Below 2°C or 1.5°C depends on rapid action from both Annex I and Non-Annex I countries

Climate Action Tracker

Policy Brief

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Summary: Next decade critical to keep warming below 2°C or 1.5°C

- The UNFCCC climate talks in June 2014 are aimed at increasing emissions reduction actions in the pre-2020 period, as well as substantially improving mitigation ambition for the post 2020 period in the new climate agreement to be concluded next year.
- In order to prevent dangerous climate change and limit warming to below 2°C or 1.5°C, both Annex I and Non-Annex I countries need to both significantly increase the level of current action to reduce emissions ahead of 2020 and commit to deeper cuts in emissions than currently pledged post 2020.
- In this update the Climate Action Tracker has conducted a new analysis of the IPCC AR5 emissions database to evaluate the required level of global and regional action for 2020, 2025 and 2030 to limit warming to below 2°C or 1.5°C with a likely (66%) and high (85%) probability. A likely pathway for limiting warming below 2°C still has a one in three chance of exceeding this level, and possibly higher when uncertainties in the climate sensitivity and carbon cycle not included in the climate models are considered. A higher probability set of emission pathways then gives much greater security that investments in limiting warming below 2°C will be successful. The high probability 2°C pathways in general also limit warming to 1.5°C or below by 2100.
- Limiting warming below 2°C with a high chance of success means that **total GHG emissions would need to be zero between 2060 and 2080, and likely negative thereafter. CO_2 emissions from fossil fuel combustion and industry would need to be zero between as early as 2045 and no later than 2065, and be negative thereafter.**
- Required emission reductions for Annex I and Non-Annex I groups depend on the economic and equity assumptions applied. For Annex I (developed) countries an equity approach based on capability to mitigate would require reductions of 25-55% below

1990 levels by 2025 and 35-55% below 1990[1] levels by 2030 for a likely 2°C pathway. Other equity approaches would require even deeper reductions.

- For Non-Annex I (developing countries) an equity approach based on capability to mitigate would require an emissions allocation limited to 0-95% above 1990 levels by 2025 for the likely 2° scenarios, and an emissions allocation limited to 5-90% above 1990[2] levels by 2030. Other equity approaches would allow higher emissions allocations. In 2010 Non-Annex I emissions were about 75-80% above 1990 levels, hence in overall terms during the 2020s these emissions under this equity approach would need to be, at their highest, close to present levels or, more likely, significantly below present levels.
- Rapid and deep emissions reductions are not only necessary to limit warming below 2° (or 1.5°C), but are feasible at a modest cost. However, the window of opportunity to limit warming below 2°C could be closed by end of the 2020s unless action is accelerated.
- The IPCC AR5 estimates that currently implemented policies put the world on track to a 3.7 to 4.8°C warming by 2100, confirming earlier projections carried out by the Climate Action Tracker.
- One of the main causes of the recent global increase in emissions growth is the post-2000 reversal of historic decarbonisation trends, driven in large part by the growth of coal combustion. In all of the studies assessed in the IPCC AR5 consistent with limiting warming below 2°C with a high probability **the energy sector needs to decarbonise rapidly and reduce to zero emissions as early as 2045 but no later than 2065.**
- One of the major challenges for Ministers at the UNFCCC meeting in Bonn is to take concrete steps to arrest and reverse this adverse trend in decarbonisation.

USA "Clean Power Plan" emissions reductions and decarbonisation rates far from those needed for 2°C

- In light of this need for decarbonisation of the industry and energy sectors, the CAT has also analysed the US Government's "Clean Power Plan" proposed rule leading to a 30% cut (from 2005 levels) in emissions from power plants.
- While the proposal is welcome, it is insufficient by itself to meet the USA pledge of a 17% reduction of all greenhouse gas emissions by 2020. In 2030, we project the US economy-wide emissions would be around 5% above 1990 levels (or 10 % below 2005 levels), far above levels required for a likely 2˚C pathway.
- The US "Clean Power Plan" implies an economy-wide decarbonisation rate of about 0.9% per annum over the next 15 years, significantly lower than the 1.4% p.a. achieved in the last decade. This is not as fast as is needed for a 2°C decarbonisation pathway.

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[1] 26-48% below 2010 levels

[2] 41% below to 8% above 2010 levels

Emissions levels compatible with 2°C and 1.5°C

The Climate Action Tracker has conducted a new analysis of the mitigation scenarios assessed by IPCC AR5 WGIII, to evaluate the global emissions pathways compatible with holding warming below 2°C and returning to below 1.5°C warming by 2100. The emissions pathways were selected on the basis that:

- These emission scenarios fall within historical limits up to 2010. This excludes some studies whose emissions diverge significantly below historic emissions before 2010.
- They limit warming to below 2°C with a likely (66%) or high (greater than 85%) probability. The latter pathways also return to, or below, 1.5°C by 2100.
- We differentiated between "overall least-cost" mitigation scenarios, which reach long-term targets by reducing emissions at any time over the 21st century to minimise costs, and those that involved a "deliberate" delay in mitigation action. We focussed on the former.

