UNEP

The Emissions Gap Report

Are the Copenhagen Accord Pledges Sufficient to Limit Global Warming to 2° C or 1.5° C?

A preliminary assessment

ADVANCE COPY

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Foreword

Climate change represents one of the greatest challenges but also an inordinate opportunity to catalyse a transition to a low carbon, resource-efficient Green Economy.

This report informs Governments and the wider community on how far a response to climate change has progressed over the past 12 months, and thus how far the world is on track to meet wider goals,.

The pledges associated with the Copenhagen Accord of 2009 are the point of departure for this report. What might be achieved in terms of limiting a global temperature rise to 2° C or less in the twenty-first century and in terms of setting the stage for a Green Economy?

And what remains to be done—what is the gap between scientific reality and the current level of ambition of nations? The analysis focuses on where global emissions need to be in around 10 years time to be in line with what the science says is consistent with the 2° C or 1.5° C limits, and where we expect to be as a result of the pledges.

If the highest ambitions of all countries associated with the Copenhagen Accord are implemented and supported, annual emissions of greenhouse gases could be cut, on average, by around 7 gigatons (Gt) of CO_2 equivalent by 2020.

Without this action, it is likely that a business-as-usual scenario would see emissions rise to an average of around 56 Gt of CO_2 equivalent by around 2020. Cuts in annual emissions to around 49 Gt of CO_2 equivalent would still however leave a gap of around 5 Gt compared with where we need to be—a gap equal to the total emissions of the world's cars, buses and trucks in 2005.

That is because the experts estimate that emissions need to be around 44 Gt of CO_2 equivalent by 2020 to have a likely chance of pegging temperatures to 2° C or less.

However, if only the lowest ambition pledges are implemented, and if no clear rules are set in the negotiations, emissions could be around 53 Gt of CO_2 equivalent in 2020—not that different from business as usual—so the rules set in the negotiations clearly matter.

This report, the result of an unprecedented partnership between UNEP and individuals from 25 leading research centres, underlines the complexity of various scenarios.

The Emissions Gap Report emphasizes that tackling climate change is still manageable, if leadership is shown. In Cancun action on financing, mitigation and adaptation need to mature and move forward—supported perhaps by action on non-CO_2 pollutants such as methane from rubbish tips to black carbon emissions.

Above all, Cancun must demonstrate to society as a whole that Governments understand the gaps left by Copenhagen. But at the same time remain committed to counter climate change while meeting wider development goals.

Achim Steiner,
UN Under-Secretary-General,
UNEP Executive Director

The Emissions Gap Report

Are the Copenhagen Accord Pledges Sufficient to Limit Global Warming to 2° C or 1.5° C?

A Preliminary Assessment

November 2010

The Copenhagen Accord declared that deep cuts in global emissions are required *"so as to hold the increase in global temperature below 2 degrees Celsius"*. The Accord called for an assessment that would consider strengthening the long-term goal including *"temperature rises of 1.5 degrees"*. Since December 2009, 140 countries[1] have associated themselves with the Copenhagen Accord. Of these, 85 countries have pledged to reduce their emissions or constrain their growth up to 2020.

The question remains, however, whether these pledges are sufficient to achieve the Accord's temperature limits, or if there will be a gap between what is needed and what is expected as a result of the pledges.

Many scientific groups have identified global emission pathways[2], or emissions trajectories, that are consistent with various temperature limits, while others have estimated global emissions in 2020 based on the Copenhagen Accord pledges. Some groups have calculated both. Not surprisingly, different groups have come up with different estimates. The range of estimates is caused, for example, by the fact that some of the pledges have conditions attached, such as the provision of finance and technology or ambitious action from other countries. This leads to a range of potential outcomes rather than a single estimate.

To understand and interpret the range of results coming from different studies, the United Nations Environment Programme (UNEP), in conjunction with the European Climate Foundation and the National Institute of Ecology, Mexico, convened a six-month preliminary assessment of these studies. This assessment aims to provide policymakers with an overview of results from various studies, as well as their areas of agreement and disagreement. Individuals from twenty-five groups have contributed to the assessment and co-authored this publication. This report is a summary of that work.

Notably, the 2020 emissions reduction pledges analysed in this report were not decided under a quantitative top-down approach to emissions management — one that starts with temperature limits for which the mitigation effort is distributed among countries by negotiation. Therefore, at this time we are only analysing the effect of the offers brought forward by countries in the form of pledges under the Copenhagen Accord.[3]

[1] As of 12 November 2010.
[2] An "emission pathway" shows how emissions change into the future
[3] We note that this is a technical report that explores possible outcomes associated with the implementation of the Copenhagen Accord. It is not intended to legitimize the Accord, nor does it constitute an endorsement of a pledge-and-review architecture vis-à-vis a target-based approach for emission reductions. In addition this report is not indtended to advocate any particular policy or emissions pathway.

The final plenary meeting at COP 15, Copenhagen, Denmark
19 December, 2009

This assessment addresses four main questions:

- **What 2020 emission levels are consistent with the 2° C and 1.5° C limits[4]?**
- **What are the expected global emissions in 2020?**
- **How big is the "emissions gap"?**
- **How can the gap be reduced?**

[4] Although the Copenhagen Accord is not explicit about the baseline against which temperature increase should be measured, we have assumed that it is pre-industrial levels.

