February 2015

Benchmark Emission Levels for 2025 and 2030 consistent with the below 2°C limit and the 1.5°C limit

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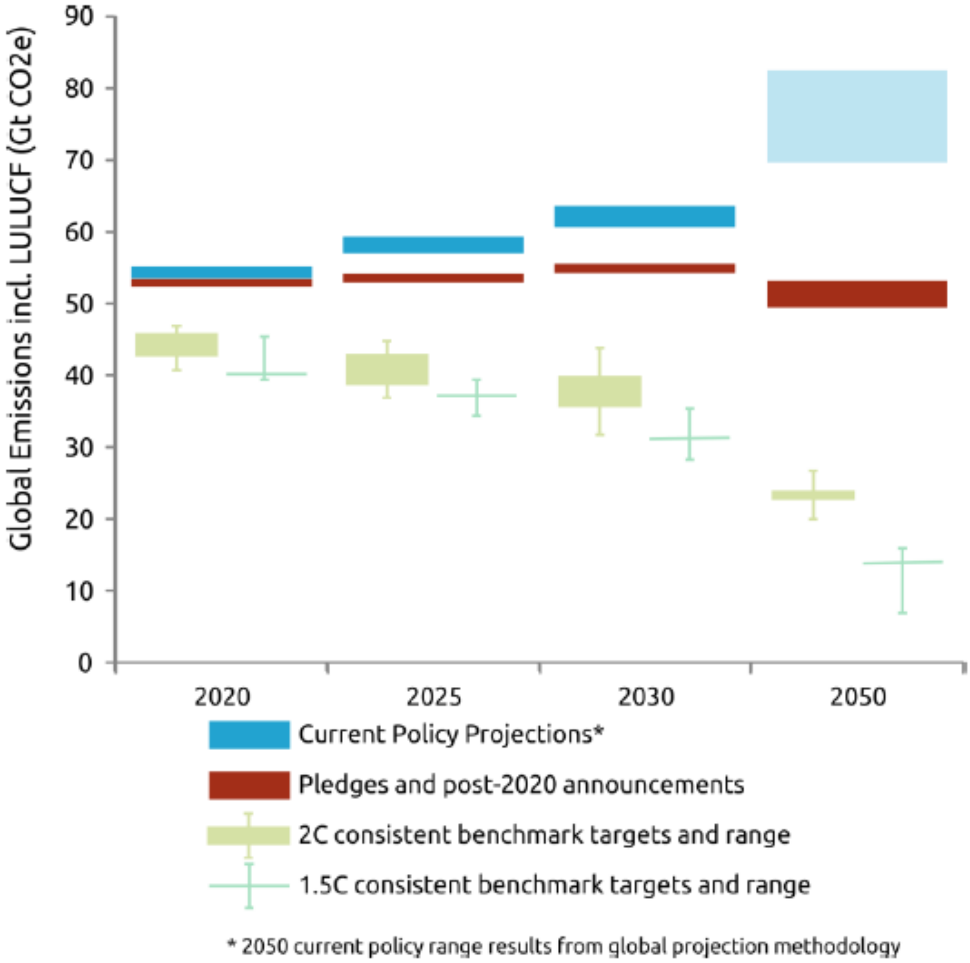
SUMMARY

- Available information in the 2014 UNEP Emissions Gap Report[1] ('EGR') and IPCC AR5 are analysed to produce recommended benchmark emission levels for 2025 and 2030.
- Global emissions in 2012 were 54 billion tonnes of annual carbon-dioxide equivalent emissions ($GtCO_2e$ per year or $GtCO_2e/yr$)
- Global emissions in 2020 from current pledges are estimated to be 53 $GtCO_2e/yr$ and projections for current policy trajectories for 2020 emissions are estimated to be around 55 $GtCO_2e/yr$.
- Emissions in 2020 consistent with a likely 2°C pathway are estimated to be around 44 $GtCO_2e/yr$
- Comparison of 1.5°C[2] and 2°C pathways shows that for the period 2020-2030 the pathways overlap, with the 1.5°C pathways requiring much faster and deeper reductions than the 2°C pathways from the late 2020s onwards.
- Suggested global emission benchmarks for 2025 and 2030 consistent with both the below 2°C limit and with the 1.5°C limit are:
  - 2025 approximately 43 $GtCO_2e/yr$
  - 2030 approximately 39 $GtCO_2e/yr$
- Pathways after 2030 for the below 2°C limit and the 1.5°C limit diverge rapidly.

