

The eight most important things we've learned from the IPCC since its Fourth Assessment Report

7 November 2014



The following eight key issues are the most important findings of the IPCC in its Fifth Assessment Report (AR5, released in November 2014), in comparison to the findings in the AR4 from 2007.

WWF's assessment is not limited to the last and final Synthesis Report of the IPCC in AR5 but rather considers all outcomes of Working Groups I, II, and III of the last 12 months.

While there are many new results in AR5, these eight key issues represent the most powerful findings for policy makers and other constituencies to address the climate threat but also the opportunities for deep cuts in GHG emissions.

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1. AR4 was too conservative

In hindsight, projections for various responses by nature resulting from climate change were too conservative in AR4, and underestimated the real and observed impacts that triggered new and more alarming projections for the future in AR5:

- Sea level rise was higher in the last years on average than projected, and the new AR5 sea level rise projection for all scenarios until 2100 are significantly higher than in AR4;
- At same time, Arctic summer sea ice melting (*which does not lead to sea level rise*) was also much stronger over the past few years than projected by AR4;
- Ocean acidification is a key issue in AR5. The amount (*26% more acidic ocean today since 1900*) and the speed (*fastest since 65 million years*) were, for the first time, described in detail by AR5, including the impacts on nature and people.

WWF conclusion

While the IPCC's findings are generally conservative (it is based on consensus rule among governments), what the AR5 shows is that nature is less resilient and more people and cultures are threatened than previously understood. This includes small island states, freshwater supply and urban settlements in low lying coastal areas, coral reefs, mangroves, fish [catch is reduced by acidification], food security and the Arctic ecosystem.

This means that government actions must be precautionary and take into account this additional sensitivity, as well as the conservatism of the IPCC reports.

We must move to a full phase out of fossil fuels by 2050 in order to minimise the risks of irreversible disintegration of terrestrial ice sheets (such as that of Greenland) and the further summer decline of Arctic sea ice, and to maintain the physical integrity of coral reefs and even entire nations (small island states).

2. The poor are most impacted by climate change

The reports describes in much more detail the physical, social and political impacts of climate change on people. The reports explicitly singles out the poor, mainly in developing countries, to be the hardest hit by unmitigated climate change since their adaptive capacities are the lowest among the various income groups.

For instance, risk of coastal flooding in low-lying areas might impact hundreds of millions of people, aggravate poverty and create emerging hotspots of hunger and diseases. Fisheries catch potential will change as marine species shift towards the poles and cooler waters which threaten many poor communities in tropical areas largely dependent on local fish as an important food source.

There is also now high agreement that climate change will induce migration and increased displacement of people. Many communities lack the resources for planned migration and will experience higher exposure to extreme weather events, particularly in developing countries with low income. With respect to food security, crop yield reductions caused by global warming - particularly in maize and wheat – are still masked by the higher yield-increasing effects of better harvest, pest and fertiliser management as well as improved irrigation practice and new heat- and water-stress tolerant species/seeds.

But projected overall negative climate impacts on yields (listed in AR5) are much stronger in the decades after 2030 than the positive effect of new technologies, better agricultural practice, CO₂-fertilisation and potential adaptation management. In short the impacts of climate change will soon outweigh advances in agricultural practice, threatening food security with disproportionate impacts on the poor.

But perhaps most important is the equity issue addressed in AR5: *“Mitigation and adaptation raise profound issues of equity, justice, and fairness, and are necessary to achieve sustainable development and poverty eradication. Delaying mitigation shifts burdens from the present to the future, and insufficient adaptation response to emerging impacts is already eroding the basis for sustainable development”*. This hints to the inter-generational equity issue.

WWF conclusion

We cannot hide from the impacts of climate change. The report stresses that although all countries are vulnerable, developing countries with less capacity and resources are more vulnerable compared to developed countries.

We need to urgently move towards decarbonising our world, and increase our efforts on adaptation exponentially, especially in vulnerable developing countries.