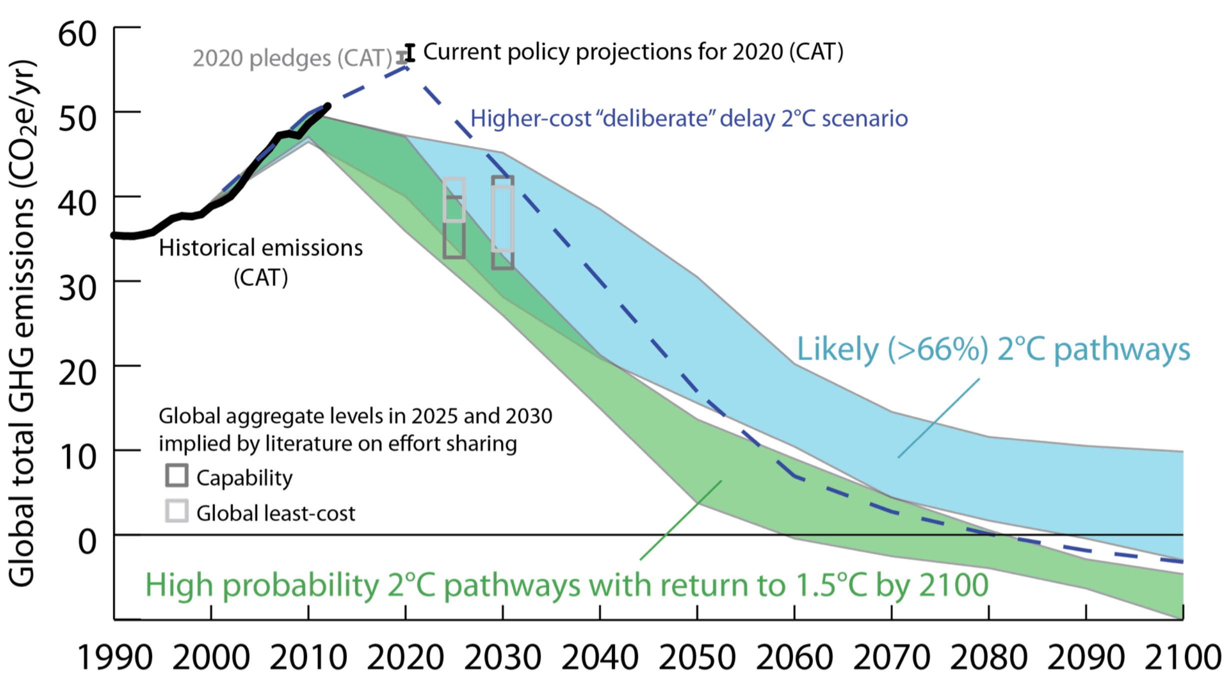

Figure 1: Timeline for global emissions (in Gt CO_2-equivalents per year) to peak and decline towards zero for 2°C and 1.5°C long-term temperature limits. The dashed line indicates the medium of the few scenarios from IPCC AR5 WGIII that reach emission levels in 2020 close to those implied by the Cancun pledges, while still reaching later-century deep reductions sufficient to hold warming below 2°C. Source: Climate Action Tracker calculations based on IPCC database (10-90% range of AR5 WGIII emissions scenarios that are not deliberately forced to reach 2020 emission levels comparable to those implied by the Cancun pledges and do hold warming below 2°C in >66% of climate-model runs) and scenarios that hold warming below 1.5°C by 2100 in >50% of climate-model runs.

	2020	2025	2030	2050	Zero emissions	2100
Stay below 2°C during 21st century with *likely* (more than 66%) probability						
Total GHG below 1990	25 to 10% above 1990	25% above to 5% below 1990	20% above to 25% below 1990	20 to 60% below 1990		75 to 105% below 1990
$GtCO_2e/yr$	40 to 47	35 to 46	28 to 45	16 to 31	2090 or after	-3 to 10
CO_2 emissions from fossil fuel and industry	26 to 35	21 to 34	16 to 33	3 to 19	2060 of after	-15 to 2
Stay below 2°C with at least 85% probability – return to below 1.5°C by 2100 with at least 50% probability						
Below 1990	25% above to 5% below	10% above to 15% below	10-30% below	65-90% below		110-125% below
$GtCO_2e/yr$	36 to 47	31 to 40	26 to 33	4 to 14	2060-2080	-10 to -5
CO2 emissions from fossil fuel and industry	21 to 31	17 to 26	13 to 20	-8 to 4	2045-2065	-17 to -9

Table 1: Global emissions pathway to 2°C and 1.5°C for 2020, 2025, 2030, 2050 and 2100 Source: Climate Action Tracker; calculations based on the scenarios assessed by IPCC Working Group 3 in AR5. Range represent 10-90% range for AR5 WGIII "no delay" emission scenarios, i.e. those for which the energy-economic models are not deliberately forced to reach 2020 emission levels comparable to those implied by the Cancun pledges. Likely 2°C scenarios hold warming below 2°C with over 66% probability over the whole of the 21st century. 1.5°C scenarios hold warming below 1.5°C by 2100 with over 50% probability and hold warming below 2°C with over 85% probability over the whole of the 21st century. Probabilities refer to the percentage of climate model runs within a large ensemble of runs, with varying sensitivity and carbon-cycle characteristics, that hold warming below 2 or 1.5°C.

The motivation to examine high probability 2°C pathways stems from that a likely pathway for limiting still has a one in three chance of exceeding 2°C. The chance of exceeding 2°C is possibly higher than this when uncertainties in the climate sensitivity and carbon cycle not included in the climate models are considered. A higher probability set of emission pathways would then give a much greater security that investments in limiting warming below 2°C will be successful. The high probability 2°C pathways in general also limit warming to 1.5oC or below by 2100.

As a consequence of these selection criteria, the detailed results differ from those presented in the IPCC AR5 WGIII Summary for Policy Makers. We confirm the broad findings of WGIII: **that limiting warming to 2°C implies halving global GHG emissions in 2010 (49 $GtCO_2eq$) by 2050 and reaching very low or even negative levels by 2100.**

However, for CO_2 emissions from the industry and energy sector, emissions must reach zero much sooner, from around 2045. In this report we have generally compared emissions to 1990 levels to enable easy cross-comparison with previous assessments. The emissions levels consistent with 2°C and 1.5°C pathways are displayed in Table 1 and Figure 1.

The lowest of the AR5 scenarios (RCP2.6) indicates global warming can be limited to close to 1.5°C above pre-industrial levels. Negative emissions play a larger role than in the 2°C scenarios. It is as likely as not that sustained globally negative emissions after 2050 will be required to achieve the reductions in atmospheric CO2 in RCP2.6 (AR5, WG1).

The global GHG emissions compatible with below 2°C or 1.5°C follow a steep declining pathway for the period 2020 through 2050. During the 2020s and early 2030s the 1.5°C emissions pathways overlap with the lower part of the 2°C emission ranges, before diverging:

- In 2020, global emissions should have peaked and dropped below 47 GtCO2 (25% above 1990 emissions; just below 2010 emissions) and safer, as low as 40 GtCO2: 10% above 1990 emissions levels and 15% below 2010 levels
- By 2025, emissions should have returned to 35-46 GtCO2eq (5% below to 25% above 1990 emission levels; 5-30% below 2010) for 2°C pathways and 31-40 GtCO2eq (10% above to 15% below 1990 emission levels; 15-35 below 2010) for 1.5°C pathways
- By 2030, emissions should have returned to 28-45 GtCO2eq (20% above to 25% below 1990 emissions levels; 5-40% below 2010) for 2°C pathways and 26-33 GtCO2eq (10-30% below 1990 emissions levels; 35-45% below 2010) for 1.5°C pathways.
- In 2050, emissions should be 16-31 GtCO2eq (20-60% below 1990 emissions levels; 35-65% below 2010) for 2°C pathways and 4-14 GtCO2eq (65-90% below 1990 emission levels; 70-90% below 2010) for 1.5°C pathways

Limiting warming below 2°C with a likely probability implies that total GHG emissions eventually have to decline towards zero by 2100 and CO_2 emissions from fossil fuel and industry would need to be zero as soon as the late 2050s. This contrasts with the high probability 2°C pathways where total GHG emissions reach zero between 2060 and 2080. In the case of CO_2 emissions from fossil fuel and industry the high probability require zero emissions about ten years earlier than in the likely pathways.