[1] http://www.unep.org/publications/ebooks/emissionsgapreport2014/

[2] The 1.5°C scenarios underlying the emission numbers here can also be seen as high probability below 2°C pathways (around 85% chance to hold warming below 2°C), compared to the likely (>66%) 2°C pathways. For the return below 1.5°C/ high probability below 2°C pathways full decarbonisation of the energy sector is needed by 2050 (2045-2055).



Global Emissions incl. LULUCF (Gt CO2e)
90
80
70
60
50
40
30
20
10
0
2020
2025
2030
2050
Current Policy Projections*
Pledges and post-2020 announcements
2C consistent benchmark targets and range
1.5C consistent benchmark targets and range
* 2050 current policy range results from global projection methodology

Introduction

Governments are preparing to submit intended nationally determined contributions (iNDCs) as inputs to the preparations for the ADP agreement in Paris in 2015 that is expected to include mitigation commitments. Decision 1/CP.19[3] acknowledges that these are to put forward in the context of moving towards achieving the objective of the Convention in Article 2. With the global goal of holding warming below 2°C, and with a review of the 1.5°C limit, as called for by SIDS and LDCs, now underway, the question arises as to what are the global emission levels in the period 2020, 2025 and 2030 consistent with these goals, and against which the aggregated effect of iNDCs can be assessed for adequacy.

There are also proposals for the inclusion of aggregate global emission limits in elements of the ADP agreement. Parties are presently preparing iNDCs with submissions requested by March 2015. Assessment of the aggregate effect of these with respect to the below 2°C goal, and also with respect to the return to 1.5°C limit by 2100, are under review by the UNFCCC. This will require knowledge of emission levels in the 2020s consistent with these long-term global goals.

This briefing paper analyses the available information in the 2014 UNEP Emissions Gap Report 2014[4] ('EGR') and the IPCC AR5 to produce recommended benchmark emission levels for 2020, 2025 and 2030. We evaluate the implications of the data in the 2014 UNEP EGR and the IPCC AR5 for benchmark emission levels that can be used to assess whether the aggregate level of pledges put forward for 2025 and 2030 - in the context of the ADP negotiations - are consistent with limiting warming below 2°C, and with limiting warming below a 1.5°C increase above preindustrial. We also review the outcome of the 2014 UNEP EGR in relation to the emissions gap for 2020, 2025, and 2030. Results are put in the context of the 2013 UNEP EGR and of the IPCC Fifth Assessment Report, and differences explained.

"2020 Pledge Gap" vs "2020 Current Policy Gap"

The 'emissions gap' in 2020, as defined in the 2014 UNEP EGR, is the difference between emission levels in 2020 consistent with a cost-effective pathway towards limiting warming below 2°C, and the level of emissions resulting from pledges estimated in that year. This is referred to here as the "2020 Pledge Gap". Current policy trajectories show that without further action aggregate global emissions will likely be higher than the level implied by the pledges, as many pledges are unlikely

[3] Decision 1/CP.19 Paragraph 2(b): To invite all Parties to initiate or intensify domestic preparations for their intended nationally determined contributions, without prejudice to the legal nature of the contributions, in the context of adopting a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties towards achieving the objective of the Convention as set out in its Article 2 and to communicate them well in advance of the twenty-first session of the Conference of the Parties (by the first quarter of 2015 by those Parties ready to do so) in a manner that facilitates the clarity, transparency and understanding of the intended contributions, without prejudice to the legal nature of the contributions

[4] http://www.unep.org/publications/ebooks/emissionsgapreport2014/

to be met based on present levels of action[5]. This "2020 Current Policy Gap" is thus larger at present than the "2020 Pledge Gap".

Key 2020 Gap Numbers

The 2014 UNEP EGR estimates the emissions gap in 2020 based on the emission reduction pledges to be roughly of the same magnitude as the estimate of the 2013 report[6]: in other words no real improvement since 2013.

- Global emissions in 2012 were 54 billion tonnes of annual carbon-dioxide equivalent emissions ($GtCO_2e$ per year or $GtCO_2e/yr$)
- Global emissions for 2020 from current pledges[7] are now projected to be 53 $GtCO_2e/yr$ as opposed to a range[8] of 52-56 $GtCO_2e/yr$ in the 2013 Gap Report.
- Emissions in 2020 consistent with a likely 2°C pathway are estimated to be around 44 $GtCO_2e/yr$ (similar to the 2013 estimate)
- The 2020 pledge emissions gap estimate is now 8-10 $GtCO_2e/yr$. In 2013 the gap in 2020 was estimated to be 8-12 $GtCO_2e/yr$.
- As not many countries are on track to meet their pledges, the real emissions gap could be even larger. Current policy trajectories estimate 2020 emissions to be around 55 $GtCO_2e/yr$, approximately 2 $GtCO_2e/yr$ higher than the level estimated from current pledges[9], and making the actual "2020 current policy gap" around 11 $GtCO_2e/yr$.
- The 2020 gap is not becoming smaller. Country pledges and commitments for 2020 represent only a moderate reduction in global emissions below business-as-usual levels.
- The emissions gap for 1.5°C is wider than these estimates as this limit needs earlier action and deeper reductions in the medium term.