Key findings

- Studies show that emission levels of approximately 44 gigatonnes of carbon dioxide equivalent ($GtCO_2e$) (range: 39-44 $GtCO_2e$*) in 2020 would be consistent with a "likely" chance of limiting global warming to 2° C.
- Under business-as-usual projections, global emissions could reach 56 $GtCO_2e$ (range: 54-60 $GtCO_2e$) in 2020, leaving a gap of 12 $GtCO_2e$.
- If the lowest-ambition pledges were implemented in a "lenient" fashion**, emissions could be lowered slightly to 53 $GtCO_2e$ (range: 52-57 $GtCO_2e$), leaving a significant gap of 9 $GtCO_2e$.
- The gap could be reduced substantially by policy options being discussed in the negotiations:
  - » By countries moving to higher ambition, conditional pledges
  - » By the negotiations adopting rules that avoid a net increase in emissions from (a) "lenient" accounting of land use, land-use change and forestry activities and (b) the use of surplus emission units.
- If the above policy options were to be implemented, emissions in 2020 could be lowered to 49 $GtCO_2e$ (range: 47-51 $GtCO_2e$), reducing the size of the gap to 5 $GtCO_2e$. This is approximately equal to the annual global emissions from all the world's cars, buses and transport in 2005— But this is also almost 60 per cent of the way towards reaching the 2°C target.
- It will also be important to avoid increasing the gap by "double-counting" of offsets.
- Studies show that it is feasible to bridge the remaining gap through more ambitious domestic actions, some of which could be supported by international climate finance.
- With or without a gap, current studies indicate that steep emission reductions are needed post 2020 in order to keep our chances of limiting warming to 2° C or 1.5° C.

* Range here refers to the "majority of results", i.e. their 20th and 80th percentile.

** "Lenient" in this report is used to refer to the situation in which LULUCF accounting rules and the use of surplus emission units result in a net increase in emissions

Box 1: Method for assessing emission levels consistent with temperature limits

In this assessment we examine two groups of pathways: (1) pathways produced by integrated assessment models (IAM), which simulate the energy-economic system including the turnover of energy infrastructure; and (2) "stylized" pathways, produced by other models that do not explicitly model the change in the energy system or feasibility of emission reduction rates. We focus on results from IAMs because they are able to actually describe the system's response to different policies and measures and emission-related targets (see Box 2). However, we also draw on "stylized" scenarios in order to better understand the theoretical rates of emission reduction and magnitude of negative emissions needed to be consistent with particular temperature limits.

A total of 223 emission pathways produced by 15 modelling groups have been analysed[5]. We account for many, but not all, sources of the uncertainty of models and data by compiling results from a number of studies and identifying conclusions that appear robust.

[5] Detail on the studies reviewed can be found in Chapters 2 and 3 of the full report.

What 2020 emission levels are consistent with the 2° C and 1.5° C limits?

1. The level of human-induced global warming is primarily determined by the cumulative emissions over time, i.e. when emissions peak, at what level, and how fast they decline thereafter.

The total stock of greenhouse gases in the atmosphere has a strong effect on climate forcing related to climate change. This stock is determined by the accumulated emissions of greenhouse gases in the atmosphere. It follows that cumulative emissions have a profound influence on the long-term increase of global temperature[6].

An important point is that several different emission pathways can result in the same cumulative emissions over a period of time. But not all pathways are considered equally feasible; some are thought to be constrained by an upper ceiling on the rate of emission reductions due to technological, economic, social and political factors. Hence, the feasibility of reduction rates plays a central role in determining which 2020 emission levels are consistent with temperature limits. Also important are assumptions about the feasibility of "negative emissions", i.e. the net removal of carbon dioxide (CO_2) from the atmosphere through, for example, planting forests or capturing CO_2 from biomass (see Box 3).

