The Climate Crisis – Racing over the edge

"No time to lose – the longer we wait, the greater the damage"

Leo Meyer, presentation on main findings IPCC AR4, October 2008

A multitude of new scientific findings and empirical evidence show the rate of climate change is surpassing the International Panel on Climate Change's (IPCC) [1] worst case forecasts as made in their Fourth Assessment Report, released just last year.

Since 2000, emissions and concentrations have grown faster than expected. At the same time alarming impacts are appearing much earlier, indicating our biosphere is more sensitive to warming than anticipated. The dramatic summer melting of the Arctic sea ice in 2007 and 2008 – which was more than 30 years ahead of model predictions – is probably the most visible of many examples, and has forced a significant re-evaluation of how quickly tipping points may be reached.

With a greater urgency than ever before, the world must take immediate and effective action to achieve a peak in global greenhouse gas emissions by 2015 and adopt a joint long term goal of reducing emissions by at least 80-95% by 2050 from 1990 levels. This means that the current negotiation round, culminating in the Copenhagen climate summit in December 2009, is virtually our last chance to agree on the drastic measures needed, as reversing the aggressive growth trend that we are witnessing will not happen overnight.

1 The Intergovernmental Panel on Climate Change (IPCC) was established to provide decision-makers with an objective source of information about climate change. The IPCC does not conduct any research but assesses on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature produced worldwide relevant to the understanding of the risk and future impacts of human-induced climate change, and the options to prevent these risks and impacts. It comprises government representatives and hundreds of scientists. A rigorous process ensures its reports and assessments are agreed unanimously by all of the countries and all of the leading scientists.

IPCC's Fourth Assessment Report

The international scientific consensus on climate change is clear. The IPCC's Fourth Assessment Report stated "warming of the climate system is unequivocal", and that there is a more than 90% probability that most of the warming since 1950 has been caused by the rapid increase in greenhouse gas concentrations due to human activities.

It warned that dangerous impacts will start to occur at lower temperatures than was assumed by the Third Assessment Report, in 2001. Even the current temperature rise of about only 0.8°C above pre-industrial levels is causing, and will cause serious negative impacts for ecosystems and the human population.

By the end of this century, temperatures may rise by 1.7°C to 7°C above pre-industrial levels, depending on the rate at which we continue to emit greenhouse gases. This means that children born today may witness a temperature change equal to that which took place from the last Ice Age to the present.[2] Shockingly, given current emission trends, we are now heading towards the worst case scenario - an increase of 7°C. Revising these trends will require radical actions, as modest emission reductions would still result in climate chaos.

Reality outpaces IPCC's worst case scenarios

The latest scientific studies show climate change is accelerating at a rate beyond the IPCC's 2007 assumptions. Impacts are being observed much earlier, sometimes by decades, than was forecast, as the following examples demonstrate.

The Arctic

During the 2007 and 2008 melt seasons, Arctic sea ice levels were their lowest since satellite measurements began.[3] The Arctic Ocean is losing summer sea ice at a rate of 30 *or more* years ahead of the IPCC projections, according to researchers from Harvard University and the National Snow and Ice Data Center.[4] Even this estimate can be conservative. In recent model results, Whelan et al. (2007) predicted there may be no Arctic sea ice in summer by 2013.[5] This has not happened for more than a million years.

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[2] During the last glacial maximum about 20 000 years ago the global mean temperature was 'only' 4-7 °C below current levels. IPCC. AR4. WG I. Chapter 6. p. 435

3 NSIDC. 2008: Arctic sea ice down to second lowest extend. Likely record-low volume. Press release. 2 October 2008.

4 Stroeve J. et.al. 2007: Arctic sea ice decline: faster than forecast. Geophysical research Letters. 34, L09501 and Eisenman I. et al. 2008: On the reliability of simulated Arctic sea ice in global climate models. Geophysical Research Letters 35(4).

[5] Whelan J, Maslowski W, Clement Kinney JL, Jakacki J. (2007) Understanding Recent Variability in the Arctic

The “modest” 0.8°C rise in global temperatures since the 19th century seems already to be pushing the climate system past a dangerous tipping point[6] in the Arctic, likely leading to rapid and abrupt changes in regional climate with irreversible effects.

Another possible tipping point we may be close to passing relates to the irreversible melt of the Greenland ice sheet. This could already start at 1.9°C above pre-industrial levels, leading to widespread or near total deglaciation of the island and a sea level rise of up to seven metres during the next centuries or millennia.