2030 "Pledge Gap" Estimates

Looking further into the future, the 2014 UNEP EGR estimates the emissions gap in 2030 to be about 14-17 billion tonnes of annual carbon-dioxide equivalent emissions ($GtCO_2e/yr$). It is important to note that this is based on an extrapolation of emission trends through 2030 using 2020 pledge cases as starting points, not on a detailed analysis of the effects of actual 2030 pledges, or of policies through 2030.

Building on the latest assessment of the Intergovernmental Panel on Climate Change (IPCC), the 2014 UNEP EGR estimates that to limit warming to below 2°C relative to preindustrial levels zero

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[5] See e.g. 2014 UNEP EGR Executive Summary page xix and Climate Action Tracker 8th December 2014 http://climateactiontracker.org/news/178/China-US-and-EU-post-2020-plans-reduce-projected-warming.html

[6] In the 2013 report the 2020 gap was estimated at 8-12 $GtCO_2e/yr$. The difference on the high side is caused mainly by the US pledge (17% below 2005 by 2000) included by default in the 2014 report, in all gap scenarios (cases) and not as a "conditional" pledge to be excluded from the high end, as in the 2013 report.

[7] For the "Current pledges, current rules" case, which assumes that all parties implement the pledges they are currently pursuing. The use of LULUCF credits, offset double counting, and surplus emission units is allowed. The range over all policy cases is 52-54 $GtCO_2e/yr$

[8] Range of the median estimates for the four cases assessed by the 2013 UNEP Emissions Gap Report.

[9] Applies to the "Current pledges, current rules" case

global CO_2 emissions[10] needs to be achieved between about 2055 and 2070. Total greenhouse gases are estimated to reach zero globally around 2080 to 2100.

Although the 2014 UNEP EGR takes into account that emissions reductions by 2020 will likely fall short of cost-effective approaches of keeping warming to below 2°C, it also indicates that closing the gap by 2030 is technically feasible, but requires real action beyond the current pledges. The EGR also indicates that emission reductions by 2020 can still be strengthened further, with emissions lower than pledge levels feasible: in other words also the "Pledge Gap" in 2020 can still at least partly be closed.

The 2014 UNEP EGR estimates that without further action current pledges will not be met by a number of countries and actual global emissions could be higher than the assessment of the pledge range. Not closing the gap by 2020, in line with current trends, increases the overall risk of exceeding 2°C and therewith also the feasibility of bringing warming to 1.5°C, or below, by 2100. This would also increase climatic damages due to higher rates of warming.

Not closing the 2020 gap has higher long-term and overall costs and a greater risk of economic disruption, greater lock-in of carbon-intensive and energy-intensive infrastructure, greater reliance on so-called negative emissions technologies, and narrows options and choices for mitigation. Putting greater effort into reducing emissions over the next few years ahead of 2020 would reduce all of these risks and would bring many co-benefits along with climate mitigation.

Altogether, postponing stringent emissions reductions by not closing the gap in either 2020 or 2030 will entail greater risks of failing to meet the 2°C target, which would lead to substantially higher adaptation challenges and costs. Particularly when postponing stringent emission reductions until after 2030, the IPCC Fifth Assessment Report[11] indicates that this will substantially increase the challenges associated with limiting warming to below 2°C. Finally, the 2014 UNEP EGR highlights the important potential of energy efficiency improvements and its many ancillary benefits for sustainable development.

Benchmark 2020, 2025 and 2030 global emission levels consistent with limiting warming below 2°C

[10] This is termed 'carbon neutrality' in the gap report: "Here global carbon neutrality means that annual anthropogenic carbon dioxide emissions are net zero on the global scale (Figure ES.1). Net zero implies that some remaining carbon dioxide emissions could be compensated by the same amount of carbon dioxide uptake (negative emissions) so long as the net input of carbon dioxide to the atmosphere due to human activities is zero." If the focus is on fossil fuel and industrial sources of CO_2 emissions then, at the global scale, "net" has little or no meaning in relation to qualifying the term "emissions". In other words, there is no need to qualify global fossil fuel CO_2 emissions as being "net" zero. The term "net" is only of significance in relation to the "compensation" of fossil fuel CO_2 emissions by carbon dioxide uptake in terrestrial or other ecosystems. This concept remains controversial scientifically and in policy terms due to unresolved concerns over the security and permanence of land use change sinks, concerns in relation to accounting for the anthropogenic component of such sinks, the risks of asymmetric accounting of sources and sinks, i.e. emphasizing sinks and minimizing sources.