That's why not only within the UN climate negotiations WWF is pushing for rapid, deep emissions cuts and a global goal on adaptation.

3. Climate change is happening at an unprecedented speed

Generally, AR5 has much more advanced scientific findings available than AR4. This is particularly true for recent new science on paleo- and last Ice Age period data for climate comparison reasons.

For instance AR5 describes the likely sea level, temperature and atmospheric CO₂ in the last interglacial (150 000 years ago) and even earlier in the Pliocene (2-5 million years ago).

Comparing this to current data, it is evident that almost all human impacts on the natural world, including those we presently observe from man-made climate change, are the most speedy (often by a factor 10), largest and in some cases irreversible relative to periods with no man-made climate change.

This is true for instance for atmospheric greenhouse gas (GHG) concentrations (*the largest in 800 000 years*), GHG emissions (*the largest ever in human history and likely since before that*), the exponential increase in glacial melting in last 10-20 years (*Greenland, Himalayas*), and the rate of sea level rise and ocean acidification. All of these are happening at unprecedented speed compared to natural climate change.

AR5 illustrates clearly that about 90% of heat stored from recent decades of global warming is contained in the ocean surface and only 1% on land. This is caused by the much higher heat storage capacity of water compared to air. But this also shows that we are committed to further warming over the decades to follow even if global GHG emissions are rendered zero over night since from physical reasons atmosphere and oceans try to reach certain equilibrium in heat and gas exchange.

WWF conclusion

We are experiencing an unprecedented speed of change in our climate. As the record rise in GHG emissions rapidly fills the atmospheric space left to stay well below 2 degrees, and given that up to 40% of all CO₂ stays in the atmosphere for longer than 1 000 years, governments need to react with similar, unprecedented speed to bring down emissions.

In parallel, societies will need to react decisively to adaptation and preparedness in an already changing climate. The consequences on species and nature will be very severe at more than 2 degrees global warming or more.

4. The importance of adaptation and its limits

AR5 explicitly addresses both the importance of and the limits to adaptation. It concludes that coral reefs, low-lying coastal areas and the Arctic are at very high risk of not being able to adapt to levels as high as 2°C global warming; and that they will exceed their adaptation limits beyond this point and that may not be irreversible.