The Antarctic

Similarly, the observed loss of Antarctic ice exceeds the projections. Glaciers in the Antarctic Peninsula have started to flow faster, which leads to faster sea level rise.[7]

Sea-level rise

According to the IPCC, model-based projections of global average sea levels show an 18-59 centimetre rise at the end of the 21st century.[8] However, these figures do not include uncertainties in climate-carbon cycle feedback nor the full effects of changes in ice sheet flow observed in Greenland and Antarctica.[9] Recent studies that do take these changes into account predict sea-levels will rise by up to two metres by 2100.[10]

Emissions growth rate

In 2000 and 2007, the growth rate of emissions from fossil fuel and cement production was 3.5% per year, an almost four fold increase from the 0.9% per year over the previous decade. This at the top or higher than the growth rates forecast for 2000-2010 by the IPCC Special Report on Emissions Scenarios (see figure 1).[11]

CO_2 concentrations growth rate

The CO_2 concentration in the atmosphere has now grown to 383 parts per million (ppm), 37% above pre-industrial levels. *The present concentration is*

Sea Ice Thickness and Volume - Synthesis of Model Results and Observations. Eos Trans. AGU 88(52):Fall Meet. Suppl., Abstract C22A-06.

6 Examples of elements of the climage system which are susceptible to tipping include Arctic sea ice, Greenland ice sheet, West Antarctic ice sheet, Atlantic thermohaline circulation and the Amazon rainforest.

7 Pritchard H.D. And Vaughan D.G. 2007: Widespread acceleration of tidewater glaciers on the Antarctic Peninsula. Journal of geophysical Research. 112, FO3S29.

8 IPCC AR4, WGI, spm, p 13.

9 IPCC AR4, WGI, spm, p 14.

10 See for example: Pfeffer, et al. Kinematic Constraints on Glacier Contributions to 21st-Centure Sea-Level Rise. Science 321, 1340 (2008); DOI: 10.1126/science. 1159099
University at Buffalo (2008, February 12). Global Warming: Sea Level Rise Could Be Twice As High As Current Projections, Greenland Ice Sheet Study Suggests. *ScienceDaily*. Retrieved November 24, 2008, from http://www.sciencedaily.com /releases/2008/02/080211172517.htm.
E. J. Rohling, K. Grant, Ch. Hemleben, M. Siddall, B. A. A. Hoogakker, M. Bolshaw & M. Kucera. High rates of sea-level rise during the last interglacial period Nature Geoscience 1, 38 - 42 (2008) Published online: 16 December 2007doi:10.1038/ngeo.2007.28.

11 Global Carbon Project (2008) Carbon budget and trends 2007, [www.globalcarbonproject.org, 26 September 2008]

the highest during the last 650,000 years, and likely for much longer. Between 1980 and 1999, the CO_2 concentration grew on average by 1.5 ppm annually. Now the growth has accelerated. Between 2000 and 2007 the annual growth rate was 2 ppm, and in 2007 the growth was already as high as 2.2 ppm.[12]

There are three factors behind this alarming acceleration: rapid growth of the global economy, increase in the economy's carbon intensity (as the use of fossil fuels has increased) and decreased efficiency of natural sinks.[13]

Implications for setting targets

How much warming we eventually witness will depend on the level at which the greenhouse gas concentrations in the atmosphere are stabilised and on the sensitivity of our climate system. Several countries have stated a goal of limiting average global warming *to below 2°C compared to pre-industrial levels, with the most vulnerable (Aosis, Least Developed Countries) calling for an upper limit of 1.5°C.*

The IPCC AR4 showed that to stabilise concentrations to 450 ppm CO_2-eqv would require Annex I countries as a group to cut their emissions by 25-40% below 1990 levels by 2020 and by 85-90% by 2050. For developing countries as a group emission will need to be reduce below business as usual significantly by 2020, However, even a 450 ppm CO_2-eqv stabilisation has a 26-78% likelihood of exceeding 2°C warming, so the actual emission reductions will need to be at least at the upper end of these emission reduction ranges (see figures 2 & 3).

Conclusions and recommendations

Recent observations and a range of new studies have shown climate change is happening even faster than the IPCC's worst case predictions. As a result, previous estimates of necessary emissions reductions urgently need to be revised if we are to have any chance of avoiding runaway climate change.