[11] IPCC 2014. Climate Change 2014. Synthesis Report

With the ADP negotiations building momentum, attention is beginning to focusing on how to assess whether the aggregate level of pledges put forward for 2025 and 2030 are consistent with emission pathways consistent with limiting warming below 2°C, and with bringing warming back to below 1.5°C by 2100. In order to do this, the starting level in 2020 of such a 2°C consistent emission pathway needs to be defined. The starting 2020 emission level influences the level of feasible emissions for 2025 and 2030 – reducing emissions from very high 2020 levels is harder than when emissions in 2020 are lower, while at the same time ultimately deeper emission reductions need to be achieved to compensate for the higher emissions early on. Furthermore, these feasible 2025 and 2030 emissions are provided as a range, because of uncertainty about what is technologically and economically feasible. Altogether, this creates a dilemma related to the still on-going effort to increase the level of action before 2020, so that existing pledges for 2020 are actually met. Successful action in this regard would reduce emissions in 2020 from where they would otherwise be, and make corresponding benchmark emission levels in 2025 and 2030 lower, though easier to achieve. On the other hand, if emissions in 2020 are not further reduced from current projections, also 2025 and 2030 benchmark emission levels will be higher, but with faster rates of reduction in following decades, which are more challenging and harder to achieve.
The 2014 UNEP EGR analyses the IPCC AR5 WGIII emission scenario database for scenarios that meet the 2°C limit with a likely or higher probability (>66%). The 2014 UNEP EGR gives particular attention to emission levels beyond 2020, as in addition to 2020, countries are giving increasing attention to where they need to be in 2025 and 2030, particularly in the context of the ADP negotiations. The emission levels for 2020, 2025 and 2030 under different assumptions are shown below in

Table 1.

Table 1 Global Emission Levels (*GtCO2e/yr*) Limiting Warming Below 2°C with at least 66% chance

Policy Assumptions for <2°C emissions pathway	2020	2025	2030	2050	2100
Pledges met in 2020, "Pledge Gap" not closed - requires negative emission technologies (1)	52	47	42	22	-3
2020 "Pledge Gap" closed - assumes global negative carbon emissions in 21st century (2,4)	46	43	40	24	-1
2020 "Pledge Gap" closed - assumes no global negative carbon emission in 21st century (3,4)	43	39	36	23	5
2013 Estimates of 2020 "Pledge Gap" closed – assuming availability of all mitigation technologies	44	40	35	22	N/A
Notes: (1) Limited action prior to 2020, least-cost action post 2020 to limit warming below 2°C. Negative emission technologies required. (2) Least cost-action from 2010, assuming negative emission technology available in the 21st century to such a degree that global CO_2 emissions from fossil fuel and industry can become negative. (3) Least cost-action from 2010. Assuming negative emissions technologies are not available or only available to a limited degree in the 21st					

century so that global CO_2 emissions from fossil fuel and industry do not become negative. (4) Benchmark for 2020 for all scenarios irrespective of availability of negative emissions is 44 *GtCO2e/yr*, equal to the 2013 Estimates.

There is a wide range of pathways shown to be consistent with limiting warming to below 2°C, underscoring the importance of background policy assumptions in establishing benchmark aggregate emission levels for the years 2020, 2025 and 2030. The level chosen as a benchmark level for 2020, 2025 and 2030 depends on the underlying policy assumptions. These assumptions differ in whether or not the "2020 Current Policy Gap" is reduced (indicating that the reductions which are currently pledged are achieved), or further, whether the "2020 Pledge Gap" (the difference between the pledges and 2°C consistent pathways) is reduced, or closed.

In the 2014 UNEP EGR, the default calculations for 2025 and 2030 benchmark emission levels consistent with the below 2°C limit as presented in the report's executive summary (Table ES.1 reproduced below), assume that "2020 Current Policy Gap" is reduced so that country pledges are met by 2020. In other words, this assumes that the 8-10 $GtCO_2e/yr$ "Pledge Gap" in 2020 is **not** closed. UNEP made this choice because we are already almost halfway between 2010 and 2020, and emissions have continued rising instead of declining. This choice leads, in effect, to a 2°C benchmark in 2020 of 52 $GtCO_2e/yr$, which is about 8 $GtCO_2e/yr$ higher than the 2°C benchmark (44 $GtCO_2e/yr$ – see footnote 4 of Table 1).