Bringing warming back to 1.5°C implies faster emission reductions and an earlier approach to zero GHG and CO_2 emissions: total GHG emissions would need to be zero between 2060 and 2080.

CO_2 emissions from fossil fuel and industry would need to be zero by the 2040s and no later than 2070, and negative thereafter.

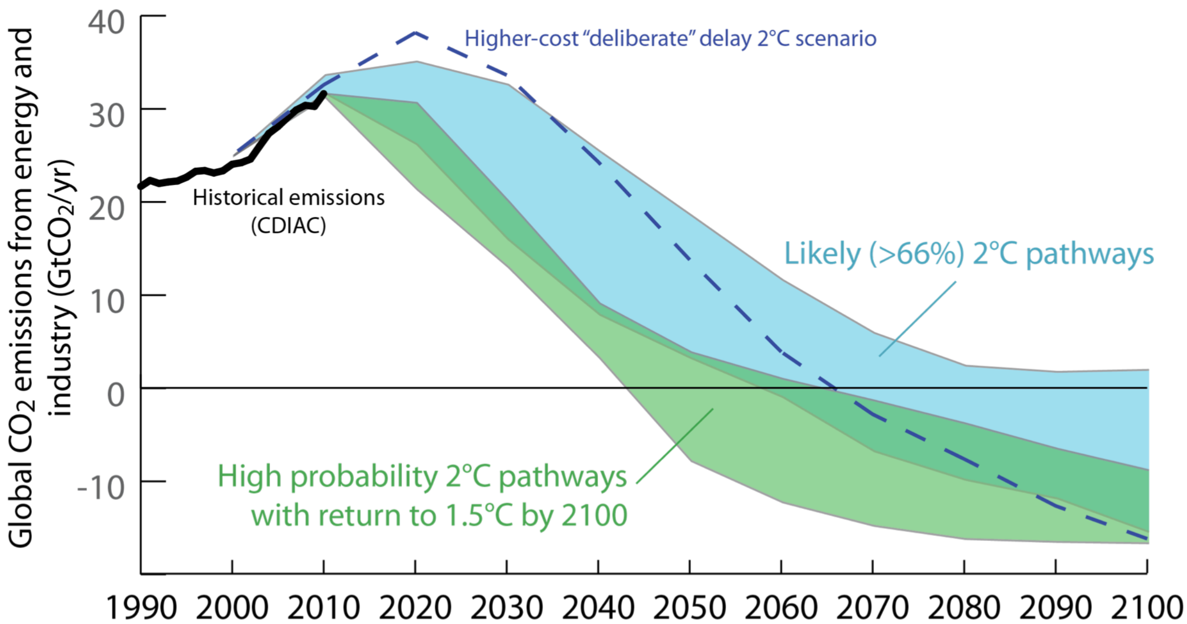

Figure 2: Total global CO_2 emissions from energy and industry 2005 – 2100 compatible with a 2°C pathway. Source: Own calculations based on IPCC database (10-90% range of AR5 WGIII emission scenarios that are not deliberately forced to reach 2020 emission levels comparable to those implied by the Cancun pledges and do hold warming below 2°C in >66% of climate-model runs) and scenarios that hold warming below 2°C in >66% and return to below 1.5°C by 2100 in >50% of climate-model runs.

These emissions reductions would ensure a high chance (>85%) of limiting warming below 2°C, significantly better than the "likely" 2°C pathway described above.

Comparing Figure 2 below with Figure 1 illustrates that for CO2 emissions, the picture looks quite different than is the case for all greenhouse gases.

A high probability 2°C pathway requires a full decarbonisation of the energy sector by as early as 2045, when CO_2 emissions from industry and energy use reach zero in the low emission scenarios.

For such low emission scenarios, IPCC WGIII notes that global CO2 emissions from the energy supply sector are projected to decline over the coming decades and are characterised by reductions of 90% or more below 2010 levels between 2040 and 2070. Emissions in many of these scenarios are projected to decline to below zero thereafter (IPCC AR5, WGIII, SPM).

The IPCC AR5 warns: "*Delays in mitigation through 2030 or beyond could substantially increase mitigation costs in the decades that follow and the second-half of the century*" (IPCC AR5, WGIII, SPM).

Delayed action also implies increased use of technologies that can provide 'negative emissions,' primarily bio-energy combined with carbon capture and storage (BECCS).

Mitigation scenarios without BECCS are found in the lower half of the emission ranges around 2020-2030 and at the upper end by the end of the 21st century.

