Climate Change Reality Check

Key take-home messages from the IPCC 5th Assessment Report

Greenpeace briefing 2.11.2014

Climate change is here and it's rapidly getting worse. But how bad is it really? What can we still do about it? What if we don't? The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC)[1] provides grim reading. But, as solutions are more readily available than ever before, there is also renewed hope. This briefing summarises the key findings of the AR5 and *supplements them with a few other recent scientific findings and developments*, followed by Greenpeace action guidelines.

Climate change is here, there and everywhere

Climate change can now be detected on all continents and across the ocean. The impacts are widespread and substantial. Our greenhouse gas emissions, resulting mainly from fossil fuel use, deforestation and agriculture, have warmed the atmosphere and oceans, melted glaciers, raised sea levels, changed water cycles and increased the frequency of extreme weather events. Coral reefs are dying, species are going extinct, and the Arctic is melting faster than expected.[1]

2001-2010 was a 'Decade of Climate Extremes'

According to the World Meteorological Organisation, the world experienced unprecedented high-impact climate extremes during 2001-2010, the warmest decade since modern measurements began in 1850[2]. Recent bouts of heat waves, droughts, floods and wildfires have demonstrated how vulnerable ecosystems and people are to such events[3].

Polar ice is melting substantially faster

In 2002-2011, on average, the Greenland Ice Sheet was melting about six times faster than during the previous decade[4]. The Antarctic ice sheet, too, was losing mass five times faster[5]. The Arctic sea ice covering the North Pole has been diminishing *significantly faster* than projected[6]. The 2012 minimum sea ice extent was just half of the 1979 to 2000 average[7].

Ocean acidification is happening at unprecedented rates, threatening marine life

Carbon dioxide (CO_2) emissions are causing the ocean to acidify at a rate that is likely the fastest in 300 million years[8]. In combination with warming waters and overfishing, it poses a serious threat to marine life and could trigger mass extinction[9]. Overall, relatively low levels of warming (2°C) already pose high risks for marine biodiversity[10].

Scientists warn of hunger, forced migration, conflicts, violence

Climate change threatens the fundamentals of human security: housing, food, water, income, health and livelihoods[11]. The IPCC even warns that climate change may increase the risk of violent conflict in the form of civil war and inter-group violence[12]

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[1] The Intergovernmental Panel on Climate Change (IPCC) is world's leading body for the scientific assessment of climate change. It is most known for its comprehensive Assessment Reports, published about every six years since 1990. The 5th Assessment Report (AR5) has been published during 2013 and 2014 in four pieces that altogether form the AR5. This briefing draws from all the four parts of the AR5, complementing the picture with a few other, even more recent studies.

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Governments were to limit warming to *less than* 2°C, but we're heading for 4-5°C
The world mean temperature has now increased by about 0.85°C above pre-industrial levels[13]. Governments have agreed to limit warming to *less than* 2°C with emission cuts, but they have not acted accordingly. With recent emission trends, we are heading towards 4-5°C warming[14]. This approaches the difference between today and the last ice age, happening during one lifetime instead of millenia[15].

We can still prevent catastrophic warming
Limiting warming *below* 2°C, to about 1.5°C by 2100 is still possible – and maybe even below 1.5 – if we cut emissions fast[16]. And we should. 2°C warming would already imply serious problems for many regions, species and ecosystems[17]. It could even be enough to cross tipping points in the Earth system beyond which further impacts can be severe, abrupt and irreversible. The fact that six key glaciers in the West Antarctic are already now reported by NASA and others to have passed a point of no return in melting, is a serious warning and a motivation for why we should work extra hard to stay as far below 2°C as possible[18]. During the last interglacial period, when the temperature was not more than 2°C above pre-industrial, sea level was about 5m – 10m higher, due to substantial melting of ice-sheets[19].