Starting at higher emission levels in 2020 has consequences: after 2020, emissions reductions have to be more rapid and the change in emissions trends before and after 2020 is thus much more drastic. Over the 21st century as a whole, the pathways that reproduce the current pledge levels by 2020 are more expensive and less technologically feasible than the least-cost emission pathways starting in 2010.

In general, when starting from a higher global emissions level in 2020 than around 44 $GtCO_2e/yr$[12] (least cost-action starting from 2010) benchmark emission levels in 2025 and 2030 will also still be higher in 2025 than the least-cost 2020 levels. However, as emissions need to drop faster after 2020 than in the least-cost case, emissions by 2030 will be much closer to the least-cost range for that year 36-40 $GtCO_2e/yr$. Emissions in the 2nd half of the 21st century, however, need to compensate for the higher emissions early on, hence need to be lower than the original least-cost pathway.

Emissions levels in 2020 in line with the pledges imply significantly smaller emission reductions up to 2020 than in estimated least-cost pathways[13] that start in 2010 towards limiting warming to below 2°C scenarios. When limiting warming to below 2°C at lowest costs and starting from 2010, benchmark emissions in 2025 are 4 $GtCO_2e/yr$ lower (and in 2030 2 $GtCO_2e/yr$ lower), than when a pathway only starts from 2020 "Pledge Gap" levels (the case in which the "2020 current policy gap" is closed so only the "pledge gap" remains – see

Table 1 and also "Optimal" cases in the 2014 UNEP EGR Table 2.2 reproduced below).

[12] This level is based on least-cost scenarios starting action 2010. See the Executive Summary of the 2014 UNEP EGR.
[13] Least-cost or "optimal" pathways take advantage of lowest cost options for emission reductions and minimize total direct costs of mitigation over the 21st century and discounted to the present. The direct costs of mitigation do not account for the co-benefits of mitigation.

A further important factor is the assumption of whether or not negative emission technologies[14] will become available at large scale in the future. The critical character of this assumption can be seen from the fact that for emission pathways starting with emissions in 2020 at the level of the current pledges, there are **no** scenarios capable of limiting warming below 2°C with a likely chance that do not use this technology at such a scale that global CO_2 emissions become negative (**"Pledge Gap" not closed** case in Table 1, and "limited action until 2020 and cost-optimal mitigation afterwards" in Table 2.2 below). In other words, if this is not available at large scale by the 2050s, achievement of the 2°C goal may be very difficult.

Benchmark 2020, 2025 and 2030 global emission levels consistent with returning warming below 1.5°C by 2100

The 2014 UNEP EGR does not provide a detailed assessment of pathways for returning warming to below 1.5°C by 2100. It reiterates that Working Group III of the IPCC AR5 indicated that only a small number of studies have explored the question of 1.5 °C. These studies, however, indicate that pathways for returning warming to below 1.5 °C by 2100 are characterized by:

(1) immediate mitigation action;
(2) the rapid upscaling of the full portfolio of mitigation technologies; and
(3) development along a low-energy demand trajectory (i.e. high energy efficiency improvements).

We here provide an assessment of pathways that return warming to below 1.5°C by 2100 based on these available studies, and perform a similar analysis as was carried out in the 2014 UNEP EGR. Table 2 and Table 3 report the results of this analysis.

Virtually all 1.5°C pathways available from the scientific literature reach a peak warming level slightly above 1.5°C around mid-century, before dropping down to 1.5°C or below by 2100, with at least a 50% chance, consistent with the approach taken by the UNEP Emissions Gap Reports. The early emission reductions and often deep negative CO_2 emissions in these pathways in the 2nd half of the 21st century result in the fact that such 1.5°C pathways also hold warming well below 2°C during the whole of the 21st century, with a probability of around 85%. Hence, the 1.5°C scenarios underlying the emission numbers here can also be seen as high probability below 2°C pathways (around 85% chance to hold warming below 2°C), compared to the likely (>66%) 2°C pathways. For these return below 1.5°C/ high probability below 2°C pathways full decarbonisation of the energy sector is needed by 2050 (2045-2055). In addition, all these pathways are still on track by 2100 for a slowly further declining warming beyond 2100, while warming implied by the *likely* 2°C pathways assessed above can be stabilizing, slowly declining, or still slowly increasing by 2100 and hence potentially beyond 2100.