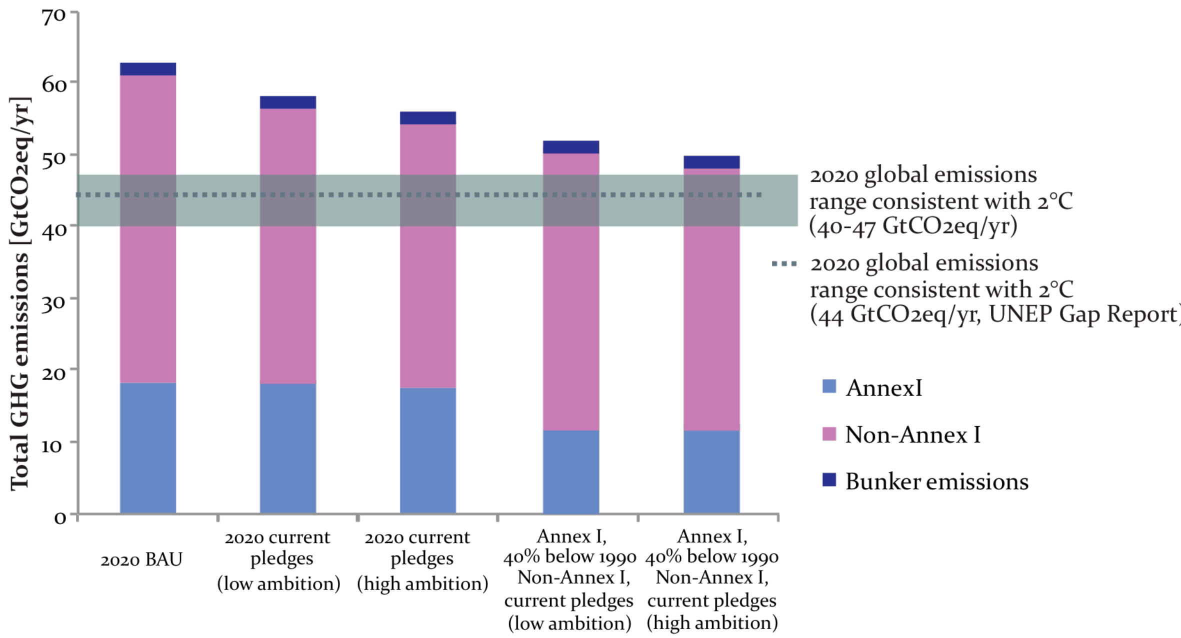

Figure 3: Effect of Annex I increasing mitigation efforts to 40% reduction below 1990 level in relation to 2020 global emissions level consistent 2 and 1.5°C. The emissions gap is the result of total global emissions (top of the bar) and the 44GtCO2eq level, depicted by the grey dotted line.

All Governments need to commit to deeper emissions reductions.

The results from the scientific research clearly show that international cooperation is a prerequisite for effective mitigation action. The endeavour to stay below 2°C will not be achieved if individual agents advance their own interests independently.

The numbers show that further action is needed by both Annex I and non-Annex I Governments to close the 2020 'emissions gap.'

Some parties to the UNFCCC have argued that if Annex I countries were to reduce emissions by 40%, this would be sufficient to close the so-called emissions gap in 2020. Figure 3 above shows the contribution of Annex I and Non Annex I Parties to 2020 levels of emissions. Even if Annex I Parties reduced emissions by 40% below 1990 levels, there would still be an emissions gap in 2020 that the major emitters in the Non-Annex I group would need to close through additional efforts .

Mitigation costs keeping warming below 2°C are modest

The costs of keeping warming levels below 2°C by the end of this century are modest. Estimates of average global macro-economic costs over the century show that loss in total global consumption is limited compared to overall expected economic growth. It is important to note that these cost estimates do not take co-benefits of climate action into account.

Under a cost-effective approach, assuming a global and unique carbon price, macro-economic costs equal an average annual reduction of consumption of about 0.04-0.14 % per year.

Given that the models project a baseline increase of consumption over the 21st century of **1.6-3% per year**, this means that annual economic growth in 2030 would be 1.4%-3.0% instead of 1.6-3.0%.

In 2050, growth rates would be 1.5%-2.9% instead of 1.6-3% and, in 2100, the annual growth rate with mitigation action consistent with the 2C pathway is 1.5%-3.0% instead of 1.6-3.0% (IPCC AR5, WGIII, Chapter 6, p. 8)

This means that with mitigation action, GDP would grow by 43-107% in 2030 in relation to 2005, instead of 49-109% without mitigation action. In 2050, world GDP is projected to be 92-271% larger than in 2005 with implemented climate policy, against 104%-278% in the baseline scenario. In 2100, the economy is projected to grow by 302-1508% instead of 352-1558%, compared to 2005 levels. The differences in final global consumption of goods are marginal as displayed in Figure 4 below.

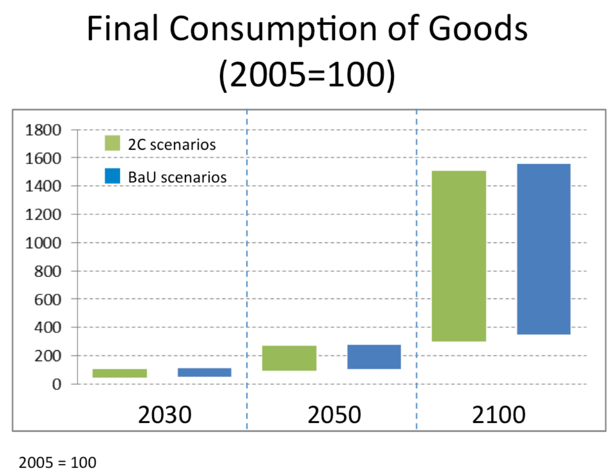

Figure 4: Final total global consumption of goods in 2030, 2050 and 2100, with and without mitigation action required to stay below 2°C. Source: Own elaboration based on IPCC numbers.

Regional distribution of emissions reductions on a below 2°C pathway

The overall emissions pathways to stay below 2°C in 2025 span a range of 35Gt – 46 $GtCO_2e$/yr, which reduces to 28-45 GtCO2e/yr by 2030. This translates into global emissions cuts of approximately 5% below 1990 to 25% above 1990 by 2025 and 25% below 1990 to 20% above 1990 by 2030.[3] It should be noted the feasible emissions pathways cannot be at the top of both the 2025 and 2030 ranges. The task now is to share this fixed global emissions level amongst all countries.

This condition could be met, for example, if all individual Governments were to reduce their emissions by the same percentage, say, 30% below today's level in 2030.

This is highly unlikely since the basic principle of the United Nations Framework Convention on Climate Change is that "Parties should protect the climate system […] on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities."

This means that, depending on each government's responsibility and capability, countries' emissions cuts would diverge from the global average.

[3] 5-30% below 2010 by 2025 and 5-40% below 2010 by 2030

Option	Annex I			Non-Annex I			
	Total	OECD90	EIT	**Total**	LAM	MAF	ASIA
	Relative to 2010						
Global least cost	**-33% to -40%**	-30% to -35%	-39% to -53%	**3% to -32%**	-23% to -75%	21% to -22%	2% to -26%
Average	**-28% to -73%**	-32% to -79%	-20% to -59%	**15% to -28%**	-12% to -54%	-10% to 26%	17% to -28%
Equal cumulative per capita	**-75% to -85%**	-76% to -84%	-72% to -85%	**4% to -12%**	-15% to -71%	n.a.	12% to -13%
Capability	**-20% to -50%**	-19% to -52%	-23% to -44%	**10% to -42%**	-16% to -66%	-9% to 47%	3% to -48%
	Relative to 1990						
Global least cost	**-39% to -46%**	-26% to -31%	-60% to -69%	**21% to 81%**	-11% to -71%	62% to 152%	37% to 90%
Average	**-35% to -76%**	-27% to -78%	-47% to -72%	**28% to 104%**	1% to -47%	89% to 164%	34% to 119%
Equal cumulative per capita	**-77% to -86%**	-74% to -83%	-82% to -90%	**55% to 83%**	-3% to -67%	n.a.	63% to 109%
Capability	**-27% to -54%**	-14% to -49%	-48% to -63%	**2% to 94%**	-3% to -61%	91% to 207%	-3% to 93%

Table 2: 2025 Regional distribution of emission reductions for illustrative cases (relative difference to 1990 and 2010 emissions in 2025) staying within atmospheric GHG concentrations keeping temperature increase below 2°C above preindustrial levels. The same exercise could be done for 1.5°C, however data for sharing efforts under these scenarios are less available. Source: Own analysis based on supplemental data from Höhne et al. 2013

If some governments manage to reduce more than 30%, others can reduce less or even increase their emissions. Developed countries currently emit two thirds of the total greenhouse gas emissions of all developing countries. As a rule of thumb, three percentage points additional reduction to 30% by all developed countries would give room for two percentage points less reduction below 30% for all developing countries, if the same global total is to be reached.