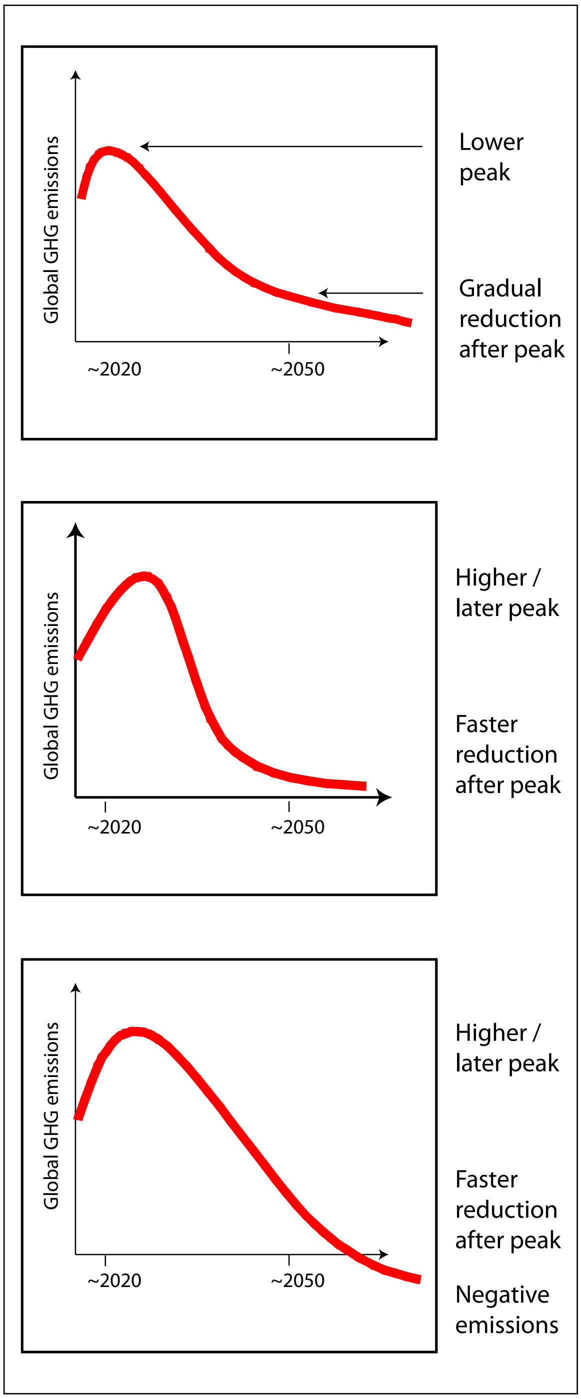
Studies show that there is a trade-off between the timing of the peak and the rate of decrease in emissions afterwards—the sooner and lower the peak, the slower the rate of decrease can be afterwards. Conversely, the longer the peak is delayed and the higher it is, the faster emissions must decline afterwards, and/or the stronger the negative emissions over the long term, in order to stay within the temperature limit (see Figure 1).

Many recent modelling studies have assumed that it would be unrealistic for global emissions to immediately start decreasing (because of political and economic factors) and therefore have focused on scenarios in which global emissions continue to increase for a few years and then decrease sharply afterwards.

[6] It is important to note that a number of other factors, such as the level of sulphate aerosols and the shape of the pathway, also have a significant influence on the maximum temperature increase.

Figure 1: Illustration of different pathway types for the same temperature increase.

See Point 1 for explanation.



Box 2: Understanding temperature limits

A temperature increase of 2° C or 1.5° C represents an increase in global average near surface temperature compared with pre-industrial times. This is meant to be an indicator of local climate changes. Importantly, a 2° C or 1.5° C global average increase can translate into much higher temperature changes locally.

There are significant uncertainties in the relationship between temperature, emission pathways, cumulative emissions, and atmospheric concentrations. Therefore, in this assessment, each emission pathway is associated with a range of probabilities for temperature, reflecting uncertainties in the carbon cycle and many other aspects of the climate system. Hence, an emission pathway is associated with probabilities of staying within a range of different temperature changes.

To illustrate, an emission pathway that has a 50 per cent chance of limiting warming to under 2° C, may also have a 5 per cent probability that warming will exceed 3° C and, say, a 10 per cent probability of staying below 1.5° C. Similarly, an emission pathway that has a 66 per cent chance of staying under 2° C, may also have a probability of less than 3 per cent that warming will exceed 3° C and, say, a 20 per cent probability of staying below 1.5° C.

In this assessment we focus on emission pathways that lead to a global average temperature increase of less than 2° C over this century with a "likely" chance (greater than 66 per cent probability) and then explain how they would be different for a "medium" chance (50-66 per cent probability). In addition we examine pathways in which the temperature changes are below 1.5° C by the end of the century, but "overshoots" this value for part of the century.

2. Emission pathways consistent with a "likely" chance of meeting the 2° C limit generally peak before 2020, have emission levels in 2020 around 44 $GtCO_2e$ (range: 39-44 $GtCO_2e$[7]), have steep emission reductions afterwards and/or reach negative emissions in the longer term.

Emission pathways assessed in this report that provide a "likely" (greater than 66 per cent) chance of staying within the 2° C limit, have the following characteristics:

A peak in global annual emissions[8] before 2020.

2020 global emission levels of around 44 $GtCO_2e$ (range: 39-44 $GtCO_2e$).[9]

Average annual reduction rates of CO_2 from energy and industry between 2020 and 2050 of around 3 per cent (range: 2.2 - 3.1 per cent)[10].

2050 global emissions that are 50-60 per cent below their 1990 levels.

In most cases, negative CO_2 emissions from energy and industry starting at some point in the second half of the century.

Accepting a "medium" (50-66 per cent) rather than "likely" chance of staying below the 2° C limit relaxes the constraints only slightly: emissions in 2020 could be 1 $GtCO_2e$ higher, and average rates of reduction after 2020 could be 2.5 per cent per year (range 2.2-3.0 per cent). Nevertheless, global emissions still need to peak before 2020 in the majority of cases.

See Box 1 for details on the assessment method employed in this report.

[7] All ranges given in this report represent the 20th and 80th percentiles of results, unless otherwise stated. This range has been chosen to reflect the majority of results of the analysis.
[8] Global annual emissions consist of emissions of the "Kyoto basket of gases" coming from energy, industry and land use.
[9] These are rounded numbers. If numbers with one decimal place were shown it would be clear that the upper end of the range is slightly greater than 44 $GtCO_2e$ and the median slightly smaller than 44. The fact that both the median and upper end of the range are 44 indicates that many of the estimates were close to 44.

