

2° be or not 2° be

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Summary

- Limiting global warming below 2°C – or even to below 1.5°C remains technically and economically feasible, but only with political ambition backed by rapid action starting now. If nothing more is done except the current pledges, costs would be much higher to reach deeper reductions necessary later, and/or the damage from climate impacts would be far greater. Society also would lose the ability to choose whether it wants technologies like carbon capture and storage and nuclear energy, because those, along with bio-energy, would likely have to be deployed on a larger scale.
- This update provides an analysis of policies in place to meet pledges for China, the USA, EU, Russia, India, Brazil, Indonesia, Japan, Mexico, Canada, South Korea, Australia and South Africa. We assessed the results from this analysis in the context of the ambition level of the pledges made by these countries.
- The aggregated emissions level from all countries' pledges is still likely to induce warming exceeding 2degC by a wide margin, unless pledges are improved and more policies implemented on a national level. While we see some improvement, the fundamental problem remains: Few countries have policies in place to meet their pledges and even fewer have sufficiently ambitious pledges.
- For the first time, China has presented greenhouse gas emissions projections that, if accurate, would deliver a reduction in emissions of 4.5 GtCO₂ in 2020 below a hypothetical scenario without any policies after 2005, to meet its pledge of a 45% reduction in emissions intensity.

Is it too late to limit global warming below 2°C or even 1.5°C?

Many claims have been made in media and policy circles that meeting the 2°C maximum warming goal is no longer possible, and that the goal called for by AOSIS and the LDCs to reduce warming below 1.5°C by 2100 cannot be met.

Others argue that closing the 2020 emissions gap is not important as there is still time for action after 2020, with 'infinite' emission pathways possible afterwards to limit warming to below 2°C. This briefing presents our analysis of these claims from a scientific and quantitative perspective¹. We address key questions relating to the feasibility and practicality of limiting warming to these levels.

In summary, science clearly shows that:

- **Limiting global warming to below 2°C maximum, or even reducing to below 1.5°C by 2100 remains technically and economically feasible, provided there is sufficient political ambition backed up by action to introduce the required measures and policy changes now.**
- **The window for reversing emission trends is rapidly narrowing. Emissions must be reduced by roughly 15% from present levels by 2020 to be on a pathway holding warming below 2°C and/or reducing warming to below 1.5°C by 2100.**
- **Entirely closing the emissions gap remains technically and economically feasible, but it can only be achieved by increasing ambition beyond the current pledges.**

Do historical emissions prevent us from staying below 2°C?

No, they do not. It has been argued that the physics of the climate system will lead to warming exceeding 2°C because of past emissions, no matter what we do with emissions in the future. *This is not true.* If total global greenhouse gas emissions were, hypothetically, set to zero in 2016, "best-guess" temperature increase would not exceed 1.5°C². So from a purely geophysical point of view, 2°C remains within reach. Setting emissions to zero now is of course not realistic, but many technologically and economically feasible pathways that limit warming to these levels have been published.

Are there achievable emission pathways to stay below 2°C?

Yes, many. Many scenarios that simulate the global economy and associated energy system can simulate global pathways that are able to limit warming to below 2°C with a likely (>66%) chance, as well as return warming to below 1.5°C by 2100. Energy-economic scenarios show multiple options to limit warming to these levels, but delayed action brings increasing limitations and costs.

- These scenarios, available in the scientific literature³, show that the order of magnitude of the cost of staying below 2°C can be less than 1% of global GDP⁴, *when investments are spread over time*. However, such scenarios show that *coordinated early action* (ie, starting now, well before 2020) will deliver the least cost way of staying below 2°C. The longer the delay, the higher the cost and the bigger the technological challenges.

¹ Assessing the feasibility of achieving the 2°C objective requires looking at various aspects: geophysical feasibility (how does the climate system respond), energy-economic feasibility (what are the technological options and what do they cost) and social and political feasibility (are the trade-offs acceptable and can changes happen fast enough).

² E.g. Friedlingstein and Solomon (2005); Meehl et al (2005); Matthews and Weaver (2010); Schaeffer et al (2012)

³ Thirty-nine scenarios are found by the UNEP 2012 Emissions Gap Report (ISBN: 978-92-807-3303-7). Moreover, five scenarios returning temperature increase to below 1.5°C by 2100 were also found.