One way to differentiate between country reductions would be to assume they would need to happen where they are the cheapest. Global models provide such scenarios where total global costs are minimised. Results for such a case depend on the model used and the assumptions on costs. Illustrative results of such scenarios are provided in Table 2 and Table 3 as Option "global least cost."

Reductions for developing countries as a whole would be less stringent than a 30% flat rate, because these calculations take into account consumption growth in the developing world. For Latin America, however, it would be more than 30%,

Option	Annex I			Non-Annex I			
	Total	OECD90	EIT	**Total**	LAM	MAF	ASIA
				Relative to 2010			
Global least cost	**-33% to -41%**	-30% to -35%	-39% to -57%	**2% to -32%**	-25% to -75%	21% to -22%	2% to -27%
Average	**-36% to -65%**	-39% to -69%	-28% to -54%	**-28% to 11%**	-18% to -51%	-7% to 38%	7% to -31%
Equal cumulative per capita	**-81% to -85%**	-82% to -85%	-80% to -85%	**1% to -12%**	-35% to -75%	n.a.	10% to -15%
Capability	**-26% to -48%**	-28% to -49%	-23% to -47%	**8% to -41%**	-15% to -58%	-7% to 48%	-1% to -49%
				Relative to 1990			
Global least cost	**-39% to -47%**	-26% to -31%	-60% to -71%	**20% to 80%**	-14% to -71%	62% to 152%	37% to 90%
Average	**-42% to -68%**	-35% to -67%	-52% to -69%	**26% to 95%**	-6% to -44%	93% to 189%	29% to 100%
Equal cumulative per capita	**-83% to -86%**	-81% to -84%	-86% to -90%	**56% to 78%**	-25% to -71%	n.a.	58% to 105%
Capability	**-33% to -53%**	-23% to -46%	-48% to -65%	**4% to 90%**	-2% to -52%	94% to 210%	-4% to 85%

Table 3: 2030 Regional distribution of emission reductions for illustrative cases (relative difference to 1990 and 2010 emissions in 2030) staying within atmospheric GHG concentrations keeping temperature increase below 2°C above preindustrial levels. As there is no data for MAF, we use the same reduction as in the second option for this region when adding up the total non-Annex I. The same exercise could be done for 1.5°C, however data for sharing efforts under these scenarios are less available.
Source: Own elaboration based on data from Höhne et al. 2013

because some models assume there is a large potential to reduce emissions from deforestation at relatively low costs.

A second way to look at it is to distribute differentiated reductions across countries based on their responsibility and/or capability, building on the Convention principles.

Below we show several options for how emission reductions can be distributed among different groups of countries or regions. We draw upon the summary of these studies in the IPCC AR5,[4] which is based on Höhne et al. 2013.[5] They find a large variation across different options, reflecting that there are many ways to share emission reductions.

Taking a broad average over all possible ways of sharing the reductions based on the principles, emission reduction targets for OECD1990 countries would be roughly half of current emissions by 2030.

Targets for Economies in Transition (EIT) would be approximately two

[4] IPCC AR5, working group III, Figure 6.28 and 6.29, www.mitigation2014.org

[5] Niklas Höhne, Michel den Elzen & Donovan Escalante (2014) Regional GHG reduction targets based on effort sharing: a comparison of studies, Climate Policy, 14:1, 122-147, DOI:10.1080/14693062.2014.849452

thirds of current levels. Emissions reduction targets in Asia would be similar to current levels; for the Middle East and Africa (MAF), slightly above the 2010 level and, in Latin America (LAM), well below the 2010 level (Option "Average"). Compared to the "global least cost" option, developing countries as a group would have to reduce less: their mitigation potential is larger than their responsibility and capability.

To cover the extremes of the spectrum, we also show the results for two categories of approaches to share reductions. One extreme approach is "equal cumulative per capita emissions", i.e. equal carbon budgets for countries. In this case, developed countries would have to reduce significantly more, because they have already used most of their per capita carbon budget in the past.

Another extreme approach is sharing emissions reductions according to capability, defined as equal mitigation costs per GDP. In this case, developed countries would have to reduce a lot less, but still more than the 30% we started from.

When the regions are added up in groups of Annex I and non-Annex I countries, Annex I countries will need to reduce emissions beyond the 30% average under all options. Some approaches suggest substantial additional reductions (Table 3).

A related question is where international financial flows should support mitigation actions. Trading of emission allowances may be necessary as expected developed country emission reductions go beyond mitigation potentials.

Changing the negative trend: reversal of recarbonisation is both critical - and possible

From 2000-2010, the energy sector saw a reversal of the decarbonisation trend that took place over the preceding 30 years (1970 – 2000).

This is a critical observation when considering the fact that global CO_2 emissions from energy and industry will have to decrease to zero around 2060 to keep warming below 2°C as shown in Figure 2 above.

The IPCC's interpretation of this development is that economic growth and population continue to be the most important drivers of the increase in CO_2 emissions from fossil fuel combustion.

While it is true that population and GDP are responsible for the largest absolute changes in decadal CO_2 emissions, both these parameters cannot be "improved" like carbon intensity and energy intensity can.

On the one hand, population is an exogenous driver to the models that calculate the emission scenarios. On the other hand, the goal of these models is to maximise consumption of final goods per capita, which is directly linked to GDP growth.

Therefore reducing GDP growth in order to meet a climate target is an option of last resort for these models. The only parameters that can actually be changed are therefore carbon intensity and energy intensity. Achieving the 2°C targets hence requires substantial efforts in these two areas.

Carbon intensity

Figure 5 illustrates how carbon intensity has increased over the past ten years. The figure shows historical development of carbon intensity from 1970 to 2010. It also draws the line for the continued trend from 1970 – 2000 to 2010, to show the significant deviation from the previous trend.