[10] Throughout this report emission reduction rates are given for carbon dioxide emissions from energy and industry and expressed relative to 2000 emission levels except when explicitly stated otherwise.

3. It turns out that the 2020 emission levels with a "likely" chance of staying within the 2° C limit can be about the same as those with a *"medium" or lower chance* of meeting the 1.5° C target. However, to have a higher chance of meeting the 1.5° C target the emission reduction rates after 2020 would have to be much faster.

In this assessment we have identified some emission pathways that keep the increase in temperature below 1.5° C by 2100, but "overshoot" this limit by a small amount for a few decades prior to 2100. However, the chance of doing so is low (range: 27-35 per cent probability). The emission levels in 2020 of these pathways are about the same as those in Point 2 above, i.e. they are consistent with a likely chance of staying below the 2° C limit throughout the twenty-first century.[11]

[11] One IAM pathway has been identified that has a "medium" chance of complying with the 1.5° C limit by 2100 (with some overshoot for a few decades) and shows emission reduction rates considered feasible in the IAM literature. See Chapter 2, full report.

In addition, the most ambitious "stylized" pathways show that staying within the 1.5° C limit with overshoot (and with a "medium" or "likely" chance) have emission reduction rates after 2020 that are at the high end or faster than presently found in the IAM literature. Lower emission levels in 2020 would allow slower emission reduction rates after 2020.

These findings should be considered preliminary, however, as few studies have explicitly looked at the question of achieving the 1.5° C target.

4. The range in results stems from uncertainties of assumptions and models used for calculations.

The range in estimates of emission levels comes from model uncertainties including the omission of feedback phenomena in the climate system and (in some models) the impact of aerosols on climate forcing. The uncertainty of key assumptions, such as baseline emissions, also has an influence on calculations.

Box 3. What are feasible emission reduction rates? What are negative emissions?

The behaviour of the climate system dictates that future temperatures will be strongly influenced by emissions throughout the coming decades. Hence, the consistency of 2020 emissions with a given temperature limit can only be judged if emissions after 2020 are taken into account. For that reason it is important to know the feasible rates of emission reductions after 2020. Feasibility refers to whether a particular emission pathway is considered achievable. It depends upon technical, economic, political and social constraints and the extent of mitigation policy. Some of these factors, in particular technological and economic feasibility, can be represented in models such as integrated assessment models (IAM). These include assumptions about the maximum feasible rate of introducing technology, maximum costs of technologies, feasibility of specific system configurations, and limits regarding behavioural changes. Another important factor determining the maximum emissions reduction rate is the typical lifetime of machinery and infrastructure. These lifetimes are important if mitigation strategies aim to avoid premature replacement of capital, which is often considered to be very expensive. Other factors, such as political or social attitudes, might also influence the rate of emission reductions, but they are usually not taken into account by IAMs.

There are different views about feasible emission reduction rates. The highest average rate of emission reductions over the next four to five decades found in the IAM literature is around 3.5 per cent per year. This would imply a decarbonization rate (the rate of decrease in emissions per unit of GDP) of more than 6 per cent per year. Historically (1969-2009), a decarbonization rate of about one per cent has been seen globally. However, it is important to note that expectations about feasibility can change with future developments in technology, attitudes, and economics.

One of many important elements related to the feasibility of emission pathways is negative emissions. Many of the scenarios compiled in this assessment show global negative CO_2 emissions (from energy and industry) from mid-century onwards in order to achieve the temperature limits examined here[12].

Global negative CO_2 emissions would occur if the removal of CO_2 from the atmosphere is greater than the emissions into it. This might be achievable through large-scale afforestation efforts, for example. Many models assume a large deployment of bioenergy combined with carbon-capture-and-storage (BECCS) technology in order to achieve negative emissions. The feasibility of large scale bioenergy systems is related to its sustainability, including the availability of sufficient land and water, its impact on biodiversity, and the productivity of biomass.

If negative CO_2 emissions at a significant scale are not possible, then the options for meeting the limits are substantially constrained.

[12] In this assessment, 75 per cent of scenarios with a "likely" chance of staying below 2° C and 50 per cent of the scenarios that have a "medium" chance of staying below 2° C.

What are the expected global emissions in 2020?

5. Global emissions in 2020 will depend on the pledges implemented and the rules surrounding them. On one hand, emissions in 2020 could be as low as 49 $GtCO_2e$ (range: 47-51 $GtCO_2e$) when countries implement their conditional pledges with "strict" accounting rules. On the other hand, they could be as high as 53 $GtCO_2e$ (range: 52-57 $GtCO_2e$) when countries implement unconditional pledges with "lenient" accounting rules.

As a reference point, without pledges global greenhouse gas emissions may increase from 45 $GtCO_2e$ in 2005 to around 56 $GtCO_2e$ in 2020 (range: 54-60 $GtCO_2e$) according to business-as-usual projections. These results come from thirteen studies that have been reviewed in this assessment.