[14] Negative emissions technologies are technologies that provide the benefit of actively removing CO_2 from the atmosphere. The most well-known of such technologies is the use of bioenergy which is combusted in large power plants, after which the produced CO_2 is captured and stored in a geological reservoir. As plants capture CO_2 while growing, during the process of photosynthesis, this results in CO_2 being removed from the atmosphere by this process – hence its name: negative emissions.

Table 2 Overview of global cumulative CO_2 emissions ("CO_2 emission budgets") between 2015 and 2100 consistent with scenarios that hold warming below 2°C in the 21st century and have at least a 50% chance of returning warming to below 1.5°C by 2100.

Return warming to below 1.5°C by 2100 with >50% chance	Global carbon dioxide emissions budgets ($GtCO_2$)			
Pledges met in 2020: Limited action until 2020 cost-optimal mitigation afterwards				
	Number of available scenarios: **6** Year of annual net global CO_2 (including LULUCF) emissions becoming zero*: **2050 (2045-2050)**			
Time window	*2015-2025*	*2025-2050*	*2050-2075*	*2075-2100*
minimum* **	360	309	-281	-372
median	**394**	**369**	**-204**	**-355**
maximum* **	401	395	-150	-289
Pledge Gap closed in 2020: Cost-optimal mitigation from 2010 onwards				
	Number of available scenarios: **31** Year of annual net global CO_2 (including LULUCF) emissions becoming zero*: **2055 (2045-2060)**			
Time window	*2015-2025*	*2025-2050*	*2050-2075*	*2075-2100*
20th percentile	266	250	-188	-352
median	**284**	**317**	**-110**	**-336**
80th percentile	328	380	-57	-249

*** Rounded to nearest 5 years. Format: median (20th percentile – 80th percentile)**
**** Reduction rates are computed as compound annual growth rates.**
***** Due to the small number of scenarios in this category, the minimum and maximum range is provided instead of the 20th to 80th percentiles**

Similar to 2014 UNEP EGR 2°C scenarios, also 1.5°C scenarios can be categorized in a group which by 2020 is in line with current trends and pledges, and a group with significant additional emission reductions by 2020. There are only few scenarios that return warming to below 1.5°C by 2100 starting from emissions in 2020 in line with the current pledges (in this case 53-56 $GtCO_2e/yr$ in 2020). Starting from these high 2020 levels, 1.5°C-consistent emission benchmarks for 2025 and 2030 are around 47 and 39 $GtCO_2e/yr$, respectively. If mitigation were to start from 2010 onward, 1.5°C-consistent benchmarks in the next decades are significantly lower, for instance, around 41, 38, and 32 $GtCO_2e/yr$ in 2020, 2025, and 2030, respectively.

Table 3 Overview of global emissions of total Kyoto-basket greenhouse gases in 2020, 2025, 2030, 2050 and 2100 consistent with scenarios that hold warming below 2°C in the 21st century and have at least 50% chance of returning warming to below 1.5°C by 2100.

Return warming to below 1.5°C by 2100 with >50% chance	Annual emissions of global total greenhouse gases [$GtCO_2$-e/yr]				
Pledges met in 2020: Limited action until 2020 cost-optimal mitigation afterwards					
	Number of available scenarios: **6** Year of annual net global Kyoto-GHG emissions becoming zero†: **2070 (2060-2080)**				
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
Pledge Gap closed in 2020: Cost-optimal mitigation from 2010 onwards					
	Number of available scenarios: **31** Year of annual net global Kyoto-GHG emissions becoming zero†: **2080 (2070-2085)**				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**41**	**38**	**32**	**15**	**-5**
range and spread**	32(40/46)49	32(35/40)44	27(29/36)39	4(8/17)20	-10(-5/-4)-2

*** Rounded to the nearest 1 $GtCO_2$-e/yr**
**** Rounded to the nearest 1 $GtCO_2$-e/yr. Format: minimum value (20th percentile/80th percentile) maximum value, if less than 10 scenarios are available, no percentile values are given. As higher emissions in the near term have to be compensated by deeper reductions later, following 80th percentile benchmarks over the near term would need to followed by 20th percentile benchmarks in the second half of the century.**
† Rounded to nearest 5 years. Format: median (20th percentile – 80th percentile)
‡ Reduction rates are computed as compound annual growth rates.