Bringing emissions to zero would come with many co-benefits
It's not enough to manage emissions. Eventually, they must be brought to net zero[20]. By when, depends on the risks we are ready to take. For the scenarios that are more likely than not to bring temperature change back to below 1.5°C warming, *all* greenhouse gas emissions would have to decline by about 70-95% by 2050 (and be followed by negative emissions)[21]. For scenarios that are likely to keep below 2°C, emission cuts would have to be about 40-70% by 2050 and near zero or below by 2100[22]. However, fossil fuel CO2 emissions and other CO2 emissions must reach zero much faster than that – by around 2070, or earlier if peak happens later than 2020 and/or if negative emissions are excluded[23]. In the power sector, where coal accounts for 73% of the emissions[24], zero must be reached by around 2050[25]. Such action would come with significant co-benefits for air quality, human health and ecosystems[26].

Energy systems must change fundamentally
About two thirds of man-made greenhouse gas emissions result from burning of fossil fuels[27]. Hence, the IPCC says we need a "fundamental transformation of the energy sector", including a "long-term *phase-out* of unabated fossil fuel conversion technologies"[28]. Oil, coal and gas technologies must go, unless they are equipped with carbon capture and storage (CCS). This technology, then again, is "much discussed but not much deployed[29]". Since the previous IPCC report in 2007, "studies have underscored a growing number of practical challenges to commercial investment in CCS[30]". Barriers to large-scale deployment of CCS include economics, concerns about the operational safety and long-term integrity of CO2 storage, as well as risks related to transport and the required upscaling of infrastructure[31]. CCS is essential in many emission reduction scenarios assessed by the IPCC, but as long as it remains theory rather than practise, keeping warming below 2°C means phasing out fossil fuels within a few decades[32]. (In the power sector, the first commercial-scale CCS demonstration project only came online this year, so it's not covered in the IPCC AR5. The captured CO2 will be used to increase oil production.[33])

There's very little room for new investments into coal, oil and gas infrastructure
We are on a tight carbon budget. According to the IPCC, less than 1000 million tons (Gt) of carbon dioxide can be released from now on, to keep below 2°C[34]. Estimated total fossil carbon reserves exceed this remaining budget by a factor of 4 to 7, with resources much larger still[35]. A recent study estimates that the existing power plants can eat up over 300 Gt of this budget during their life-times[36]. Other *existing* infrastructure, such as buildings, cars and planes will eat up a big chunk of the budget too. This means, that there is very little room for any *new* high-carbon infrastructure. The IEA estimated a couple of years ago that after about 2017 all *new* energy production built should be emission free[37]. Those owning high-carbon asset should prepare for **stranded assets**, as eventually, fossil fuel reserves will have to stay in the ground, and power plants be taken off use ahead of their planned lifetimes.

Invest in efficiency with benefits now, or face higher risks and limited options in the future
The more we take action now, with technologies that are already available, affordable and come with little risks and many co-benefits, such as energy efficiency, the less we will be locked-in to high

emissions, high costs and risky technologies in the future[38]. In the next 15 years, major shifts are needed in energy investment trends. Investments into energy efficiency across sectors, in particular, will have to increase, up to 650 bln USD / year, while investments into fossil fuel extraction and power plants need to decline by hundreds of billions of USD a year[39]. Efficiency investments in buildings, transport and industry provide large potential for emission cuts and typically come with economic gains and many co-benefits[40]. Next in the order of scale of new investments needed comes renewable energy[41].

Renewable energy shines out as the option with most promising trends

By 2050 zero and low-carbon energies would need to at least triple to quadruple, says the IPCC[42]. Out of the options outlined (renewables, nuclear, CCS and biomass+CCS), renewable energies shine out with most promising trends[43] and many co-benefits[44]. Renewables have advanced substantially in performance and costs-efficiency since the last IPCC report in 2007 and many technologies are now ready to be deployed at a significant scale[45]. Overall, the aggregated global technical potential for renewable energy as a whole is significantly higher than global energy demands[46]. Nuclear is mature, but in decline and continues to face various barriers and risks[47]. Excluding it from future options wouldn't make a big difference to mitigation costs[48]. Carbon Capture and Storage (CCS) is essential in many scenarios, but faces problems and barriers described above. Keeping below 2°C without CCS is still possible too. This would imply faster emission reductions in energy use (buildings, transport & industry), and storing carbon in terrestrial systems (for example, through afforestation)[49].