Results show that the pledges, if implemented, are expected to reduce global emissions in 2020 compared to business-as-usual projections. How much lower will depend on:

i. Whether countries implement their unconditional (lower ambition) or conditional (higher ambition) pledges. Conditions attached to the pledges include, for example, the provision of adequate climate finance and ambitious action from other countries.

ii The extent to which accounting rules for land use, land-use change and forestry (LULUCF) can be used to weaken the mitigation targets of industrialized countries. This could occur if credit is given for LULUCF activities that would have happened in any case without further policy intervention.

iii The extent to which surplus emissions units, particularly those that could be carried over from the current commitment period of the Kyoto Protocol, are used to meet industrialized country targets.

For the purposes of this report, we have developed four cases that provide a range of plausible outcomes from the UNFCCC negotiations, each with different combinations of the factors mentioned above. We use the term "lenient rules" to refer to cases in which countries maximise the use of surplus emission units and "lenient LULUCF credits", and thereby weaken mitigation targets.[13] We use "strict rules" for the cases in which they do not[14].

Case 1 – Unconditional pledge, lenient rules: If countries implement their unconditional pledges and are subject to "lenient" accounting rules (as explained in the paragraph above), global emissions are expected to be about 53 $GtCO_2e$ in 2020 (range: 52-57 $GtCO_2e$), or about 3 $GtCO_2e$ lower than business-as-usual projections.

Case 2 – Unconditional pledge, strict rules: If countries implement their unconditional pledges and are subject to "strict" accounting rules (as explained in the paragraph above), global emissions are expected to drop to 52 $GtCO_2e$ (range: 50-55 $GtCO_2e$).

Case 3 – Conditional pledge, lenient rules: If countries implement their higher ambition, conditional pledges and are subject to "lenient" accounting rules, global emissions are expected to drop to 51 $GtCO_2e$ (range: 49-53 $GtCO_2e$)

Case 4 – Conditional pledge, strict rules: If countries implement their higher ambition, conditional pledges, and are subject to "strict" accounting rules, global emissions are expected to drop to 49 $GtCO_2e$ in 2020. (range: 47-51 $GtCO_2e$).

Thus, under the most ambitious outcome, the pledges could result in 2020 emissions that are 7 $GtCO_2e$ lower than business as usual.

[13] Credits given for carbon removals from existing forests or other sinks that would have occurred without policy intervention. See Chapter 3 of the full report for more detail on the "lenient" and "strict" definitions.

[14] Note that surplus emission units and credits given for LULUCF activities do not necessarily weaken mitigation targets.

6. Emissions could be lower or higher than these estimates, as a result of other factors. Emissions could be higher if offsets were to be "double-counted" towards both industrialized and developing country pledges or if pledges were to be ineffectively implemented. Emissions could be lower as a result of international climate finance for further mitigation efforts, or if countries were to strengthen their pledges, or if domestic activities went beyond their pledges.

The estimates reflected in the four cases do not take into account all factors that could affect emissions in 2020.

Two factors could increase emissions and lessen the impact of the pledges. If industrialized countries were to use offsets to meet their targets, and the developing countries that supplied the offsets also counted them towards their pledges, then emissions would be higher than estimated in Point 5. This "double-counting" of offsets could increase emissions in 2020 by up to 1.3 $GtCO_2e$ in 2020. Similarly, if domestic policies were to be ineffective in meeting the pledges, emissions could be higher in 2020.

There are also factors that could further decrease emissions in 2020. If substantial international funds were to become available as agreed to in the Copenhagen Accord, emissions could be as much as 2.5 $GtCO_2e$ lower in 2020 than in the four cases above. Similarly, if domestic policies went beyond international pledges or if pledges were strengthened, emissions could be substantially lower.

7. A number of uncertainties lead to a significant range in estimates of expected 2020 emissions.

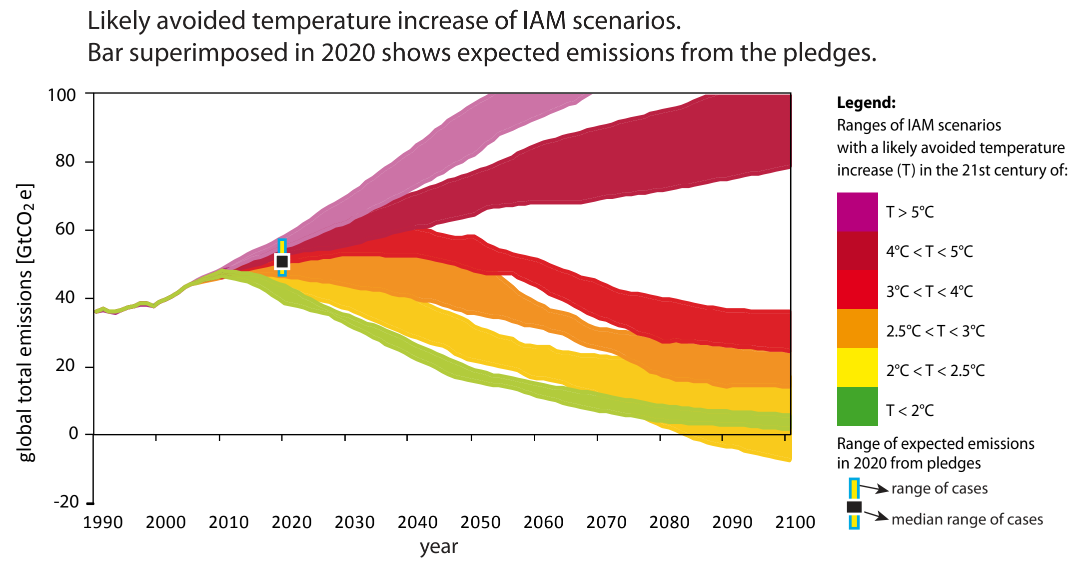
There is a large range between different groups' estimates for 2020 emission levels, even under the same assumptions regarding conditionality of pledges and accounting rules (range: -4 to +8 $GtCO_2e$ around the median estimate, depending on the case). The range of estimates is caused, for example, by differences in the underlying data sets, the treatment of emissions from LULUCF, the estimates of emissions from international transport, and the assumptions made about business-as-usual emissions growth of developing countries.