⁴ World Bank. 2009. World Bank Development Report 2010 - Development and Climate Change. Washington DC: World Bank.

- Scenario assessments⁵ show that when key mitigation technologies (like carbon-capture and storage) fail, temperature increase can still be kept below 2°C, provided substantial energy efficiency measures are implemented quickly to compensate. Science thus shows, with multiple technological paths available at moderate costs, that limiting warming to below 2°C is feasible from an economic and energy-system transition point of view.

How feasible is this really?

Very feasible, and very beneficial. The IEA Energy Technology Perspectives 2012 reported that:

“a technological transformation of the energy system is still possible, despite current trends. [...] Investing in clean energy makes economic sense – every additional dollar invested can generate three dollars in future fuel savings by 2050. By 2025, the fuel savings realised would outweigh the investments.”

The new IEA World Energy Outlook’s ‘Efficient World Scenario’ shows that removal of policy and other barriers can tap the potential and provide huge co-benefits in energy security, economic growth and the environment, without requiring unexpected technological breakthroughs. The growth in global primary energy demand could be halved by 2035, producing a net gain in cumulative economic output of \$18 trillion, or 0.4% of GDP through more efficient allocation of resources. Biggest GDP gains would be expected in India (3%), China (2.1%), the US (1.7%) and Europe (1.1%).

Why are 2020 emission levels important for the feasibility of the warming goals?

The longer we wait the more difficult it gets. The series of UNEP Gap reports provide a range of optimal pathways, with a focus on associated global emission levels by 2020 if one’s objective is to hold warming below 2°C with a ‘likely’ chance (>66%).

These scenarios find a global total emission range of 41-47 GtCO₂e by 2020 (yellow path in Figure below). *They require ambitious action before 2020*, almost instantaneous change by all actors and reduction rates that are technically and economically feasible. They also provide opportunities for innovation and energy security.

Sixteen years ago, when the EU agreed on the 2°C limit, pathways compatible with 2°C were calculated that would have had lower global emissions in 2020 (green line in Figure below). These scenarios still would have required ambitious, but realistic reduction rates. They would have allowed delayed participation of developing countries and left significant options for different technologies.

Aggregates of current emission reduction pledges by all countries (the Copenhagen pledges) indicate that emissions in 2020 will be *above* the range of optimal reduction pathways⁶ (see red range in Figure below). 2°C scenarios with these higher 2020 levels (blue pathway in Figure below) would be more difficult to achieve (see next section).

⁵ Riahi, K., et al. (2012) Chapter 17 - Energy Pathways for Sustainable Development. In Global Energy Assessment - Toward a Sustainable Future, 1203-1306. Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria.
<http://www.iiasa.ac.at/web/home/research/researchPrograms/Energy/Home-GEA.en.html>

⁶ See www.climateactiontracker.org, UNEP (2010; 2011; 2012)

What happens if governments fail to increase pledges and the 2020 emissions gap is not closed?

It will require much higher long-term and overall costs, a narrowing of options and choices for society, decreasing feasibility and increased climatic damages due to higher rates of climate change, ocean acidification and sea level rise.

Recent studies⁷ show that when no, or insufficient, coordinated action is taken before 2020, and emissions are left to increase through 2020, there are still options to limit warming to below 2°C through steeper and deeper emission cuts post-2020. However, these options are characterised by rapidly increasing risks and cost. Delays would lead to:

- **Higher long-term and overall costs.** These higher costs would have to be carried by the next generation(s): with estimates showing at least 50% higher costs around the 2050⁵⁷;
- **A higher dependence on the full potential of all mitigation technologies,** including uncertain technologies, such as carbon capture and storage (CCS);
- **More pressure on future policy requirements.** For example, full global participation would be required after 2020, and society may have little freedom to choose technologies, such as the freedom to reject large-scale nuclear energy, CCS, or bio-energy.
- **Increased climatic risks,** like higher rates of warming and the probability of warming overshooting 2°C by a substantial margin. Continuation of the coal-intensive development reported in the IEA 2012 World Energy Outlook leads to a significant chance of a warming of 4°C as early as the 2060s.