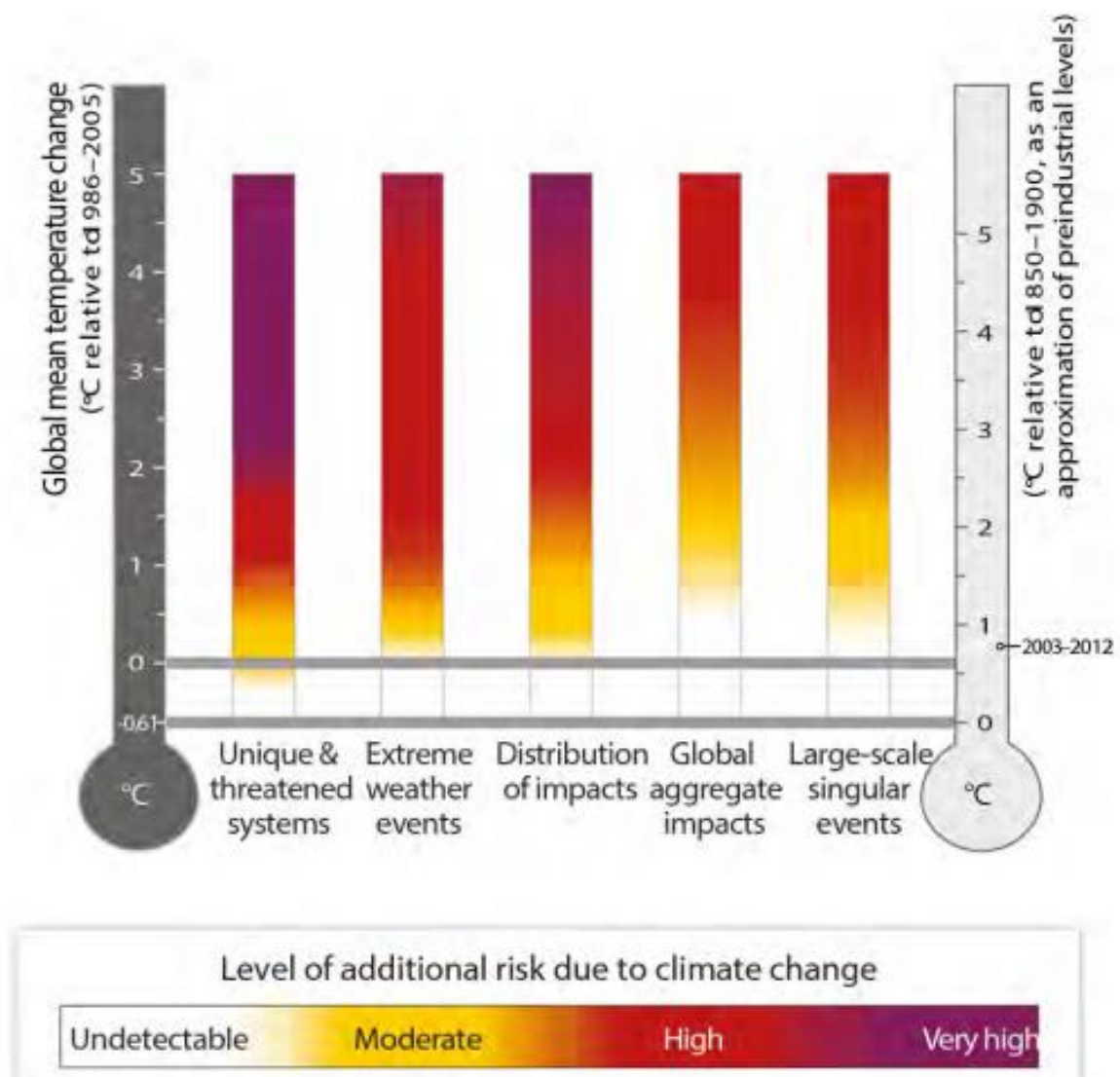
The report says, with high confidence, that *“there are limits to adaptation, and greater rates and magnitude of climate change increase the likelihood of exceeding those limits”*.

Continued unmitigated sea level rise also beyond 2100 will unavoidably eradicate entire countries from the landscape (like small island states); continued warming might trigger large scale disintegration of glaciers; and heat waves, droughts and other weather extremes limit the adaptability of many commercial food crops and hence affect food security, freshwater availability and ecosystems.

The five ‘reasons for concern’ aggregate climate change risks and illustrate the implications of warming and of adaptation limits for people, economies and ecosystems across sectors and regions. The five responses for concerns are associated with

- unique and threatened systems,
- extreme weather events,
- distributions of impacts,
- global aggregate impacts, and
- large-scale singular events.

(see the graph below from the IPCC reports which shows the risks of moving to 2 degrees)



It is clear that delaying mitigation shifts burdens from the present generation to the future, and insufficient adaptation responses to emerging impacts are already eroding the basis for sustainable development.

WWF conclusion

Adaptation is necessary and urgent to save lives and livelihoods, but it must happen in parallel with aggressive action to cut emissions.

Adaptation will not be effective under continued, high emission scenarios as it has its own limits. It is also very clear that staying below 1.5 °C global warming is much safer, in particular for coral reefs, low-lying coastal areas and the Arctic, than 2°C global warming.

Under any scenario, there will be impacts, and some residual impacts, that cannot be avoided and for which adaptation might not be sufficient. The AR5 provides a scientific basis for a new space “beyond adaptation”, the scenario where adaptation fails. In the UN climate negotiations, WWF is championing the “beyond adaptation” concept which is expressed in the loss and damage mechanism. It is intended that this mechanism provides compensation for unavoidable impacts to poor and vulnerable countries.