Box 4. What are the temperature implications of present pledges?

It is not possible to precisely answer the above question because the trend in temperature will strongly depend on the pathway of emissions after 2020. But results from integrated assessment models give us a hint at the range of pathways that could occur between 2020 and 2100. If we start at the level of emissions expected from the Copenhagen Accord pledges in 2020 and then follow the range of these pathways through to 2100, we find that they imply a temperature increase of between 2.5 to 5° C before the end of the century (see Figure 2). The lower bound is the case in which emissions are fairly stringently controlled after 2020, and the upper in which they are more weakly controlled. In other words, emission levels in 2020 implied by current pledges do not seem to be consistent with 2° C or 1.5° C temperature limits. To stay within these limits, emission levels would have to be lower in 2020 and then be followed by considerable reductions.

(Box continued on next page)

Figure 2 – Temperature increases associated with emission pathways and compared to the expected emissions from the pledges. Coloured bands show groups of IAM emission pathways that have approximately the same "likely" avoided temperature increase in the twenty-first century. Specifically the coloured bands show the 20th to 80th percentile range of the IAM pathways associated with those temperature increases[15]. Superimposed on top of the pathways is the range of estimated emissions resulting from the Copenhagen Accord pledges. The small black bar shows the range of median estimates from the four pledge cases. The thin blue bar represents the wider range of estimates associated with those four cases (the 20th to 80th percentile range).



[15]The gaps between the coloured bands come about because this report mainly compiled pathways from low greenhouse gas stabilisation scenario.

How big is the "emissions gap"?

8. A "gap" is expected in 2020 between emission levels consistent with a 2° C limit and those resulting from the Copenhagen Accord pledges. The size of the gap depends on the likelihood of a particular temperature limit, and how the pledges are implemented. If the aim is to have a "likely" chance (greater than 66 per cent) of staying below the 2° C temperature limit, the gap would range from 5-9 $GtCO_2e$, depending on how the pledges are implemented.

As a reference point, we saw in Point 2 that to have a "likely" chance of staying below the 2° C temperature limit, global emissions should be around 44 $GtCO_2e$ (range: 39-44 $GtCO_2e$). But according to business-as-usual projections global emissions in 2020 may be around 56 $GtCO_2e$ (range: 54-60 $GtCO_2e$). This leaves a gap of about 12 $GtCO_2e$ (range: 10-21 $GtCO_2e$).

The four pledge cases, each with different assumptions about the future outcome of the UNFCCC negotiations, result in different gaps as follows[16]:

Case 1 – Unconditional pledges, lenient rules. The gap would be reduced down to 9 $GtCO_2e$ (range: 8-18 $GtCO_2e$) or about 3 $GtCO_2e$ below business as usual.

Case 2 – Unconditional pledges, strict rules. The gap would be about 8 $GtCO_2e$ (range: 6-16 $GtCO_2e$), or about 4 $GtCO_2e$ below business as usual.

Case 3 – Conditional pledges, lenient rules. The gap would be about 7 $GtCO_2e$ (range: 5-14 $GtCO_2e$) or about 5 $GtCO_2e$ below business as usual.