In general, timing of emissions becoming zero is advanced by about one to two decades compared to 2°C consistent scenarios. This is the case both for global total carbon emissions and for global total Kyoto-GHG emissions. Assuming that the "Pledge Gap" is not closed by 2020, global CO_2 emissions become zero around 2050 in 1.5°C scenarios, while total Kyoto-GHG emissions do so by 2060-2080.

Suggested benchmark levels for 2025 and 2030 for assessing the adequacy of the aggregate effect of INDCs

Given the policy dilemmas described above, choosing the benchmark levels to assess pledges for 2025 and 2030 is not trivial. A suggested approach would be to choose benchmark levels that would provide a safety margin, reducing pressure on future rates of emission reduction should they be achieved. Such a level could be chosen assuming that the 2020 Pledge Gap is partly closed

– in other words assuming that there is substantially increased action that has an effect prior to 2020 as is called for in ADP Work Stream 2 on pre-2020 mitigation ambition.

Such a choice would also provide a near-term incentive to close the gap between where emissions are presently headed (55 *$GtCO_2e/yr$*) and the 2°C consistent benchmark of about 44 *$GtCO_2e/yr$* in 2020. Whilst emissions are most likely to end up higher than the purely least-cost pathway (44 *$GtCO_2e/yr$*), a significant incentive is still provided to continue efforts to advance pre-2020 action. With emissions on this pathway, rates of emission reductions required during the 2020s would be significantly lower than if emissions in 2020 were higher (see Figure 1). A further important conclusion from the comparison of 1.5°C and 2°C pathways evaluated here is that for the period 2020-2030 the pathways overlap, with the 1.5°C pathways requiring much faster and deeper reductions from the late 2020s onwards than the 2°C pathways.

Taking these factors into account, the corresponding benchmarks for 2025 and 2030 that would be consistent with both the below 2°C limit and with the 1.5°C limit are:

- 2025 approximately 43 *$GtCO_2e/yr$*
- 2030 approximately 39 *$GtCO_2e/yr$*

Pathways after 2030 for the below 2°C limit and the 1.5°C limit diverge rapidly.

These emission levels could be used as the initial benchmark to compare the adequacy of aggregate emission levels resulting from INDCs submitted in 2015 in preparation for the mitigation commitments to be made in the new ADP agreement against the pathway needed to limit warming below 2°C and 1.5°C. Whilst the 2025 level is lower than if the pledge gap were not closed, this level provides a small safety margin (about 4 *$GtCO_2e/yr$*) reducing pressure on subsequent rates of emission reductions which would result from a higher benchmark level (such as 47 *$GtCO_2e/yr$*) in 2025. The suggested 2030 level of approximately 39 *$GtCO_2e/yr$* is close to the median of the range of emissions for '"Pledge Gap" closed - assumes global negative emissions in 21st century' scenarios shown in Table 1 and with the 2030 emissions for the 1.5°C pathways in Table 3 'Pledges met in 2020: Limited action until 2020 cost-optimal mitigation afterwards'.

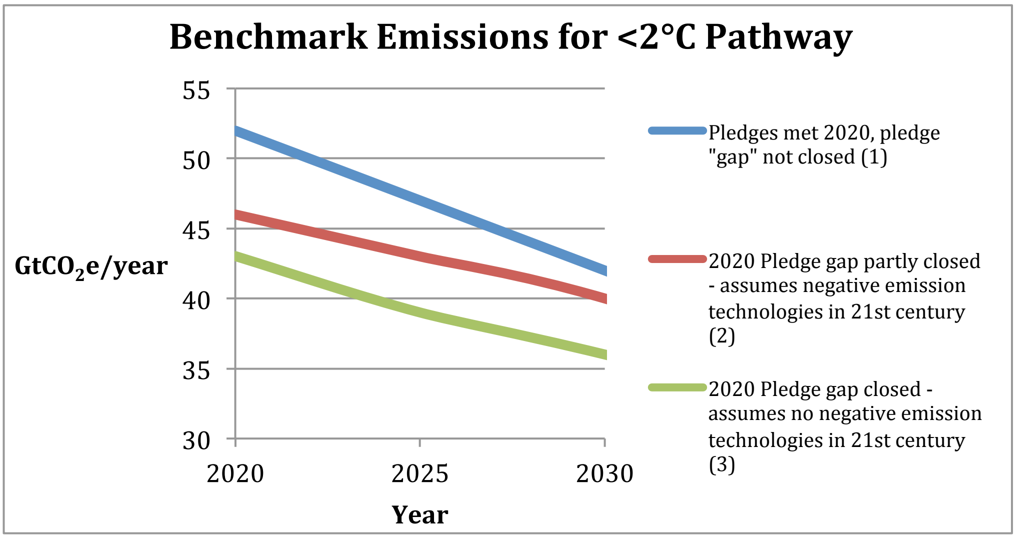

Figure 1 Benchmark emissions for below 2°C emission pathways and starting levels in 2020 for the periods 2025 and 2030. The highest benchmark pathway is starting from a situation where the pledges for 2020 are met. However, 2020 emissions in this case significantly exceed the least-cost 2°C pathways for action starting after 2010. Unless real action is significantly increased soon, actual missions in 2020 are likely to exceed 52 $GtCO_2e/yr$.