Finally, we must not hand over an insurmountable challenge to future generations.

5. There is a carbon budget

AR5, for the first time, discusses and identifies various carbon budgets, which contain the amount of CO₂ and GHG emissions permissible by all nations between now and 2050/2100 for various temperature increase scenarios with various probabilities (33% - 66%).

For staying below 2°C compared to pre-industrial temperatures, as an average number of the various low-carbon/2-degree scenarios, the IPCC concludes that the world has less than 1 000 billion tons of CO₂ left to fill the atmospheric space. That sounds like a lot but is not, since this budget will be eaten up in less than 20 years at the present rate of GHG emissions.

The budget for not exceeding 1.5°C is even lower. Hence the suggestion that in the not-so-distant future, 'negative' emissions needs to occur. This then raises concerns around land use, geoengineering, and safety of carbon storage. The faster we manage to achieve a full decarbonisation - such as WWF's position supporting 100% renewables of the energy sector by mid-century - the smaller the various associated risks.

WWF conclusion

The carbon budget – regardless how that will be distributed in the end among rich and poor nations – points to a need for immediate actions by all large emitters, particularly those that have historically emitted the largest amount of CO₂.

With the use of existing energy efficiency and renewable energy solutions, it is clear that the faster we act now the less we will depend upon negative emission solutions in the future and their associated risks.

6. We must phase out fossil fuels (*emissions*)

The AR5 illustrates clearly that in order to stay below 2°C, immediate reductions of fossil fuel CO₂ are necessary which will lead to zero carbon emissions by 2070 in the energy sector (average of RCP2.6 scenarios used).

The energy sector was singled out by the IPCC since it is responsible for about 70% of all global GHG emissions and it offers the most suitable options for zero-carbon and highly efficient demand side technologies.

The IPCC foresees a carbon-negative pathway globally after 2070.

WWF conclusions

The “proposed” timing of a full decarbonisation of the energy sector by 2070 is not too far away from WWF’s position of 100% renewable energy by 2050.

However, the IPCC’s version of decarbonisation is likely to include lots of carbon capture and storage (CCS) and nuclear power because the IPCC is ‘technology neutral’ and does not consider non-climate co-benefits or disadvantages of different technologies. At the same time the underlying IPCC reports do make clear that both CCS and nuclear face significant challenges in scaling up and commerciality, particularly on the cost side; and that for CCS there are very few existing projects and studies on which to base projections.

Note 1: As WWF, we need to be careful when talking about “decarbonisation” pathways and always make clear what we mean – primarily clean and sustainable renewables and strong energy efficiency in all sectors of society, and a full phase out of fossil fuels by 2050.

Note 2: WWF supports a 2050 deadline for the energy transition to be completed, a bit earlier than the IPCC says, as that would keep us well below 2°C - and closer to 1.5°C global warming - which is a much safer space for humanity and nature.

7. Economics and investment matter

For the first time, AR5 has a major chapter and analysis on climate economics and investment.

One key finding is that in order to stay on track for a low-carbon pathway, in the next 15 years societies need to increase renewable and energy efficiency investments by a range of about \$US 450 billion (mean) to \$US 800 billion (high range) annually.

They also need to reduce investments in upstream fossil fuel exploration by a range of \$US 100 billion (mean) to \$US 350 billion annually.

This compares to present investments into renewable energy by about \$US 250 billion and only \$US 130 billion on energy efficiency products in 2013. Investments into upstream fossil fuel exploration were about \$US 750 billion in 2013, the majority being oil¹.

WWF conclusion

Investors must engage at a much greater scale with clean technologies such as renewable energy and energy efficiency and simultaneously also decrease investments in fossil fuels.