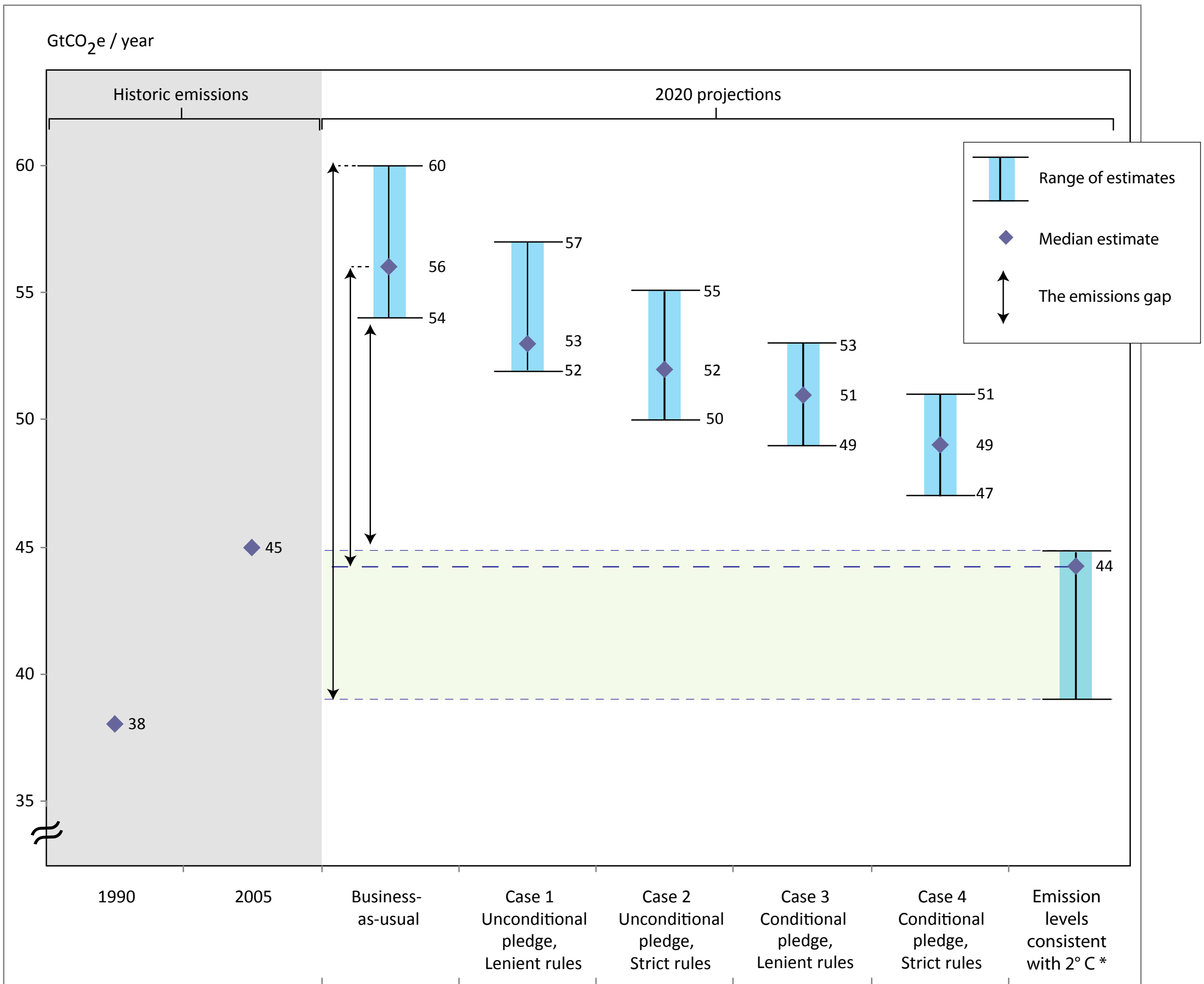
Case 4 – Conditional pledges, strict rules. The gap would be about 5 $GtCO_2e$ (range: 3-12 $GtCO_2e$). This is about 7 $GtCO_2e$ lower than business as usual, and about 60 per cent of the way to the 2° C levels. Although the gap would be considerably narrower than the business as usual case, it would still be as large as the total greenhouse gas emissions from the European Union in 2005 or from global road transport emissions in that year.

These results can be seen in Figure 3.

Double-counting of international emission offsets

[16] All cases refer to emission levels consistent with a "likely" chance of staying below 2° C.

Figure 3: Comparison of expected emissions in 2020 with the emission levels consistent with a "likely" chance of meeting the 2° C limit. The figure compares the expected emissions in 2020 resulting from the four pledge cases with the emission levels consistent with a "likely" chance of meeting the 2° C limit. The median estimates and range of estimates (20th to 80th percentile) are shown. The gap between expected emissions and the 2° C levels is given below in each case.



What is the expected "gap"? $GtCO_2e$		Business-as-usual	Case 1	Case 2	Case 3	Case 4
	Median	12	9	8	7	5
	Range	10-21	8-18	6-16	5-14	3-12

* A "likely" chance of limiting warming to 2° C by 2100

could also increase the gap up to 1.3 $GtCO_2e$. This is a real risk since the Copenhagen Accord does not include rules regarding the use of international offsets.

As a final point here, to have a "medium" rather than a "likely" chance of staying within the 2° C limit, global emissions in 2020 can be about 1 $GtCO_2e$ higher and the gap also narrows by about 1 $GtCO_2e$.

9. There are considerable uncertainties around the estimates of the gap.

Since the emissions gap is the difference between emission levels for different temperature targets and expected emissions in 2020, the gap also inherits the uncertainties of these two components. The reader will note that the range around median estimates (Figure 3) is not symmetric; the lower bound extends about 1-2 $GtCO_2e$ below the median, whereas the upper bound rises 7-9 $GtCO_2e$ above it (for a "likely" chance of staying below 2° C). One way to interpret this skewed range is that the gap may turn out to be higher rather than lower than the median.