CLIMATE ANALYTICS

Background: relevant tables from the 2014 UNEP Emissions Gap Report

Table ES.1: Required greenhouse gas emission levels (Gt CO_2e) for a likely chance of staying within the 2 °C limit

Year	Median (Gt CO_2e)	Relative to 1990 emissions	Relative to 2010 emissions	Range (Gt CO_2e)	Relative to 1990 emissions	Relative to 2010 emissions
2025	47	+27%	-4%	40 to 48	+8 to +30%	- 2 to -18%
2030	42	+14%	-14%	30 to 44	-19 to +19%	-10 to -39%
2050	22	-40%	-55%	18 to 25	-32 to -51%	- 49 to -63%

Notes: Since current emissions are 54 Gt CO_2e and rising (Section 4 of the Summary), substantial emission reductions will be needed to reach these levels.

Table 2.2 Overview of global emissions of total greenhouse gases in 2020, 2025, 2030, 2050 and 2100 consistent with scenarios with a likely (greater than 66 per cent) chance of limiting global temperature increase to below 2 °C during the 21st century, respectively.

"Likely" chance (>66%)	Annual emission of global total greehouse gases (Gt CO_2e/yr)				
Limited action until 2020 and cost-optimal mitigation afterwards					
Scenarios relying on net negative CO_2 emissions from energy and industry during the 21st century	Number of available scenarios: **18** Year of annual net global Kyoto-greenhouse gas emissions becoming zero†: **2085 (2080-2100)** Average annual reduction rates from 2020 to 2050‡: **2.8 (2.4-3.6) per cent per year**				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**52**	**47**	**42**	**22**	**-3**
range and spread**	49(50/53)55	39(40/48)50	29(30/44)44	17(18/25)29	-11(-10/0)0
Scenarios **NOT** relying on net negative CO_2 emissions from energy and industry during the 21st century	Number of available scenarios: **0 (none)** Year of annual net global Kyoto-greenhouse gas emissions becoming zero†: **no data** Average annual reduction rates from 2020 to 2050‡: **no data**				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**no data**	**no data**	**no data**	**no data**	**no data**
range and spread**	no data	no data	no data	no data	no data
Optimal mitigation from 2010 onwards					
Scenarios relying on net negative CO_2 emissions from energy and industry during the 21st century	Number of available scenarios: **50** Year of annual net global Kyoto-greenhouse gas emissions becoming zero†: **2095 (2090-after 2100)** Average annual reduction rates from 2020 to 2050‡: **2.1 (1.4-2.6) per cent per year**				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**46**	**43**	**40**	**24**	**-1**
range and spread**	22(41/47)49	23(38/45)47	23(34/44)46	14(20/27)33	-10(-4/3)7
Scenarios **NOT** relying on net negative CO_2 emissions from energy and industry during the 21st century	Number of available scenarios: **22** Year of annual net global Kyoto-GHG emissions becoming zero†: **after 2100 (after 2100-after 2100)** Average annual reduction rates from 2020 to 2050‡: **2.1 (1.9-2.4) per cent per year**				
Year	*2020*	*2025*	*2030*	*2050*	*2100*
median*	**43**	**39**	**36**	**23**	**5**
range and spread**	36(41/45)48	27(37/42)44	18(32/38)41	13(20/24)25	3(4/9)13

* Rounded to the nearest 1 Gt CO_2e/yr.
** Rounded to the nearest 1 Gt CO_2e/yr. Format: minimum value (20th percentile/80th percentile) maximum value.
† Rounded to nearest 5 years. Format: median (20th percentile – 80th percentile).
‡ Reduction rates are computed as compound annual growth rates.

Notes: Data refer to the sum of emissions of all greenhouse gases listed in the Kyoto Protocol (see Footnote 5 for a listing of these gases.) For results consistent with a "medium" (50–66 per cent) chance, see Appendix 2-C. A comparison of these results with IPCC AR5 WGIII data is provided in Appendix 2-D.