What happens if 2°C is missed?

The recent World Bank report, **Turn Down the Heat: Why a 4°C Warmer World Must Be Avoided**, projected very serious impacts of such warming, including:

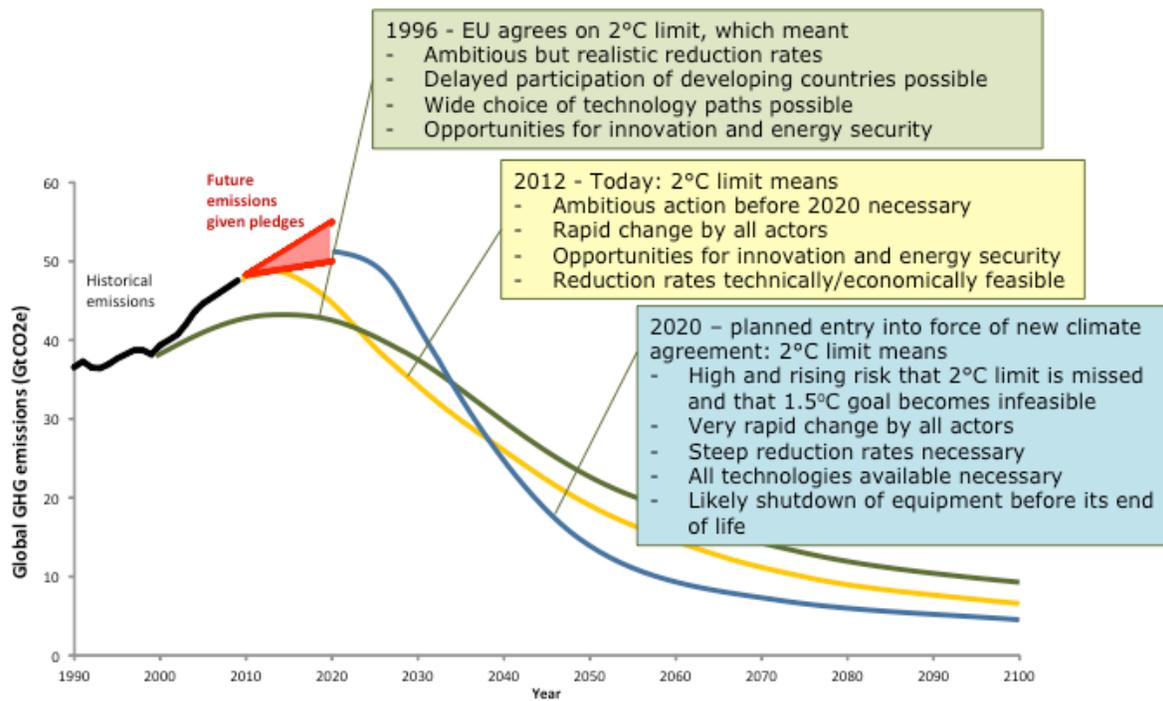
- A dramatic increase in the intensity and frequency of high-temperature extremes. Recent extreme heat waves, such as in Russia in 2010, are likely to become the new normal summer in a 4°C world.
- Tropical South America, central Africa, and all tropical islands in the Pacific are likely to regularly experience heat waves of unprecedented magnitude and duration.
- The coolest months are likely to be substantially warmer than the warmest months at the end of the 20th century.
- In regions such as the Mediterranean, North Africa, the Middle East, and the Tibetan plateau, almost all summer months are likely to be warmer than the most extreme heat waves presently experienced. The warmest July in the Mediterranean region could be 9°C warmer than today's warmest July.
- In the tropics, a 4°C warmer world would imply a new climate regime with the coolest months over the end of the 21st century being substantially warmer than the warmest months over the end of the 20th century, and extreme, unprecedented heat waves.
- Water scarcity would be substantially amplified, particularly in Northern and Eastern Africa, the Middle East, and South Asia
- Significant risk for global food security.

The report also makes a compelling case for a 1.5°C limit by 2100, which would, for example, likely bring CO₂ concentrations back to close to 350 ppm by 2100 and begin to reverse ocean acidification.