End deforestation and move to ecological farming

The land-use sector that accounts for about a fourth of man-made emissions[50] holds the keys for solutions too. Policies that both restore and improve the ability of land and vegetation to store carbon and improve their climate change resilience too are most effective.[51]

Costs of action are negligible while the costs of inaction would be unthinkable

The IPCC estimates, with many caveats, that keeping below 2°C could reduce consumption *growth* by about 0.06 percentage points below baseline. The figure even ignores the benefits of avoided climate impacts, as well as co-benefits of cutting pollution that alone can easily offset, or even exceed, mitigation costs.[52] By comparison, the New Climate Economy report estimates that mortality from air pollution in China is now valued at 10% of GDP[53]. Any cost assessments related to climate action should be treated with caution, as many economic estimates of climate risks do not account for the possibility of large-scale singular events and irreversibility, tipping points and other important factors, especially those that are difficult to monetize, such as loss of biodiversity – or loss of lives, homes, cultures. In other words: the things that we value the most are often excluded from the cost-benefit comparisons.[54]

Both rich and rapidly developing countries need to cut emissions faster

High-income countries' emissions collectively remain high, while upper middle income countries' emissions have grown fast since 2000[55]. Most of the growth took place in developing Asia, where coal burning has increased very fast[56]. A growing share of these emissions was released in the production of goods and services exported to high-income countries[57]. Lower-income countries' emissions have remained low. Most emissions are caused by a small group of countries: 10 countries accounted for about 70% of fossil and industrial CO2 emissions in 2010.[58]

In global cooperation, fair sharing of effort would help

Mitigation and adaptation raise issues of equity, justice, and fairness. Increased focus on distributional equity and fairness in global cooperation would help to move the international climate negotiations forward[59]. Often those who have polluted the least are impacted the most – with least ability to adapt.

Adaptation is necessary, but there are limits to it

No matter what we did, further warming and impacts are inevitable. Preparing realistically for what's ahead, reducing risks and building resilience in a way that meets the needs of the most vulnerable will be crucial. However, the worse the impacts get, the harder – or impossible – they will be to adapt to.

Greenpeace action guidelines

- ✓ **We need to do this faster**
  We know the problem; we have the solution. The move away from fossil fuels and towards renewable energy is already underway, but we need to speed up.

- ✓ **There is no room for new fossil fuels**
  Capping emissions won't suffice. We need to phase *out* of fossil fuel technologies altogether. Investments in new high-carbon infrastructure must be cease and investments in energy efficiency and renewable energy increase.

- ✓ **Prepare for stranded assets**
  About 80 per cent of the known fossil fuel reserves must remain untouched. Governments, the energy industry and investors must respect this and plan accordingly.

- ✓ **Climate action is the best investment**
  To view climate action as a burden is fallacious. The real burden is inaction. Energy efficiency, forest conservation and climate resilient agriculture are sound long-term economic investments with many associated benefits for health, livelihoods, security and well-being.

- ✓ **Near-term targets define long-term emissions**
  March 2015 is the deadline by which individual countries should deliver their national emissions reduction offers. These targets must reflect a fundamental change in emission trends.

- ✓ **Protect what we have – to build resilience**
  Healthy ecosystems are more resilient in the face of inevitable climatic changes. We must protect the Arctic, create more marine reserves, end tropical deforestation and adopt sustainable agricultural practices.

- ✓ **Prepare for the unavoidable**
  Climate change is a reality. All future development and water management plans, infrastructure projects and food security programmes must factor in adaption. The 'polluter pays' principle must be at the heart of adaptation and compensation efforts between and within countries.