What we see presently is investment growth in both fossil fuels and renewables. Fossil fuel divestment must happen on a large scale, too².

¹ International Energy Agency, World Energy Investment Outlook (2014).

² Speaking during the press conference to release the IPCC Synthesis Report, UN Secretary General Ban Ki-moon [urged investors](#) to divest from fossil fuels and invest in renewables.

8. It is cheaper to act now to save the world from climate change, than to do nothing

Compared to AR4, the new IPCC assessment contains a very strong and politically relevant analysis on mitigation costs. Based on the average of numerous economic analyses from various parts of the world, AR5 shows that the cost for decarbonising to stay below 2°C costs only a fraction more than following a business as usual pathway. The economic impact is only 0.06% per annum less in global average consumption compared to a fossil-intensive pathway.

This is also a very conservative calculation, according to the IPCC. It does not include the multitude of environmental, social, developmental, cultural and other benefits from a climate-friendly pathway. If social costs of carbon, such as the avoided climate impacts on people, economies and ecosystems, reduced air pollution from fossil fuels, better human health, enhanced job options and declining fossil fuel import bills, decreased freshwater consumption, etc., were to be included in the calculation, the low/zero carbon development pathway would emerge as the absolutely most cost-effective pathway.

It is also clear from the report that climate change impacts are projected to slow down economic growth and make poverty reduction more difficult. So the faster we take the path of building our economies around zero emission solutions today, the less we will suffer the consequences that will hamper economic growth tomorrow.

WWF conclusion

This economic piece is probably the politically most important message from the IPCC.

Earlier IPCC reports highlighted the numerous technological potentials and advantages of for instance renewables over fossil fuels. This report's assessment that such a decarbonisation move is roughly as expensive as a fossil pathway, and actually much cheaper considering the costs and benefits that are not included, is another nail in the coffin of the fossil fuel industry.

In essence, the IPCC lays out a roadmap to a new "business as usual" for the business sector as well as for our economies in general. Addressing climate change, says the IPCC, is "necessary to achieve sustainable development and poverty eradication". In other words, investing in measures that keeps global warming under 2°C is the best option for our future social and economic well-being.

ANNEXURE

The IPCC by numbers

800/450 billion USD / year

Upper/Mean range estimation of required **increase** in annual investment flows towards Energy Efficiency and Renewable Energy over the next two decades (2010 – 2029) for mitigation scenarios that stabilise concentrations within the range of approximately 430 – 530 parts per million (ppm) CO₂eq by 2100.³

350/100 billion USD / year

Upper/Mean range estimation of required **decrease** in annual investment flows towards extraction of fossil fuels over the next two decades (2010 – 2029) for mitigation scenarios that stabilise concentrations within the range of approximately 430 – 530 ppm CO₂eq by 2100.⁴

100 billion USD

The most recent estimation of annual, global adaptation costs range by 2050 is at least US \$70 billion to US\$ 100 billion by 2050⁵. There has been a limited number of global and regional adaptation cost assessments over the last few years⁶. These estimates exhibit a large range and have been completed mostly for developing countries. The most recent and most comprehensive to date global adaptation costs range from US \$70 billion to more than US \$100 billion annually by 2050.⁷

1 000 billion tonnes

Maximum cumulative CO₂ emissions available globally after year 2011 for limiting total human-induced warming to less than 2°C with a probability of >66%. As a reference total fossil carbon available in 2011 was 3670–7100 GtCO₂ (reserves) and 31300–50050 GtCO₂ (resources)⁸.

³ IPCC WGIII, Figure SPM.9

⁴ IPCC WGIII, Figure SPM.9

⁵ World Bank, 2010a, see Table 17-2

⁶ World Bank, 2006; Stern, 2006; Oxfam, 2007; UNDP, 2007, UNECCC, 2007; 2008; World Bank, 2010a

⁷ World Bank, 2010a, see Table 17-2

⁸ IPCC Synthesis Report, SPM, