

Halfway to Copenhagen, no way to 2 °C

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National targets give virtually no chance of constraining warming to 2 °C and no chance of protecting coral reefs.

International climate negotiations are picking up speed as the deadline for agreeing a global treaty approaches. Countries are now making clear their own commitments to reducing greenhouse gas emissions under amendments to the Kyoto Protocol¹ and under a new agreement or protocol to be decided in Copenhagen in December². Here we compile all of the current position statements from developed and developing countries and ask three questions: what do they add up to in terms of global greenhouse gas emissions, what are the consequences for the global climate system and how do they collectively compare to the goals of limiting warming to 1.5 °C or 2 °C above pre-industrial levels?

More than 100 nations endorse a goal of limiting global warming to 2 °C or less³. These countries accounted for about 25 per cent of the world population in 2005 (ref. 4). Furthermore, many of the most vulnerable nations, including the Alliance of Small Island States (AOSIS), have called for warming to be limited to 1.5 °C above pre-industrial levels.

To constrain global warming to within 2 °C, developed countries would need to cut their emissions to 25–40 per cent below 1990 levels by 2020 and to 50–80 per cent below 1990 levels by 2050, according to the best available scientific analyses. Most developed countries (referred to as Annex I parties under the UN Framework

Convention on Climate Change, or UNFCCC) have specific proposals, domestic policy processes or a clear intent expressed at high political levels from which the amount of ambition for Copenhagen in terms of emissions reductions in 2020 can be inferred. A number of countries have also stated their positions on reducing greenhouse gas emissions by 2050. Many developing countries — including Brazil, China, India and South Africa, whose combined greenhouse gas emissions in 1990 and 2005 amounted, respectively, to 58 and 60 per cent of non-Annex I emissions — have climate policies in place or have declared their intent to adopt policies with sufficient clarity to enable an estimate of their future emissions.

Pathway	Greenhouse gas sources	Group of countries	Percentage change in emissions			
			2020 relative to 1990	2020 relative to BAU	2050 relative to 1990	2050 relative to BAU
Current minimum	Total emissions	Annex 1	-10%	-	-63%	-
		Non-Annex 1	-	-4%	-	-13%
		Global	+46%	-	+88%	-
Current best	Industrial emissions	Annex 1	-8%	-	-57%	-
		Non-Annex 1	-	-4%	-	-13%
		Global	+63%	-	+111%	-
Current minimum	Total emissions	Annex 1	-16%	-	-70%	-
		Non-Annex 1	-	-4%	-	-15%
		Global	+42%	-	+80%	-
Current best	Industrial emissions	Annex 1	-14%	-	-63%	-
		Non-Annex 1	-	-4%	-	-16%
		Global	+59%	-	+102%	-

CALCULATING THE CURVES

Taken together, the countries for which quantitative estimates of future emissions can be made currently represent the lion's share of global population and emissions. These countries accounted for about 70 and 67 per cent of the global population in 1990 and 2005, respectively, and for 79 and 76 per cent of global greenhouse gas emissions in those particular years. This exercise therefore serves as an evaluation of the adequacy of current proposals to limit global warming. If additional countries come forward with quantifiable ambitions to reduce their emissions, the projections of future warming presented here could conceivably be lowered, although only to a limited extent.

The issue of interest now is to see how far these national positions, if fully implemented, would reduce total emissions over time, and hence to determine a global emissions pathway that we term 'Halfway to Copenhagen', in light of the

Figure 1 Anticipated emissions. Shown are emissions changes anticipated in 2020 and 2050 under current national commitments, as detailed in the text, for the 'current minimum' and 'current best' pathways. Total emissions include industrial, and land-use change and forestry sources. The baseline for global emissions and Annex-I emissions is measured against a 1990 baseline year, while all non-Annex I emissions are measured relative to the projected emissions under business as usual for the same year.

fact that a global climate treaty must be agreed six months from now. The resulting pathway may be a best-case scenario, as full compliance with stated national positions and international agreements is not guaranteed. The calculation of this pathway takes into account the specific gases and sectors included in various national position statements.

We estimate each country's future emissions pathway and sum these to a global trajectory. Depending on the countries' proposals, we assume limits on national emissions or only on individual sectors. The sum of all national emissions, including a business-as-usual (BAU) projection^{5,6,7} for sectors and gases not covered, forms the basis of each national emissions pathway. If national positions result in estimated emissions exceeding the BAU path, the BAU path is taken instead. In some cases, countries indicate a range of reductions that could be considered, depending on the ambition of other countries. This range of reductions has been captured here by analysing two different scenarios, which we call 'current minimum' and 'current best'.

TOTAL CUTS

So what does all this stack up to? Overall, for the Annex I countries as a group, greenhouse gas emissions from industrial sources — that is, all sources except land-use change and forestry — would be in the range of 8–14 per cent below 1990 levels by 2020 if current commitments were followed through (Fig. 1). This is far less than the 25–40 per cent reductions required from this group of countries for the same period, gases and sources if warming is to be limited to around 2 °C (ref. 8). The collective commitments of non-Annex I countries would reduce their emissions to about 4 per cent below anticipated BAU emissions for 2020. These reductions are also substantially less than those needed to get on a global emissions pathway consistent with limiting warming to about 2 °C, which would require 15–30 per cent below BAU by 2020 (ref. 9). In the longer term, Annex-I industrial emissions would fall to 57–63 per cent below 1990 levels by 2050 — if current positions were faithfully implemented. Global industrial emissions, however, would be approximately 102–111 per cent above 1990 levels by 2050.

To calculate the climatic consequences of these global emission pathways, we estimate total emissions of all the main greenhouse gases and aerosols¹⁰. We then use a reduced-complexity climate model¹¹ to obtain probabilistic estimates

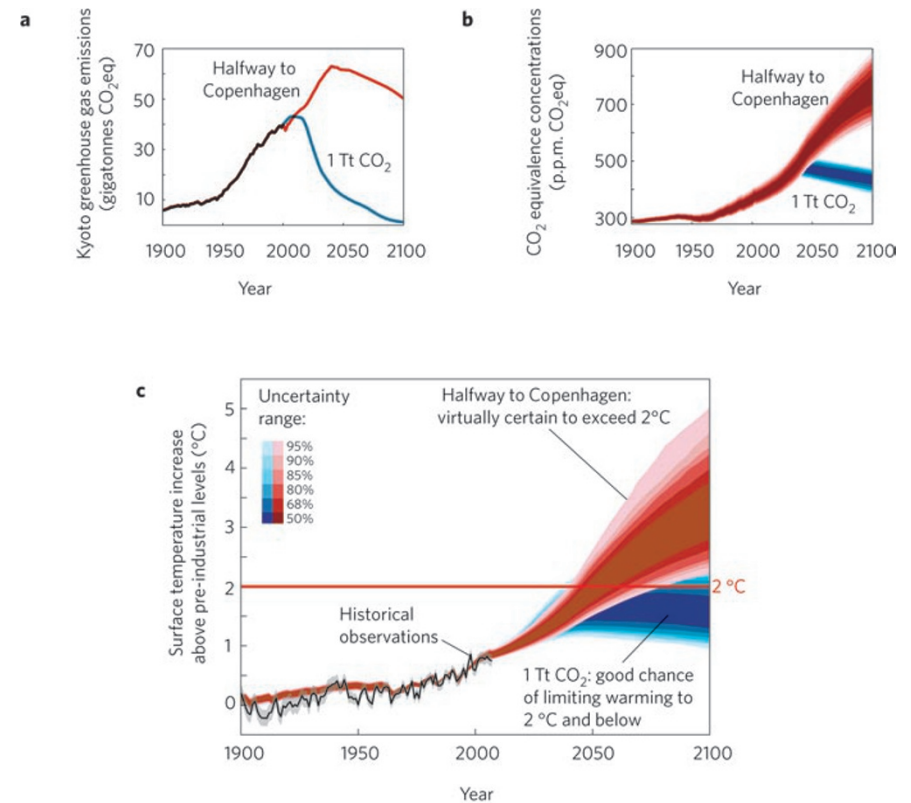


Figure 2 Pathways and consequences. Graphs show projected (a) emissions of the six greenhouse gases regulated by the Kyoto Protocol, (b) atmospheric concentrations and (c) mean surface temperature increase above pre-industrial levels during the twenty-first century, for two pathways: the 'current best' Halfway to Copenhagen pathway, and a pathway with cumulative CO₂ emissions of 1 trillion tonnes (Tt CO₂) from 2000 to 2050. Uncertainty ranges shown in c also apply to b.

of future atmospheric greenhouse gas concentrations and global temperature, given uncertainties in our understanding of how the climate system responds to changing concentrations of these gases. For the sake of conciseness, only the 'current best' pathway is presented here.

OVER THE THRESHOLD

According to this analysis, the current best Halfway to Copenhagen pathway has virtually no chance of limiting warming to 2 °C (or 1.5 °C) above pre-industrial temperatures — or, put another way, it is virtually certain to exceed 2 °C. A pathway that limits emissions to levels likely to meet current temperature goals would have quite different characteristics. Recent work has shown that the overall reduction in emissions by 2050 provides a good indicator of the likelihood of exceeding warming thresholds such as 2 or 1.5 °C in the twenty-first century; we show here a pathway for comparison that has roughly a 70-per-cent reduction in global greenhouse gas emissions by 2050 from 2000 levels and cumulative CO₂ emissions

of a trillion tonnes of CO₂ between 2000 to 2050 (Fig. 2). This pathway has about a 25 per cent chance of exceeding 2 °C, and its median estimate would begin to approach 1.5 °C by 2100.

With global emissions under the 'current best' pathway being at least 67 per cent above 2000 levels in 2050, our results indicate that the level of ambition from countries at present is insufficient to limit warming to 2 °C, let alone 1.5 °C.

The Copenhagen negotiations in December are focussed on what emissions levels should be in 2020. Our assessment of 'current best' national positions indicates that emissions in 2020 are likely to be at least 32 per cent higher than in 2000. Recent work by Meinshausen and colleagues³ has shown that if 2020 global emissions exceed 2000 levels by more than 25 per cent, the probability of exceeding 2 °C could be higher than 50 per cent.

ACID TEST

While we have focused on global mean temperature increase here, it is increasingly clear that independent of its effect on

temperature, growing CO₂ concentrations in the atmosphere will also threaten the world's oceans owing to acidification. The latest research indicates substantial risk to calcifying organisms at atmospheric CO₂ concentrations of 450 parts per million (p.p.m.), with all coral reefs halting their growth and beginning to dissolve at concentrations of 550 p.p.m. (ref. 12). The best Halfway to Copenhagen emissions pathway would result in CO₂ concentrations above this level shortly after 2050.

Unless there is a major improvement in national commitments to reducing greenhouse gases, we see virtually no chance of staying below 2 or 1.5 °C. Coral reefs, in addition, seem to have certainly no chance if the work of Jacob Silverman and colleagues¹² is correct. As then-President-elect Obama said on 18 November 2008 in relation to climate change¹³: "Now is the time to confront this challenge once and for all. Delay is no longer an option."

For a detailed compilation of individual national positions and data sources, please see the Climate Analytics website (<http://www.climateanalytics.org>).

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