CAT's assessment finds that about **80% of the accelerated increase in CO2 emissions in the period 2000 – 2010 is due to a reversal of the historical decarbonisation trend.**[6]

carbon intensity i.e. the amount of carbon emissions to energy use.

Figure 6 describes what values are required for carbon intensity from now until 2050 in order to stay below the 2°C pathway with 66% probability. It becomes clear that carbon intensity rates will have to decrease rapidly in the coming decades: increasing to 3% annually by 2030 and close to this level through the 2040s, before gradually reducing to 1.6% annually in the 2050s.

The energy sector is decarbonised at the point when global carbon intensity, i.e. total CO_2 emissions from energy and industry related to global energy consumption, approach zero.[7]

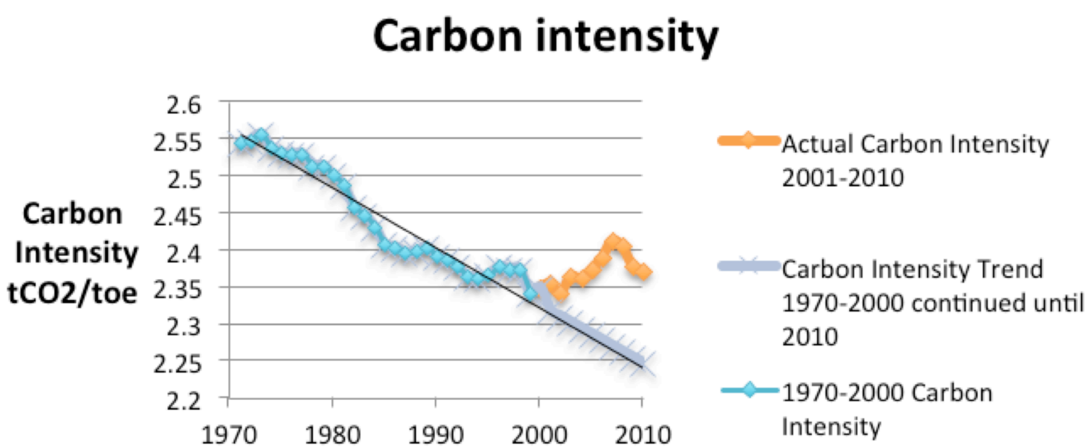

Figure 5: Carbon intensity over the period 1970-2010, actual and corrected to fit the historical trend from 1970-2000. Source: Own calculation based on IEA numbers.

Increasing emissions reductions in the energy sector means reducing the

[6] These 80% are the share of additional increase in emissions from 2000 – 2010 compared to the emissions trend from 1970 – 2000 that can be explained by the reversal of in carbon intensity. 83% of this additional increase, i.e. the increase above the trend from 1970-2000, is explained by carbon intensity, not population growth or GDP.

[7] With the Kaya identity, a decomposition method aimed at analysing emission scenarios for CO_2 emissions from energy and industry, we can investigate what the required pathways for energy intensity and carbon intensity should be in order to stay below 2°C (and 1.5°C). GDP and population are here considered as external drivers for reasons explained above.

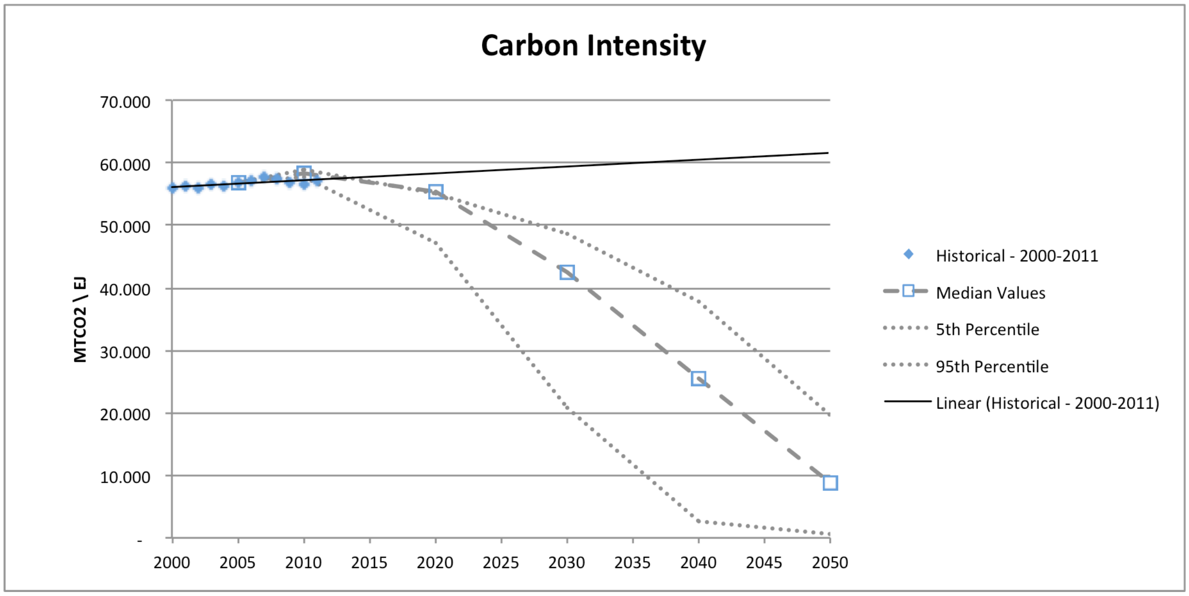

Figure 6: Carbon intensity 2000 – 2050, historical and projected. The solid line shows the trend for 2000-2010 if continued up to 2050. The dotted line shows carbon intensity compatible with 2°C. Source: Own estimates based on IEA

Rapid shifts are possible

Examples from the past show that transformative processes can move faster than initially expected.

Increase in renewable energy: Costs of renewable energy have declined dramatically over the last years and much faster than previously expected. One exceptional example is the decline of costs for solar photovoltaic. Some renewable energy technologies have achieved market competitiveness.

In 2012, renewables made up **just over half of total net additions to electric generating capacity** from all sources in 2012[8]. This could be the start of a new positive trend paving the way to a full decarbonisation of the energy sector.

A low-carbon world requires 100% of net additions from carbon-neutral technologies and phase-out of fossil fuel-based power plants. This transition has been much faster than expected. The International Energy Agency has constantly underestimated the growth of renewable energy: since 2006, every version of the World Energy Outlook has had to increase its renewable capacity projections to reflect real developments.