Greenpeace is calling for:

- A binding international agreement that forces global greenhouse gas emissions to peak by 2015;

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[12] Global Carbon Project (2008) Carbon budget and trends 2007, [www.globalcarbonproject.org, 26 September 2008]

[13] Canadell JG, Corinne Le Quéré, Michael R. Raupach, Christopher B. Field, Erik T. Buitehuis, Philippe Ciais, Thomas J. Conway, RA. Houghton, Gregg Marland (2007) Contributions to accelerating atmospheric CO_2 growth from economic activity, carbon intensity, and efficiency of natural sinks (pdf, 1.4Mb). *Proceedings of the National Academy of Science*, 0702737104

- Strong leadership by the industrialised countries towards achieving this by:
    (1) reducing emissions to 40% below 1990 levels by 2020, and 95% below by 2050;

    (2) providing adequate funding to support emission reductions in developing countries, enabling their cleaner economic growth with emissions staying 30% below business as usual in 2020.

- International and national policies to drive global greenhouse gas emissions close to zero by mid-century.

- Strict emissions reductions in virtually all sectors, including energy, deforestation and agriculture, as well as sharp reduction of other non-CO_2 greenhouse gasses to very low levels. We will need technological innovations and changes in lifestyle, consumption and trade patterns.

- Substantial funding from the industrialised world for developing countries to decarbonise their economies and adapt to the devastating effects of climate change.

Graphs

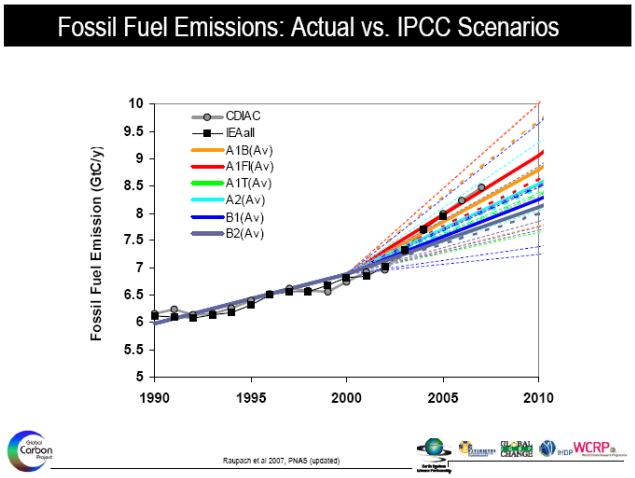

Figure 1.The actual emissions growth rate of fossil fuel emissions for 2000-2007 exceeded the highest forecast growth rates for the decade 2000-2010 in the emissions scenarios of the IPCC Special Report on Emissions Scenarios (IPCC-SRES). Source: Raupach et al 2007, PNAS (updated).

Table TS.5. *Best estimate, likely ranges and very likely lower bounds of global mean equilibrium surface temperature increase (°C) over pre-industrial temperatures for different levels of CO_2-equivalent radiative forcing, as derived from the climate sensitivity.*

Equilibrium CO_2-eq (ppm)	Temperature Increase (°C)		
	Best Estimate	*Very Likely* Above	*Likely* In the Range
350	1.0	0.5	0.6–1.4
450	2.1	1.0	1.4–3.1
550	2.9	1.5	1.9–4.4
650	3.6	1.8	2.4–5.5
750	4.3	2.1	2.8–6.4
1000	5.5	2.8	3.7–8.3
1200	6.3	3.1	4.2–9.4

Figure 2. Stabilising atmospheric greenhouse gas concentrations to 450 CO2-eqv would likely lead to warming of 1.4-3.1°C, with a best estimate of 2.1 °C. (Source: IPCC AR4, WG I, Table TS.5)

Box 13.7 The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group[a]

Scenario category	Region	2020	2050
A-450 ppm CO_2-eq[b]	Annex I	–25% to –40%	–80% to –95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2-eq	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2-eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

Notes:

[a] The aggregate range is based on multiple approaches to apportion emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.

[b] Only the studies aiming at stabilization at 450 ppm CO_2-eq assume a (temporary) overshoot of about 50 ppm (See Den Elzen and Meinshausen, 2006).

Source: See references listed in first paragraph of Section 13.3.3.3

Figure 3. Limiting dangerous warming exceeding 2°C above pre-industrial levels requires concentration levels of less than 450 ppm-eqv.