lower. Against the background of the large emissions gap that was identifie in previous reports, this further amplifies the need for ambitious early action that accelerates and strengthens the Nationally Determined Contributions of ountries.

Enhanced pre-2020 and pre-2030 action will reduce the so-called transi onal challenges associated with the necessary shift in emissions p thways, and:

- Reduce the lock-in of carbon and energy intensive infrastructure in society and the energy system, encourage the rapid deployment of state of the art technologies, and spur near-term learning and development of technologies that will be essential in the long term.
- Reduce the overall costs and economic challenges during the transitional period, for example, in terms of upscaling energy investments.
- Reduce future dependence on unproven technologies, including negati e emissions technologies, and increase the options o achieve stringent emission reductions
- Reduce climate risks, for example, by reducing the pace of the global temperature increase.
- Realise immediate co-benefits through enhanced early action on climate change miti ation, such as improved public health as a result of lower air pollution, improved energy security, and reduced crop yield losses.

Additional early action will be essential to keeping the door open to limit warming to below 1.5°C by 2100.

2. Record speed of entry into force of the Paris Agreement signals strong commitment to action

The adoption of the Paris Agreement on climate change by 195 countries and the global agreement on the Sustainable Development Goals, made 2015 a landmark year. The Paris Agreement is the fi st climate deal with universal contributions to miti ation action. With rati ation having surpassed the agreed minimum of 55 countries, representing at least 55 per cent of global emissions, the Agreement will enter into force before the Conference of Parties to the United Nations Framework Convention on Climate Change in Marrakesh (COP 22). This sends a strong signal that countries are commi ed to action

The need for urgent action has been reinforced by the fact that 2015 was the ho est year since modern record keeping began. Although high temperatures were exacerbated by the e ect of El Niño, it is notable that ten of the warmest years on record have occurred since 2000, and the trend continues, with the fi st six months of 2016 all being the warmest ever recorded.

3. Focus of the 2016 Emissions Gap Report

The United Nations Environment (UNEP) Emissions Gap Report 2016 provides an authoritati e assessment of the extent to which the current and planned national emissions reductions as specified in the submi ed Intended Nationally Determined Contributions will contribute towards the Paris Agreement goals. It does so by providing an estim te of the additiona reductions – the gap – required by 2030 to be on a least-cost path that is likely to ensure the global temperature goals.

The assessment focuses on the 2°C goal, as well as on the implications or limiting the emperature increase to 1.5°C.

The key new features and results of the 2016 Report are:

- The assessment is based on Intended Nationall Determined Contributions submi ed by almost all countries in the world, and a large number of studies supporting obustness of the estim tes.
- The key quanti ati e results stay within the ranges presented in the 2015 assessment.
- The results underpin the urgency of immediate and strong action, and the need to build on the momentum of the entry into force of the Paris Agreement. Since the results are not likely to change in the next two years, enhanced action need not wait for the facilitati e dialogue in 2018.
- The report identifie where solutions are available to deliver low-cost emission reductions at scale, including three major areas of action: contribution by non-state actors, energy efficienc acceleration and synergies with achievement of the sustainable development goals.

The report has been prepared by an international team of leading scienti ts who assessed all available information, including those reviewed by the Intergovernmental Panel on Climate Change in its fift assessment report, as well as more recent scientifi literature. The assessment production process has been transparent and particip tory, and governments of the countries with specific mention in the report have been invited to comment on the assessment findings b fore finali ation

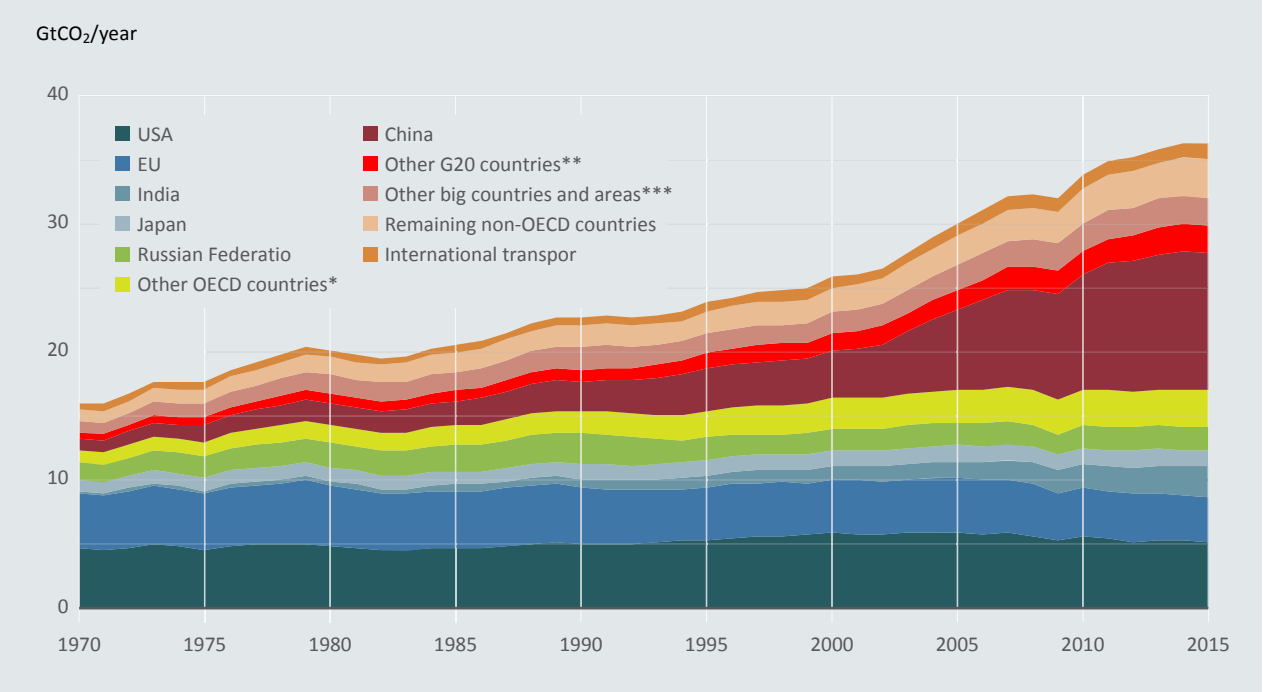
4. Global greenhouse gas emissions continue to increase

Total global greenhouse gas (GHG) emissions continu to show a steady increase, reaching approximately 52.7 gigatonnes carbon dioxide equivalent ($GtCO_2e$) in 2014. There have been small variations around this longer trend. Notably, the rate of global greenhouse gas emissions increase during the period 2000 to 2010 was faster (2.2 per cent per year) than during the period 1970 to 2000 (1.3 per cent per year), increasing in 2010 and 2011 (3.5 per cent per year) and then slowing in 2012 to 2013 (1.8 per cent per year).

Global carbon dioxide emissions from fossil fuel use and industry seem to stabilize

Global carbon dioxide emissions from fossil fuel combustion cement production and other industrial processes are the major source of total global greenhouse gas emissions. Currently, they account for about 68 per cent of total global greenhouse gas emissions, and were estim ted to be 36.2 $GtCO_2$ in 2015. Figure ES1 presents a detailed overview of the development in global carbon dioxide emissions from fossil fuel use and industry for the period 1970 to 2015.

Figure ES1: Carbon dioxide emissions from fossil-fuel use and industry.



* Other OECD countries include Australia; Canada; Mexico; Republic of Korea and Turkey.
** Other G20 countries include Argentina; B azil; Indonesia; Saudi Arabia; South Africa and Turkey.
*** Other big countries and areas include Egypt; Iran; Kazakhstan; Malaysia; Nigeria; Taiwan, Province of China; Thailand and Ukraine.

In 2015, global carbon dioxide emissions from these sources stagnated for the fi st time and showed signs of a weak decline. Prior to 2015, global carbon dioxide emissions increased by roughly 1.3 per cent per year for the period 2012 to 2014, which was signifi antly slower than that of the 12 preceding years, where the average increase was 2.9 per cent per year (2000-2011), but higher than the average growth rate of around 1 per cent per year during the 1990s. These findings are in line with other studies on trends in global energy-related carbon dioxide emissions.

In summary, **global greenhouse gas emissions continue to grow, and while the indications are encouraging that the growth rate of global carbon dioxide emissions from fossil fuel use and industry is slowing, it is still too early to say whether this is likely to be permanent.**

The continued growth of global emissions and the underlying trends show that the world is not yet on a trajectory that allows for a transition to stringent low emissions development pathways consistent with the stated temperature goals.

5. Collectively, members of the G20 are on a likely track to meet their Cancun Pledges for 2020, but these pledges do not deliver the necessary early emission reductions

From a global perspecti e, early action is especially important for the major economies of the world; crucially these countries, as members of the G20, account for approximately three quarters of global emissions. Most of the G20 members at COP 16 in Cancun formalised the emission reduction pledges they had put forward as a follow up to the Copenhagen Accord. Since then, the annual Emissions Gap Reports have consistently assessed the progress countries are making towards delivering on these pledges, as they represent the main formalised early action commitment, and their timel achievement will send very positi e signals to other countries.

It should be noted that not all pledges demand the same level of e ort. A country currently on track to achieve its pledge has not necessarily made a greater e ort to miti ate emissions than a country not yet on track. The projections assessed are subject to the uncertainty associated with macroeconomic trends, such as changes in gross domestic product, and population trends, as well as the impact of each country's climate policy action. The emission trajectories analysed here do not quanti y the potential impact of using o sets to achieve pledges, which is considered to be quite limited.

The assessment shows that according to all available estim tes three of the G20 members – China, the European Union, and India – are on track to meet their pledges without purchasing o sets. Three more – Brazil, Japan, and Russia – are on track according to most estim tes.

According to both government and independent estim tes, Canada, Mexico, and the United States of America are likely to require further action, possibly supplemented by purchased o sets, in order to meet their pledges. Mexico's Cancun Pledge is conditional on the provision of adequate financial and technological support from developed countries as part of a global agreement, and the fulfilme t of this condition has not been assessed.

Government and independent sources have found a gap between Australia's projected 2020 emissions and its target level for that year. However, Australia's latest officia projections find that for the budget period, and including carry-over from its fi st commitment period under the Kyoto Protocol, the country is now on track to meet its Kyoto target.

According to independent analysis, the Republic of Korea will also require further action to meet its pledge. This cannot be verified using available officia projections. The Republic of Korea has domesti ally abandoned its 2020 target, replacing it with the Intended Nationally Determined Contributions target in the amended Green Growth Act. However, its earlier pledge has not been officially with awn.

Suffici t information is currently unavailable to determine whether Indonesia and South Africa are on track to meet their pledges. In the case of Indonesia, independent projections span a wide range, and officia projections reflectin current policies are unavailable.

Finally, Argentina, Saudi Arabia and Turkey have not made greenhouse gas reduction pledges for 2020. All three countries submi ed post-2020 pledges to the United Nations Framework Convention on Climate Change as part of their Intended Nationally D termined Contributions

Overall, there is general progress on pledge achievement, but **several countries will need to accelerate action to meet their Cancun Pledge by 2020. It must be underlined that, collectively, these pledges are not ambitious enough to have a better starting point in 2020 to meet the 2030 levels of global greenhouse gas emissions consistent with the longer-term goals of below 2 or 1.5°C.**

The urgency of enhancing pre-2020 miti ation action is, therefore, indisputable:

- It strengthens the likelihood that countries will meet and exceed their Cancun Pledges.
- It provides a more solid foundation for implementin the Nationally Determined Contributions from 2020, and for continuously trengthening their ambition
- It supports the transition towards a least-cost emissions reduction trajectory a er 2020 that is consistent with the 2°C goal.
- It is likely the last chance to keep the option of limitin global warming to 1.5°C in 2100 open, as all available scenarios consistent with the 1.5°C goal imply that global greenhouse gas emissions peak before 2020.

6. Pathways for staying well below 2 and 1.5°C require deep emission reductions after, and preferably also before, 2020 and lower levels of emissions in 2030 than earlier assessed 2°C pathways

The central aim of the Paris Agreement is to keep the global temperature increase by the end of the century to well below 2°C compared to pre-industrial levels, with an ambition to limit the temperature increase even further to 1.5°C. While these global goals are quite clear, there is a need to interpret what they mean. For example, what if the global average temperature exceeds these goals during the century, but is below the goals by end of it? Similarly, it is necessary to define an acceptable probability for achieving the goals, which in the end is a politi al rather than scientifi question, as it requires value judgments about what is acceptable and desirable to society. In line with the Intergovernmental Panel on Climate Change's definitio of "likely", this report generally uses a 66 per cent or higher probability.

A large body of literature is available on least-cost pathways that limit warming to below 2°C with a 66 per cent or higher probability. This issue has been covered extensively by the Intergovernmental Panel on Climate Change and earlier Emissions Gap Reports. For a 1.5°C goal, the body of literature is much more sparse and there are no published scenarios that meet the 1.5°C limit permanently with more than 66 per cent probability. Therefore, the studies assessed operate with a 50 per cent probability, which in Intergovernmental Panel on Climate Change terminology is considered "about as likely as not". The 2018 Special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways by the Intergovernmental Panel on Climate Change will provide a more comprehensive picture as it will cover new studies. Table ES1 presents the pathway characteristics for achieving the two di erent temperature goals, showing the median acceptable emission levels for key years between 2020 and 2100.

As in the earlier Emissions Gap Reports, it is important to highlight that most scenarios that are available in the literature, and that limit warming to below 2 or 1.5°C, assume the use of so-called negati e emissions technologies in the second half of the century -- that is the acti e and permanent removal of carbon dioxide from the atmosphere. This can be achieved, for example, through sustainable a orestation and reforestation, enhanced soil carbon absorption, biochar, and the combination of bio-energy with carbon capture and storage. Important challenges have been identifie for large-scale application of negati e emissions technologies. For example, with biomass there is a challenge to produce enough biomass without harming biodiversity and a potential for competitio between energy and food production ver land and water resources.

Table ES1: Overview of pathway characteristics or two global temperature targets.

1.5°C (>50% in 2100)	**Pathways limiting warming to below 1.5°C by 2100 with >50% probability Limited action until 2020 and cost-optimal mitigation afterwards**				
Number of available scenarios: **6**; Number of contributing modelling f ameworks: **2** Year of global annual emissions becoming net zero† for: Kyoto-GHGs: **(2060-2080)**; total CO_2 (including LULUCF): **(2045-2050)**; CO_2 from energy and industry: **(2045-2055)**					
	Annual emissions of global total greenhouse gases [$GtCO_2e$/year]				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**56**	**47**	**39**	**8**	**-5**
range and spread**	53(-/-)56	46(-/-)48	37(-/-)40	4(-/-)14	-5(-/-)-3
	CO_2 carbon budgets [global total cumulative CO_2 emissions in $GtCO_2$]				
Time period	*2015-2030*	*2030-2050*	*2050-2075*	*2075-2100*	*2015-2100*
median*	**552**	**236**	**-199**	**-353**	**217**
range and spread**	503(-/-)567	178(-/-)259	-146(-/-)-277	-288(-/-)-372	71(-/-)383
2°C (>66% in 2100)	**Pathways limiting warming to below 2°C by 2100 with >66% probability Limited action until 2020 and cost-optimal mitigation afterwards**				
Number of available scenarios: **10**; Number of contributing modelling f ameworks: **4** Year of global annual emissions becoming net zero† for: Kyoto-GHGs: **2085 (2080-2090)**; total CO_2 (including LULUCF): **2070 (2060-2075)**; CO_2 from energy and industry: **2070 (2060-2075)**					
	Annual emissions of global total greenhouse gases [$GtCO_2e$/year]				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**52**	**48**	**42**	**23**	**-3**
range and spread**	49(49/53)55	44(46/50)53	29(31/44)44	17(18/27)29	-11 (-9/-1)0
	CO_2 carbon budgets [global total cumulative CO_2 emissions in $GtCO_2$]				
Time period	*2015-2030*	*2030-2050*	*2050-2075*	*2075-2100*	*2015-2100*
median*	**533**	**362**	**70**	**-288**	**553**
range and spread**	481(499/582)572	242(258/431)447	-97(-52/175)187	-120(-146/-327)-342	483(490/934)988

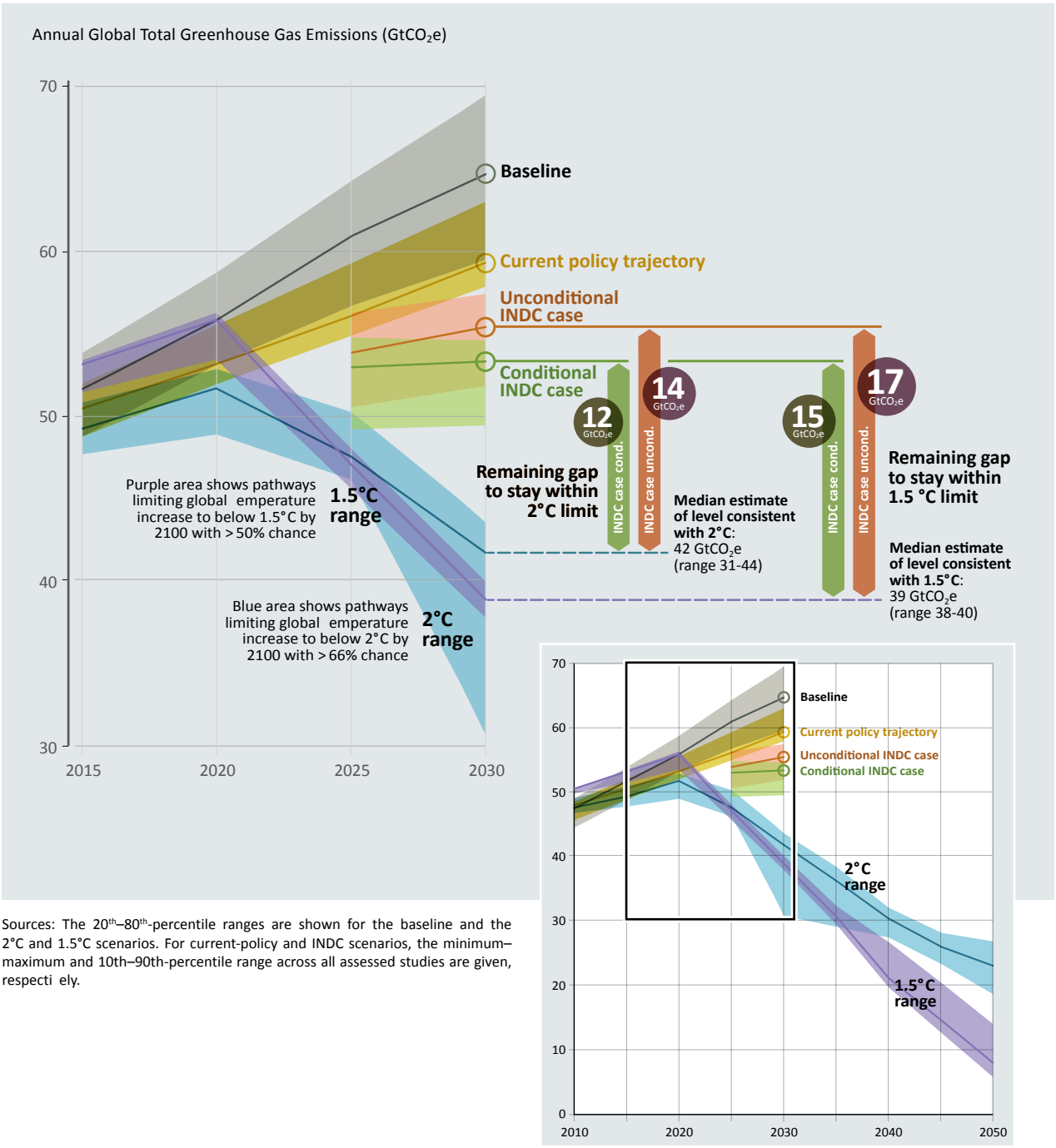
* Rounded to the nearest 1 $GtCO_2e$/year
** Rounded to the nearest 1 $GtCO_2e$/year. Format: minimum value (20^{th} percentile/8 th percentile) m ximum value – no percentiles a e provided if less than 10 scenarios are available.
† Rounded to nearest 5 years. Format: median (20^{th} percentile – 8 th percentile); (minimum – m ximum) if less than 10 scenarios are available.

Some studies have examined options for hedging against a strong reliance on negati e emissions in the long-term. These studies find that this is only possible by reducing emissions more steeply in the very near-term that is over the coming 5 to 15 years.

Table ES2: Global total greenhouse gas emissions in 2025 and 2030 under di erent scenarios.

Emissions estimates ($GtCO_2e$/year)			
Scenario	**Global total emissions in 2025**	**Global total emissions in 2030**	**Number of scenarios in set**
Baseline	61.0 (56.7-64.3)	64.7 (59.5-69.5)	179
Current policy trajectory	56.2 (54.8-59.4)	59.4 (57.9-63.1)	3
Unconditional INDCs	53.9 (50.6-56.3)	55.5 (51.9-57.5)	10
Conditional INDCs	53.0 (49.3-54.9)	53.4 (49.5-54.7)	10 (6+4)
2°C pathways (least-cost from 2020)	47,7 (46.2-50.2)	41.8 (30.6-43.5)	10
1.5°C pathways (least-cost from 2020)	47.2 (45.8-48.2)	38.8 (37.7-40.0)	6

Figure ES2: Global greenhouse gas emissions under di erent scenarios and the emissions gap in 2030.



Sources: The 20th–80th-percentile ranges are shown for the baseline and the 2°C and 1.5°C scenarios. For current-policy and INDC scenarios, the minimum–maximum and 10th–90th-percentile range across all assessed studies are given, respecti ely.

7. The emissions gap for 2030 is 12 to 14 $GtCO_2e$ compared with 2°C scenarios, for 1.5°C the gap is 3 $GtCO_2e$ larger. Even if fully implemented, the unconditional Intended Nationally Determined Contributions are only consistent with staying below an increase in temperature of 3.2°C by 2100 and 3.0°C, if conditional Intended Nationally Determined Contributions are included

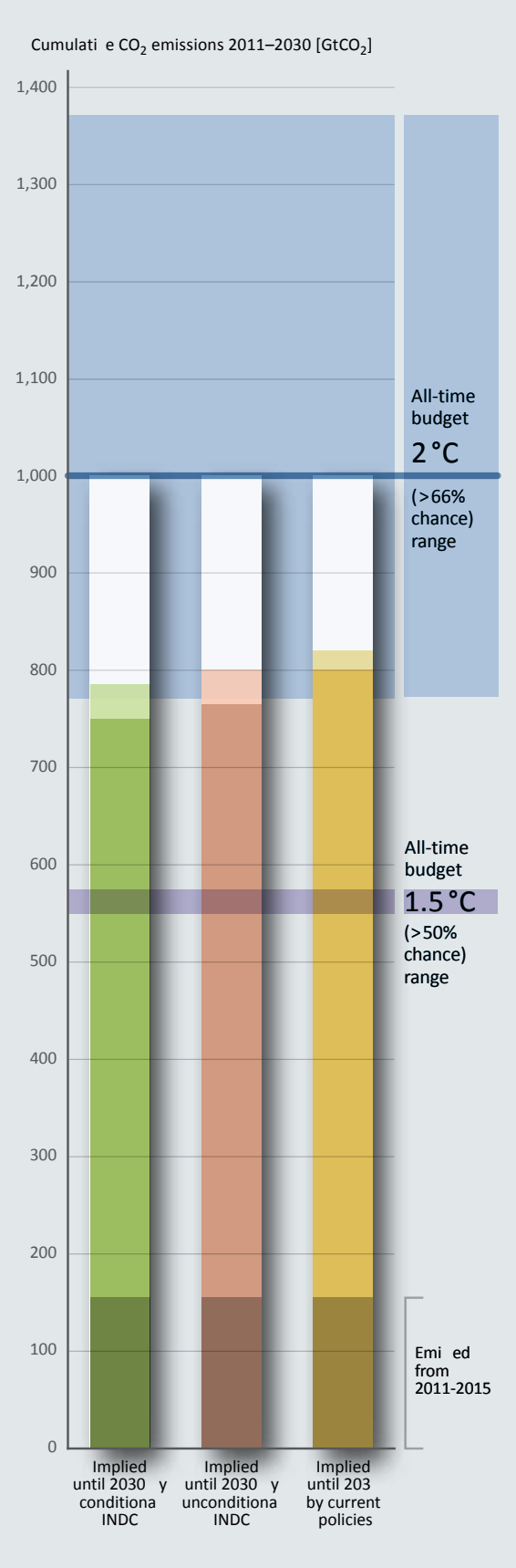
In the period up to COP 21 in Paris, United Nations Environment had, as part of the preparation of the Emissions Gap Report 2015, engaged a team of independent experts to assess the miti ation impacts of the Intended Nationally Determined Contributions. The results were presented as a key part of the Emissions Gap Report and covered the 118 countries having submi ed an Intended Nationally Determined Contribution by 1 October 2015. This year, new international studies are available that include the 160 Intended Nationally Determined Contributions submi ed, representing 187 out of 195 Parties to the United Nations Framework Convention on Climate Change. The assessment is based on 10 di erent global level Intended Nationally Determined Contribution studies that all provide analysis of the unconditional contributio s and six that cover both conditional and unconditional pledges. The scenarios presented describe the following cases:

- **The baseline scenario** reflects emission projection that assume no additional climate policies have been put in place from 2005 onwards.
- **The current policy trajectory scenario** reflects the best estim tes of global emissions taking into account currently adopted and implemented policies.
- **The Intended Nationally Determined Contribution** describe how global greenhouse gas emissions might evolve under full implementation of two Intended Nationally D termined Contribution ases:
  - **Unconditional Intended Nationally Determined Contribution case:** assuming full implementation of unconditional Intended Nationally Determined Contributions
  - **Conditional Intended Nationally Determined Contribution case:** assuming full implementation of both unconditional and conditional Intended Nationally D termined Contributions

The 1.5°C and 2°C scenarios represent least-costs global scenarios consistent with a likely chance of limiting warming to below 2°C and 1.5°C above pre-industrial levels consistent with the estim tes presented in table ES2.

Figure ES2 shows that full implementation of the **unconditional Intended Nationally Determined Contributions** – using rounded numbers – will reduce global greenhouse gas emissions in 2030 by 9 $GtCO_2e$ (range: 7-13) relati e to the median in the no-policy baseline scenario, and by 4 $GtCO_2e$ (range: 2-7) relati e to the median in the current policy trajectory. Comparing the cost-optimal 2°C and 1.5°C scenarios to the unconditional Intended Nationally Determined Contribution projections shows a gap in 2030

Figure ES3: Comparison of projected emissions by 2030 and all-time 1.5°C and 2°C arbon budgets. Cumulati e global total carbon dioxide emissions for the conditional INDC ase, the unconditional INDC case and the current policies scenario, and carbon budgets from the Fifth Assessme t Report of the Intergovernmental Panel on Climate Change (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 estim te based on complex Earth-System Models, assessed by Working Group I (IPCC, 2014a).



of 14 $GtCO_2e$ (range: 10-16) between the unconditional Intended Nation lly Determined Contribution scenario and the 2°C scenario. Comparing the unconditional Intended Nationally Determined Contribution scenario with the 1.5°C scenario would further increase the gap by 3 $GtCO_2e$, as shown in figu e ES2.

If countries were to fully implement the **conditional Intended Nationally Determined Contributions**, the estim ted global greenhouse gas emissions in 2030 would be about 2.4 $GtCO_2e$ (range: 1.2−4.8) lower in 2030 compared to the unconditional Intended Nationally Determined Contribution scenario case. This leaves a gap in 2030 of 12 (range: 8–13) $GtCO_2e$ between the conditional Intended Nationally Determined Contribution scenario and the cost-optimal 2°C scenario. When comparing with the 1.5°C scenario, the gap would increase by an additional 3 Gt O_2e.

Interestingl , a number of countries have Intended Nationally Determined Contribution targets suggestin emission levels in 2030 above their estim ted no-policy baseline or current policy scenario. These countries are, thus, assumed to overachieve on their Intended Nationa ly Determined Contribution targets, and the di erent model teams treat this issue in di erent ways, which adds an uncertainty of 1 $GtCO_2e$ (range: 0-1) by 2030, to the estim ted Intended Nationally Determined Contributio and gap projections

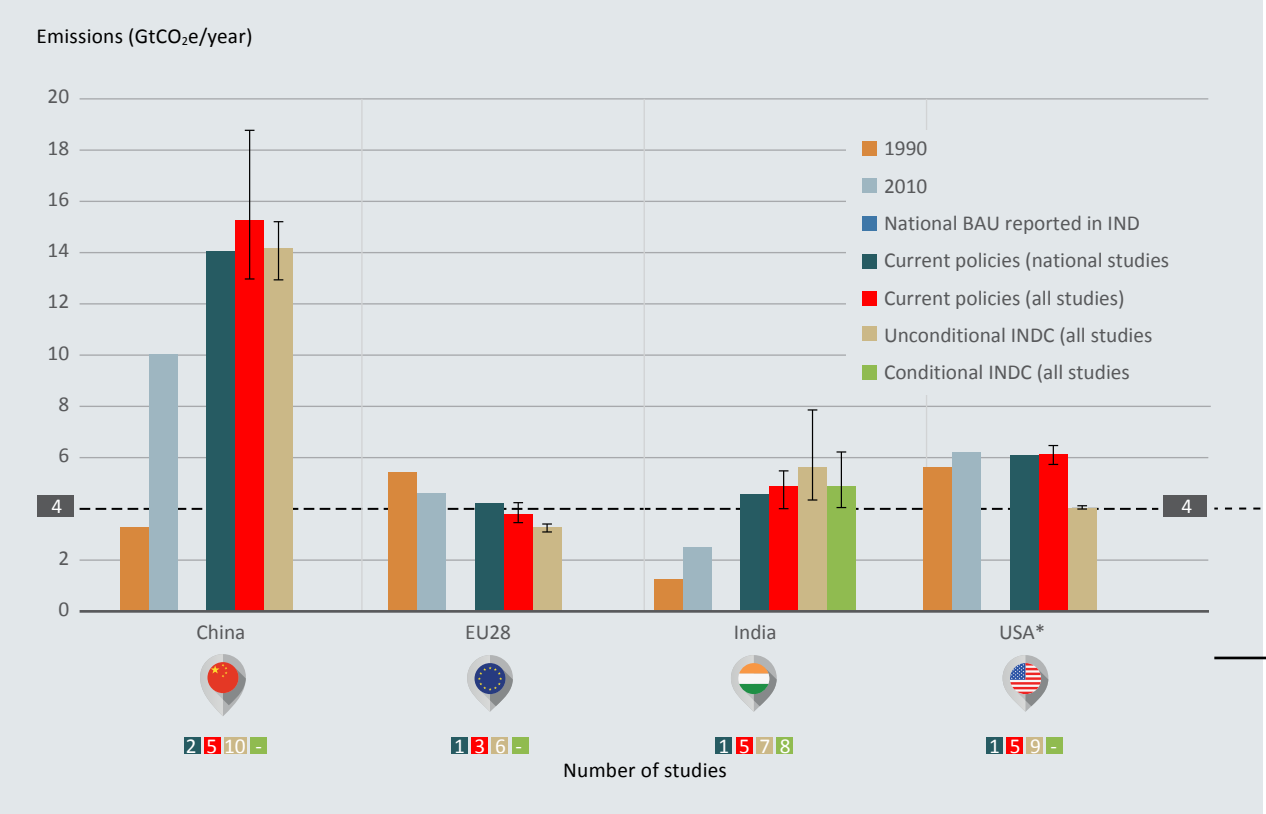
Compared to last year's report, the estim tes of the emission levels that would be realised under full implementation of the Intended Nationally Determined Contributions have not changed signifi antly. In summary, **the Intended Nationally Determined Contributions represent a first start to initiate the required transition, but are far from being consistent with the agreed upon long-term temperature goals.**