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[1] IPCC AR5. WGI. SPM. Pages 4-11, and IPCC AR5. WGII. SPM. Pages 6-8. For corals, WGII, TS page 9.
[2] "2001-2010, A Decade of Climate Extremes" World Meteorological Organisation's press release. 3.7.2013. Press Release No. 976. Online: http://www.wmo.int/pages/mediacentre/press_releases/pr_976_en.html
[3] IPCC AR5. WGII.S SPM. Page 7.
[4] IPCC AR5. WGI. SPM. Page 9.
[5] Ibid.
[6] IPCC AR5. WGI. Ch1. Page 137.
[7] IPCC AR5. WGI. Ch1. Page 136.
[8] "Record Greenhouse Gas Levels Impact Atmosphere and Oceans". World Meteorological Organization Press Release No. 1002. 9 September 2014. Online: https://www.wmo.int/pages/mediacentre/press_releases/pr_1002_en.html
[9] "IPCC Report confirms ocean is bearing brunt of carbon impact". International Programme on the State of the Ocean Press release. September 27, 2013. And IPSO State of the Ocean Report 2013. Online: http://stateoftheocean.org/threats.cfm
[10] IPCC AR5. WGII. Table TS.4.
[11] IPCC AR5. WGII. SPM. Pages 11-13.
[12] IPCC AR5. WGII. SPM. Page 20.
[13] IPCC AR5. WGI. SPM. Page 5.
[14] IPCC AR5. WGIII. SPM. Page 9.
[15] World Bank (2012) Turning Down the Heat. Executive Summary, XIV.
[16] The IPCC's lowest emission scenario, RCP2.6, would lead to about 1.6°C warming by 2100. The
[17] IPCC AR5. WGII. SPM. Assessment Box SPM.2 Table 1.