⁷ van Vliet, J., et al. (2012) Climatic Change; OECD (2012) OECD Environmental Outlook to 2050; Jakob, M., et al. (2012) Climatic Change

And can we still get below 1.5°C?

Yes, but while the 2020 emission levels for a 2°C and 1.5°C pathway are similar, these diverge rapidly soon after. Reducing warming to below 1.5°C by 2100 will require the large scale deployment of technology to take CO₂ out of the air, and store it underground (carbon capture and storage – CCS) after the 2050s. The models assume that large-scale bio-energy with CCS (BECCS) is employed to achieve the necessary CO₂ reductions. As biomass takes up carbon from the atmosphere through photosynthesis, extracting the CO₂ during biomass combustion (or using energy systems) and storing it underground will, in effect, take CO₂ out of the atmosphere – a negative emission.



Is an agreement on a temperature limit helpful for achieving required action?

A number of voices have recently argued that setting a temperature limit in the international negotiation process is hindering both national action and international agreement. We also hear this discussed in the corridors this week in Doha.

The setting of the 2°C goal, and the corresponding call by the most vulnerable countries for the global goal to be lower, 1.5°C, reflects a common approach to resolving a wide range of 'public good' problems with similar characteristics. What is, for example, the 'right' level for standards on various air pollutants? What is the 'correct' speed limit that allows citizens to reach their destination in an acceptable time that minimizes risk of accidents and air pollution? There is no exact scientific answer for any of these questions. However, resolving these issues requires standards – or focal points - to organise decisions around, to generate sufficient action by all parties.

The 2°C and 1.5°C limits have emerged as well-reasoned focal points for mitigating dangerous climate change. There is significant evidence that the 2° limit has already influenced the targets and policies of countries:

- The European Union has set its 2020 policies and goals and its longer term 2050 ambitions of an 80-95% reduction with a view to achieving the 2°C goal
- Australia has related the upper end range of its pledges and its longer term ambitions to conditions to a global CO₂eq concentrations limit of 450 ppm (about 40% chance to stay below 2°C in the long term)
- Japan set its 2020 target at 25% below 1990, i.e. within the oft-discussed 25% to 40% range compatible with the 2°C limit.
- Mexico increased its ambition in 2009 from 20% below BAU to 30% below BAU in 2020, the most ambitious end of the range compatible with 2°C discussed for developing countries.
- South Korea chose an unconditional target of 30% below BAU in 2020, similarly influenced by the range discussed for developing countries.
- Brazil, Indonesia, South Africa pledged reductions are even more ambitious than 30% below BAU in 2020.

Apart from these pledges for 2020, we also observe many countries that have announced long-term emission reduction goals for 2050, for example, Mexico, Australia and the EU. A few developing countries - Costa Rica and the Maldives - have even announced goals to become carbon neutral within the next decade. Some countries have even embedded these long-term goals into national legislation.

Governments are implementing more climate and energy policies than ever before. All major economies have renewable energy targets, most supported with policies. Standards for electric appliances and buildings are used widely. Efficiency standards for passenger cars have recently been increased by, for example, USA and Canada. Emission trading systems are spreading globally with systems adopted in Australia, South Korea and China. Brazil succeeded in reducing its deforestation rate significantly, one the biggest contributions to reductions globally by a single policy.

Together, these arguments provide a strong message that the temperature limit is helpful, and, in fact, a necessary condition to enable the international community to jointly tackle the potentially catastrophic challenges of climate change. The fact that no country has yet taken sufficient action does not undermine the significance of the 2°C goal as a focal point for policy.

Are countries likely to meet their pledge?

Pledges have induced policy efforts in all countries and are likely to deliver emission reductions. Countries are developing and implementing national climate policies, but more action is needed to reach international pledges in most countries assessed.

There has been more action to reduce energy consumption and greenhouse gas emissions than ever since the start of international climate negotiations. Yet, for some governments these national policies are not sufficient to meet their international pledges.