The **full implementation of the unconditional Intended Nationally Determined Contributions is consistent with staying below an increase in temperature of 3.2°C** (median, range: 2.9–3.4°C) by 2100 relati e to pre-industrial levels with greater than 66 per cent probability. This is lower than current policies, which imply staying below warming of 3.6°C (median, range: 3.4–3.7°C) by 2100 with greater than 66 per cent probability. **Full implementation of the conditional Intended Nationally Determined Contributions would lower the temperature projections relative to the unconditional Intended Nationally Determined Contributions by about 0.2°C.**

Under the Intended Nationally Determined Contribution scenarios, **the carbon dioxide budget estimated by the**

Figure ES4: Greenhouse gas emissions (all gases and sectors) of the G20 economies, and G20 as a whole, by 2030 for the business as usual (BAU) emissions projection f om the INDC submission (third bar), for the current policies scenario from official and tional studies (fourth bar), from global model studies used for our analysis (fifth bar), or the unconditional INDC scenario (si th bar), and for the conditional INDC scenario (s venth bar). The uncertainty ranges are explained in the main text. For reporting easons, the emissions projections or China, EU, India and USA are shown in panel (a), and the other countries in panel (b), with di erent verti al axes. The Figure also shows the number of studies underlying the estim te (if available) for the last four bars: current policies (national tudies), current policies (all studies) and the unconditional INDC and onditional INDC (all tudies).

Figure ES4a



* For USA unconditional INDC is or 2025.

Intergovernmental Panel on Climate Change for limiting warming to below 2°C with at least 66 per cent probability will be close to depleted by 2030, and the similar budget aligned with limiting warming to below 1.5°C with at least 50 per cent probability will already be well exceeded by 2030. Figure ES3 shows the cumulati e carbon dioxide emissions implied by the Intended Nationally Determined Contribution scenarios.

8. Assessments of Intended Nationally Determined Contributions from individual G20 members show ambition, but also reveal that for some countries current policies are estimated to deliver greater reductions than the Intended Nationally Determined Contributions. This indicates that there might be room for strengthening the ambition of Intended Nationally Determined Contributions, noting that the analytical uncertainties are fairly large

Refl cting on the dominant share of global emissions coming from the G20 members, this year's Emissions Gap Report presents a more detailed assessment of the Intended Nationall Determined Contributions f om this group of countries.

The calculation of the G20 members' median emission projections resulting from full implementation of the Intended Nationally Determined Contribution is based on the same data as the 2015 Emissions Gap Report, complemented with: a) the data from two new studies, and b) the estim tes for the three G20 economies, Argentina Saudi Arabia and Turkey, that were not included in the previous report.

Results of this assessment are presented for all the individual countries and the European Union in figu e ES4, noting that data is not available for all countries.

The figu e shows that for many countries the implementation of the Intended Nationally Determined Contribution would lead to lower emissions than the current policies scenario that is additional policies would have to be implemented to meet the Intended Nationally Determined Contribution. It is interesting to note that for some countries the Intended Nationally Determined Contribu on is above the current policies scenario, indicating that it should be possible to enhance ambiti n quite easily. However, additional research is necessary because for many countries the uncertainty ranges overlap, and the number of studies for the current policies and Intended Nationall Determined Contribution cases vary signifi antly.

Figure ES4b