This assessment focuses on the majority (20th – 80th percentile) of emission pathways. But there are obviously also results outside of this range. In the extreme case, if we combine the highest 2° C emission levels with the lowest estimate of expected emissions, the gap disappears. At the opposite extreme, if we combine the lowest 2° C emission levels with the highest estimate of expected emissions, the gap would be greater than 20 $GtCO_2e$.

How can the gap be reduced?

10. Various international policy actions are available to close the gap.

a) Reducing the gap through higher ambition pledges.

The gap can be reduced by around 2-3 $GtCO_2e$ (with a range of estimates from 2 to 5 $GtCO_2e$) by moving from the unconditional (lower ambition) pledges to the conditional (higher ambition) pledges.

- **Industrialized countries:** The majority of this reduction would come from industrialized countries, whose pledges are sometimes conditional on the ambitious action of other countries or on domestic legislation.

- **Developing countries:** A smaller, but still important, part of the reduction would come from developing countries, whose pledges are sometimes conditional on the adequate provision of international climate finance or technology transfer.

b) Reducing the gap by tightening the rules

The gap can be reduced by around 1-2 $GtCO_2e$ by ensuring that "strict" rules apply to the use of LULUCF credits and surplus emission units.

- **LULUCF accounting:** If industrialized countries apply "strict" accounting rules to minimise the use of what we refer to as 'lenient LULUCF credits'[17], they would strengthen the effect of their pledges and thus reduce the emissions gap by up to 0.8 $GtCO_2e$.

- **Surplus emission units:** Likewise, if the rules governing the use of surplus emission units under the Kyoto Protocol were designed in a way that would avoid the weakening of mitigation targets, the gap could be reduced by up to 2.3 $GtCO_2e$. These include units carried over from the current commitment period and any potential new surpluses created in the next.

We note that policy options (a) and (b) are interdependent and so their benefits cannot necessarily be added together. But we estimate that the two options combined could reduce emissions by around 4 $GtCO_2e$ in 2020 (with a range of estimates of 4-6 $GtCO_2e$) compared with the least ambitious case (case 1).

[17] Credits given for carbon removals from existing forests or other sinks that would have occurred without policy intervention.

In addition, the risk of the gap increasing in size can be avoided if the negotiations set rules regarding international offsets to prevent them from being counted towards both industrialized and developing country pledges. "Double-counting" would increase the gap by up to 1.3 $GtCO_2e$.

11. It is feasible to close the remaining gap through further mitigation actions by countries, some of which could be supported by international climate finance.

If the above measures were to be taken, there might still be a gap of 5 $GtCO_2e$ compared with a 2° C limit. This gap could be closed if countries were to adopt more ambitious actions or pledges. The results from integrated assessment models (IAM) suggest that it is possible to reach emission levels where there is no gap, using mitigation measures that are economically and technologically feasible.

Analysis also shows that international climate finance in line with the Copenhagen Accord could help achieve some of these reductions in developing countries.

12. Studies show that laying the groundwork for steep rates of emissions reduction from 2020 onwards would be necessary for staying within a limit of 2° C and even more so for 1.5° C, whatever the outcome of the pledges.

The results of the IAM pathways that have a "likely" (greater than 66 per cent) or even "medium" (50-66 per cent) chance of limiting temperature increase to 2° C show average annual emission reduction rates of greater than 2 per cent per year after 2020. Achieving this over the long-term would be unprecedented because, on the contrary, global emissions have almost continuously grown since the industrial revolution.

The higher the emissions in 2020, the faster the rate of decline required thereafter to meet temperature targets. Therefore, if targets are to be met, it will be essential to lay the groundwork now for such rates of reduction. This can be done, for example, by avoiding lock-in of high carbon infrastructure with long life-spans and developing and introducing advanced clean technologies.

Glossary

Double-counting: In the context of this report, double counting refers to a situation in which the same emission reductions are counted towards meeting two countries' pledges.

$GtCO_2e$: For the purpose of this report, greenhouse gas emissions are the sum of the basket of greenhouse gases listed in Annex A of the Kyoto Protocol, expressed as carbon dioxide equivalent. The carbon dioxide equivalent of the various gases is computed by using the global warming potentials published in the Second IPCC Assessment Report.

Integrated assessment model (IAM) pathways: emission pathways produced by models which simulate the energy-economic system including the turnover of energy infrastructure;

"Likely" chance: A greater than 66% likelihood. The term is used to convey the probabilities of meeting temperature limits.

"Lenient" LULUCF credits: Credits given for carbon removals from existing forests or other sinks that would have occurred without policy intervention and are likely to be included in the baseline assumed in model calculations.

"Medium" chance: A 50 to 66% likelihood. The term is used to convey the probabilities of meeting temperature limits.

Negative emissions: Either globally or for a particular sector, the emissions that could occur if, in a given period, the removal of greenhouse gases from the atmosphere is greater than the addition of emissions into it..

"Stylized" pathways: emission pathways, produced by models that do not explicitly model the change in the energy system or feasibility of emission reduction rates.

Surplus emission units: After the first commitment period of the Kyoto Protocol (2008-2012), according to Article 3, paragraph 13, Parties holding emission units not required for compliance with their commitments are able to carry over these units for future use or sale. There is also the possibility that new surplus emissions units will be created in the second commitment period, where targets are set below business-as-usual expectations.

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