[18] See: http://science.nasa.gov/science-news/science-at-nasa/2014/12may_noturningback/
[19] IPCC AR5. WGI. SPM. Page 11.
[20] In the AR5, the Representative Concentration Pathway RCP2.6 is representative of scenarios that lead to low concentration levels and are likely to keep warming below 2°C. They are characterized by atmospheric concentrations in 2100 of about 450 ppm CO2eq (parts per million carbon dioxide equivalents). The RCP2.6 scenarios imply that all greenhouse gas emissions would have to reach zero before 2100 (see Figure SPM.4 in the WGIII SPM). Fossil fuel emissions would have to get to zero faster. The Figure TS.19 in the WGI Technical Summary illustrates how all of fossil fuel emissions have to reach zero by around 2070, assuming emissions started declining around 2020 and negative emissions followed after 2070. Hence, if emissions peaked later than 2020 or CCS wasn't available, zero emissions would have to be reached earlier than 2070. Electricity sector will have to get to zero fastests: In most integrated modelling scenarios, decarbonization happens more rapidly in electricity generation than in the industry, buildings, and transport sectors (see p. 21 of the WGIII SPM). The Figure SPM.7 in the WGIII SPM illustrates how in 450 ppm COeq scenarios, electricity sector's emissions would have to be about zero by 2050. For scenarios that aim at warming below 1.5°C (the goal supported by more than 100 most vulnerable countries) zero would have to be reached much earlier, in all sectors.
[21] IPCC AR5. Synthesis report. SPM. Page 15.
[22] AR5. Synthesis Report. SPM. Page 15. And AR5. WG1. Figure TS.19
[23] AR5. Synthesis Report. SPM. Page
[24] The Global Commission on the Economy and Climate (2014) Better growth: better climate. The New Climate Economy Report. Chapter 4, page 3.
[25] IPCC AR5. Synthesis Report. SPM.14.
[26] IPCC AR5. WGIII. Technical Summary. Page 38.
[27] See: IPCC AR5. WGIII. SPM. Figure SPM.1. And: Ecofys (2013) World GHG Emissions Flow Chart 2010.
[28] IPCC AR5. WGIII. TS. Page 46.
[29] IPCC AR5. WGIII. Ch1. Page 12.
[30] IPCC AR5. WGIII. Ch1. Page 12.
[31] IPCC AR5. WGIII. TS. Page 49.
[32] See: http://e360.yale.edu/feature/can_carbon_capture_technology_be_part_of_the_climate_solution/2800/ where the IPCC Working Group III report co-chair Ottmar Edenhofer outlines the options: either CCS will have to be used in large scale OR fossil fuels phased out entirely within the next few decades:
"We depend on removing large amounts of CO2 from the atmosphere in order to bring concentrations well below 450 [parts-per-million] in 2100," said Ottmar Edenhofer, an economist at the Potsdam Institute for Climate Impact Research and co-chair of the IPCC's third working group, which was tasked with figuring out ways to mitigate climate change. Ultimately, he said, keeping a global temperature rise to 2 degrees without any CCS would require phasing out fossil fuels entirely within "the next few decades."
[33] "In a First, Commercial Coal Plant Buries Its CO2. A coal plant in Saskatchewan will capture most of its carbon pollution—and use it to extract oil from the ground". News article in "MIT Technology Review, by David Talbot. October 3, 2014. http://www.technologyreview.com/news/531321/in-a-first-commercial-coal-plant-buries-its-co2/
[34] The IPCC carbon budget for the RCP2.6 scenario, that keeps below 2 degrees C with higher than 66% likelihood, is simplified by the former IPCC Mitigation co-chair Bert Metz here: http://controllingclimatechange.net/co2budget
[35] IPCC AR5. Synthesis Report. Full report, page 24.
[36] University of California - Irvine. "Existing power plants will spew 300 billion more tons of carbon dioxide during use." ScienceDaily. ScienceDaily, 26 August 2014. <www.sciencedaily.com/releases/2014/08/140826142443.htm>.
[37] World Energy Outlook 2012
[38] IPCC AR5. SYR. SPM. Page 19.
[39] See figure Figure SPM.9 in the IPCC AR5. WGIII. SPM. Page 28.
[40] IPCC AR5 WGIII. SPM. Pages 21-25.
[41] IPCC AR5 WG III. SPM. Figure SPM.9.
[42] IPCC AR5. WGIII. SPM. Page 13.
[43] IPCC AR5. WG III. SPM.4.2.2. Pages 21-22. See also WGIII, Chapter 1, page 12:
[44] IPCC AR5. WGIII. TS. Page 47 and Table TS.3.
[45] IPCC AR5. WGIII. TS pages 46-47 and SPM page 21.
[46] IPCC AR5. WGIII. Chapter 7. Page 28.
[47] IPCC AR5. WGIII. SPM. Pages 21-22.
[48] IPCC AR5. WGIII. SPM. Table SPM.2
[49] IPCC AR5. WGIII. TS. Page 43.
[50] IPCC AR5. WGIII. SPM. Figure SPM.2
[51] IPCC AR5. WGIII. SPM. Pages 25-26.
[52] IPCC AR5. WGIII. SPM. Page 15. And Ch6, p73< and Ch5, p 59.
[53] The Global Commission on Economy and Climate (2014) Better Growth, Better Climate: The New Climate Economy Report. See Chapter 4, page 13. http://newclimateeconomy.report
[54] For limitations of economic evaluation tools, see AR5. WGIII. 2.4 and 3.5.
[55] IPCC AR5. WGIII. Technical Summary. Figure TS.4.
[56] IPCC AR5. WGIII. Technical Summary. Figure TS.2. and page 19.
[57] IPCC AR5. WGIII. Technical Summary. TS.5.
[58] IPCC AR5. WGIII. Technical summary. Page 15.
[59] IPCC AR5. WGIII. TS. Page 5.