Efficient lighting: the transition to very efficient lighting was also faster than predicted: 55 countries have agreed to phase out inefficient lighting by 2016 under the initiative En.lighten and are implementing concrete actions to meet this target.[9]

The IPCC expects very efficient LEDs to become the most widely-used light source in the future.[10] Some global lighting technology providers have switched entirely to very efficient LEDs.

[8] http://www.ipcc-wg3.de/assessment-reports/fifth-assessment-report

[9] http://www.enlighten-initiative.org

[10] http://www.ipcc-wg3.de/assessment-reports/fifth-assessment-report

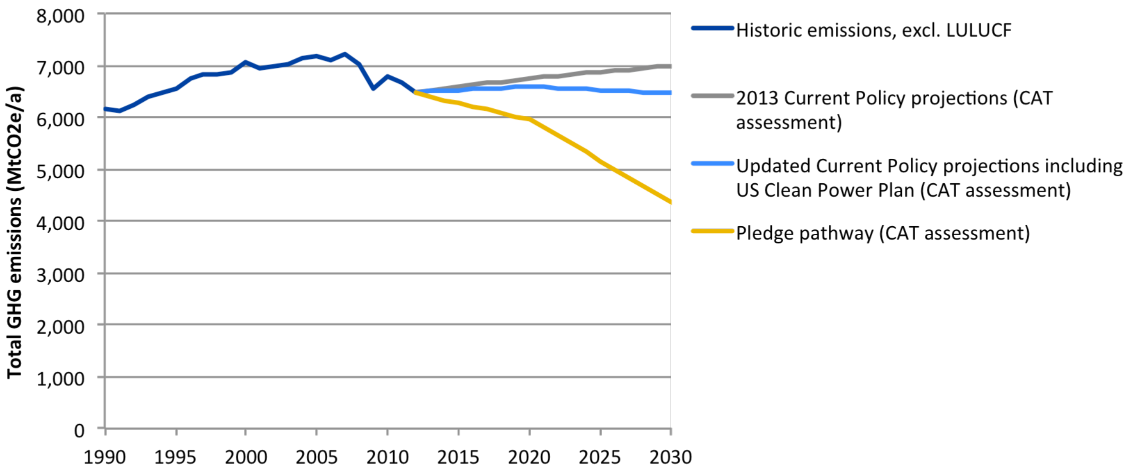

Figure 7: GHG emissions of the USA under different scenarios. Source: Own calculations and CAT update 2013.

Car standards/electro mobility: Various countries have now put in place or intend to instigate – increased efficiency or emissions standards for cars. Important examples are the US, the EU, Japan and China.

The EU has the globally strongest standard – and is overachieving it. The Global Fuel Economy Initiative, founded in 2009, promotes the improvement of the energy efficiency of vehicles globally to 50% of current energy intensity.[11] An electric car is now in the palette of every large car manufacturer, unthinkable a few years ago. They expect this technology to be the future.

US action on existing power plants an important but, taken alone, is insufficient to meet its pledge

The US Environmental Protection Agency (EPA) announced on 2 June 2014 a new regulation that will **reduce GHG emissions from the electricity sector by 30% below 2005 levels by 2030**.

This is the first time US authorities are regulating CO2 emissions from the electricity sector on a federal level. Until now, comprehensive policies that reduce GHG emissions from power plants have only been implemented at the state level.

However, the new rule is insufficient to meet the US pledge of a 17% reduction from 2005 emissions[12] of all greenhouse gas emissions by 2020 (equivalent to about 4% below 1990 levels) and is inconsistent with the long-term target of 83% below 2005 levels by 2050 (equivalent to about 80% below 1990 levels by 2050)(Figure 7).

[11] http://www.globalfueleconomy.org

[12] US 2005 emissions were 16% above 1990 levels.

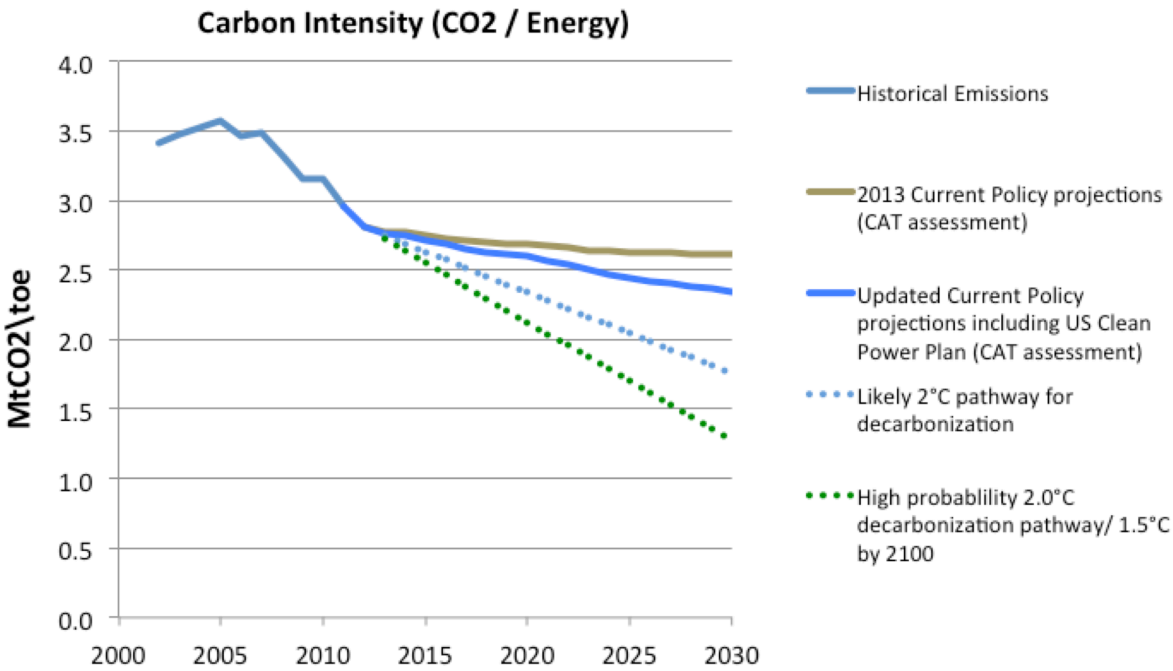

Figure 8: Carbon intensity for the USA historically and under different scenario projections, including the estimated effects of the recently announced Clean Power Plan Proposed Rule.