We draw on other work we have been involved in, published this week in the report: "Greenhouse gas emission reduction proposals and national climate policies of major economies".⁸ This report assesses how likely the current national policies are to meet

⁸ Ecofys/PBL/IIASA: <http://www.ecofys.com/en/publication/policy-brief-analysis-of-domestic-climate-policies/> or <http://www.pbl.nl/en/publications/2012/>

existing pledges. We set this in the context of the overall level of ambition of the individual pledges as assessed in our Climate Action Tracker.⁹

Our findings, illustrated in the table below, indicate that while there are some countries likely to achieve, or even exceed, their pledge, the aggregated emissions level from all countries' pledges is still likely to exceed a 2°C increase of temperature by a wide margin, unless pledges are improved and more policies implemented on a national level.

Legend for table below

-  Uncertain if pledge will be met (e.g. due to data uncertainty or unclear effect of policies)
-  Likely that pledge will be met
-  Unlikely that pledge will be met with currently implemented policies

Range of rating for evaluation of pledge:



Country highlights

(countries in descending order of current emissions)

China – pledge ambition is rated inadequate with large data uncertainty and likely to be met: Meeting the inadequate pledge, China will still continue rapidly increasing GHG emissions to about 14 GtCO₂e in 2020 according to China's second National Communication¹⁰ – and our own calculations.

USA – pledge ambition is rated inadequate and unlikely to be met: The pledge represents a 3% reduction below 1990. All effort-sharing approaches would require more stringent reductions. Even though the latest official projections from the US EIA indicate lower emissions, this can only partly be attributed to policies and will not be sufficient to meet the pledge.

Evaluation of pledge ambition

Likelihood of meeting pledge



⁹ For more detailed information on the methodology and on detailed country results, please visit www.climateactiontracker.org

¹⁰ Government of China, 2012, Second National Communication on Climate Change of The People's Republic of China, available at <http://unfccc.int/resource/docs/natc/chnnc2e.pdf>

Country highlights

(countries in descending order of current emissions)

EU – pledges ambition is rated inadequate and likely to be met:

According to its own projections, EU is expecting to meet its unconditional pledge of 20% below 1990. Planned policies would bring emissions even further down, but not sufficient yet to meet the conditional pledge of 30% below 1990.

Evaluation of pledge ambition

Likelihood of meeting pledge



Russia - pledge ambition is rated inadequate and likely to be met:

Russia's BAU emissions are already below the pledged emission level, therefore climate policies no longer affect the likelihood of achieving the target¹¹. Existing policies are unambitious in terms of emissions reductions.



India – pledge ambition is rated medium with large data uncertainty and likely to be met: Effort-sharing approaches require no or little deviation from baseline by 2020 and pledge is likely to be achieved even without policy actions. Nevertheless, India has implemented various policies at the national and state level¹².



Brazil - pledge ambition is rated medium with large data uncertainty

and it is not clear if will be met: Although the pledge falls into the 'sufficient' category, it is conditional to financial support and is therefore only rated medium. The extremely high share of emissions from land use and land use change (LULUCF) and the high uncertainty for this data makes evaluation of pledge ambition - and if Brazil will meet its target - difficult.



Indonesia - pledge ambition is rated moderate and uncertain if will be met:

High uncertainty in emissions from LULUCF in Indonesia makes it difficult to determine the ambition level of the pledge and to what extent policies have an impact on the likelihood of meeting the pledge.



Japan - pledge ambition is rated sufficient but unclear if it will be met:

Japan's energy policy may change significantly as an effect of the Fukushima accident. The policies currently being implemented in Japan may not achieve its relatively ambitious pledge. *This is unfortunate, because it threatens to undo Japan's positive example compared to other developed countries, whose pledges are generally rated inadequate.*



Mexico - pledge ambition is rated moderate and unlikely to be met:

According to our own detailed country assessment, as well as government sources, Mexico will probably reach only around half of its conditional pledge with currently implemented policies.^{13,14}



¹¹ compare <http://climateactiontracker.org/countries/russianfederation.html>

¹² Government of India, 2008, 11th Five Year Plan 2007-2012

¹³ Höhne et al., 2012, Assessment of Mexico's policies impacting its greenhouse gas emissions profile, available at http://climateactiontracker.org/assets/publications/publications/WP1_MX_Country_report_2012.pdf

¹⁴ Presentation of National Institute of Ecology (Mexico) at Workshop Enhanced Action Towards Effective Mitigation Goals: Issues & Strategies, Seoul, South-Korea, September 2012

Country highlights

(countries in descending order of current emissions)

Canada - pledge ambition is rated inadequate and unlikely to be met:

The pledge does not lead to emission reductions below the 1990 level. Although latest official projections show lower expected future emissions, they still do not meet Canada's unambitious pledge¹⁵.

South Korea - pledge ambition is rated sufficient and unclear if it will be met:

It is not clear if South Korea will achieve its rather ambitious pledge with current and planned policies. Much will depend on the effective design of the national emissions trading scheme, which South Korea will launch in 2015.

Australia - pledge ambition is rated inadequate and will possibly be met, but the latter is highly uncertain:

The unconditional pledge only reflects a reduction of 5% below 2000 levels. Our detailed country assessment last year concluded that this unambitious pledge could be achieved mainly through the Clean Energy Future package. There is significant uncertainty on the effectiveness and continuation of this policy, making a final evaluation difficult.

South Africa - pledge ambition is moderate and unlikely to be met:

South Africa's pledge covers a wide range of emission levels in 2020, referring to uncertainties in the BAU development. Looking at the most recent data, South Africa is currently exceeding its projected BAU emissions. It appears unlikely that with existing or planned policies the country will be able to turn this trend around.

Evaluation of pledge ambition

Likelihood of meeting pledge



(Only if recent policy is implemented)



Chinese government projects 4.5 GtCO₂ reduction through policy actions in 2020

For the first time, China has submitted official greenhouse gas emissions projections and states that its policies will deliver a reduction of emissions of 4.5 GtCO₂ in 2020. If accurate, this would be the largest single absolute reduction for any country in the history of action on climate change.

China's 2nd National Communication published in November 2012 contains three scenarios for energy-related CO₂ emissions: the "baseline scenario", the "policy scenario" and the "enhanced policy scenario".

- The baseline scenario specifically excludes all climate policies implemented since 2005 and leads to energy related emissions of 14.4 GtCO₂ in 2020.
- With the policy scenario, including actions taken under the 11th Five Year Plan (FYP) (2006-2010), emissions are reduced to 11.7 GtCO₂ in 2020.
- Under China's enhanced policy scenario, which includes policies and targets implemented and planned in the 12th and 13th Five Year Plan (up to 2020), emissions will result in 9.9 GtCO₂.

¹⁵ See also the Climate Action Tracker briefing from September 2012, available at <http://climateactiontracker.org/publications/briefing/129/Governments-set-world-on-more-than-3C-warming-still-playing-with-numbers.html>

According to the document, the emissions resulting from the enhanced policy scenario correlate with a reduction in emissions intensity of 45% by 2020 on 2005 levels: exactly matching China's pledge under the UNFCCC.

A reduction of 4.5 GtCO₂e in 2020 is an enormous reduction. By comparison, the emissions of the European Union in 2010 were 4.4 GtCO₂e¹⁶: 1,000 500MW coal-fired power plants running for a year would emit roughly 4 GtCO₂¹⁷.

It is exciting to see there is more detailed data available from China. Due to the short time between the data publication and COP18, we were unable to conduct a full analysis in time for publication of this paper. We intend to scrutinise the storyline, data sources and overall plausibility of the new baseline and policy pathways in the future.

¹⁶ UNFCCC Data Interface, accessed on 29 Nov 2012, available at <http://unfccc.int/di/DetailedByParty/Event.do?event=go>)

¹⁷ Assuming plants have a power of 500 MW and coal an emission factor of 900 gCO₂/kWh

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 Tracker¹⁸ 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 Report²⁰.

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

Dr. Niklas Höhne (n.hoehne@ecofys.com) - Director of Energy and Climate Policy at Ecofys and lead author at the IPCC developed, together with Dr. Michel den Elzen from MNP, the table in the IPCC report that is the basis for the reduction range of -25% to -40% below 1990 levels by 2020 that is currently being discussed for Annex I countries.

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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Ecofys – experts in energy

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Climate Analytics

CLIMATE ANALYTICS GmbH 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

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>

²⁰ www.unep.org/publications/ebooks/emissionsgapreport

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

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