Based on the CAT assessment, US 2030 economy-wide emissions would be around 5% **above** 1990 levels (or 10 % below 2005 levels). These levels are far above those required for a 2°C pathway. The CAT has calculated from the IPCC AR5 scenarios that reductions for Annex I countries in 2025 and 2030 should be 25-55% and 35-65% **below** 1990 levels respectively for an equity scenario based on relative capability to mitigate.

The EPA's Clean Power Plan addresses emissions from the electricity sector only, which is a major contributor to the USA's total GHG emissions.

In 2012, around one third of the USA's total emissions of 6488 MtCO2eq originated from the power sector.[13]

The new proposed regulation for emissions of electric power plants in the USA will bring GHG emissions down by around 200 MtCO2e/a in 2020 compared to trends without this regulation.

This will help the USA to implement its pledge, but will not be sufficient to close the full gap of around 700 MtCO2e between recent trends and the pledge from earlier assessments[14] of the Climate Action Tracker.

Under the Copenhagen Accord, the USA has announced a long-term target of reducing total GHG emissions: 83% below 2005 in 2050. This target would be just within the range of the USA's emissions

[13] In several analyses of the EPA plan a share of 38% was used. This figure arises when including carbon removals from forestry into the US total emissions.

[14] http://climateactiontracker.org/publications/publication/154/Analysis-of-current-greenhouse-gas-emission-trends.html

compatible with 2°C.[15] In order to be on track to meet their long-term target, the US GHG emissions in 2030 would have to be about 39% below 2005 levels (equivalent to 29% below 1990 levels).

Linearly extrapolating the proposed target for emissions from the electricity sector (30% below 2005 in 2030) into the future would mean that emissions reach minus 54% in 2050 and zero by 2090. This would be too late to reach the long-term pledge of the USA of -83% of all greenhouse gas emissions by 2050.

We calculate a reduction below BAU of approximately 0.5 GtCO2e in 2030 and a decrease of 726MtCO2e/a from 2491MtCO2e/a in 2005. Assuming a linear decrease from today onwards, this would mean emissions of 1950 MtCO2e/a in 2020, in comparison to 2120 $MtCO_2e$/a in the most recent projections of the USA.[16]

The **Clean Power Plan** is part of President Obama's Climate Action Plan and covers the complete electricity sector, suggesting measures in the areas of efficiency on the supply and demand side, renewable energy, and other low-carbon technologies. It will provide options for states to meet the reduction goals in a "flexible manner."[17]

Clean Power Plan decarbonisation rates far from those needed for 2°C

Over the past ten years, there has been a substantial decline in CO_2 emissions in the US energy sector.

The decline corresponds to a 15% decrease in carbon intensity from 2002 to 2012 (about 1.4% per annum improvement), primarily as a result of a fuel switch from coal to gas.

The new policy implies an economy-wide decarbonisation rate of about 0.9% per annum, significantly lower than that achieved in the last decade.

This is not as fast as is needed for a 2°C decarbonisation pathway, and **could therefore mean an actual deterioration of the current decarbonisation rate,** illustrated by the 'historical emissions' in figure 8. The CAT team has calculated the required global carbon intensity pathways for the period 2020 – 2100 consistent with a 2°C pathway.

15 According to Höhne et al. (2013) 'North America's' fair share for 2050 is at minimum an 80% reduction relative to 2010. The USA's 83% reduction below 2005 pledge is equivalent to an 82% reduction below 2010 levels. The 2050 pledge is therefore just within the range of effort-sharing proposals. If all regions only meet the top end of the range, we will not reach the 2 degree goal.

16 http://www.eia.gov/forecasts/aeo/pdf/0383(2014).pdf

17 http://www2.epa.gov/sites/production/files/2014-05/documents/20140602fs-overview.pdf

Background on the Climate Action Tracker

The "Climate Action Tracker", www.climateactiontracker.org, is a science-based assessment by Ecofys, Climate Analytics and the Potsdam Institute for Climate Impact Research (PIK) that provides regularly updated information on countries' reduction proposals.

The Climate Action Tracker[18] reflects the latest status of the progress being made at international climate negotiations. The team that performed the analyses followed peer-reviewed scientific methods (see publications in Nature and other journals)[19] and significantly contributed to the UNEP Emissions Gap Report[20].

The Climate Action Tracker enables the public to track the emission commitments and actions of countries. The website provides an up-to-date assessment of individual country pledges about greenhouse gas emission reductions. It also plots the consequences for the global climate of commitments and actions made ahead of and during the Copenhagen Climate Summit.

The Climate Action Tracker shows that much greater transparency is needed when it comes to targets and actions proposed by countries. In the case of developed countries, accounting for forests and land-use change significantly degrades the overall stringency of the targets. For developing countries, climate plans often lack calculations of the resulting impact on emissions.

Contacts

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Dr. h.c. Bill Hare (bill.hare@climateanalytics.org) (PIK and Climate Analytics) was a lead author of the IPCC Fourth Assessment Report, is guest scientist at PIK and CEO at Climate Analytics.

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[18] www.climateactiontracker.org

[19] e.g. http://www.nature.com/nature/journal/v464/n7292/full/4641126a.html and http://iopscience.iop.org/1748-9326/5/3/034013/fulltext

Ecofys – experts in energy

Established in 1984 with the mission of achieving “sustainable energy for everyone”, Ecofys has become the leading expert in renewable energy, energy & carbon efficiency, energy systems & markets as well as energy & climate policy. The unique synergy between those areas of expertise is the key to its success. Ecofys creates smart, effective, practical and sustainable solutions for and with public and corporate clients all over the world. With offices in Belgium, the Netherlands, Germany, the United Kingdom, China and the US, Ecofys employs over 250 experts dedicated to solving energy and climate challenges.

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Climate Analytics

CLIMATE ANALYTICS is a non-profit organization based in Potsdam, Germany. It has been established to synthesize climate science and policy research that is relevant for international climate policy negotiations. It aims to provide scientific, policy and analytical support for Small Island States (SIDS) and the least developed country group (LDCs) negotiators, as well as non-governmental organisations and other stakeholders in the ‘post-2012’ negotiations. Furthermore, it assists in building in-house capacity within SIDS and LDCs.

www.climateanalytics.org

Potsdam Institute for Climate Impact Research (PIK)

The PIK conducts research into global climate change and issues of sustainable development. Set up in 1992, the Institute is regarded as a pioneer in interdisciplinary research and as one of the world's leading establishments in this field. Scientists, economists and social scientists work together, investigating how the earth is changing as a system, studying the ecological, economic and social consequences of climate change, and assessing which strategies are appropriate for sustainable development.

www.pik-potsdam.de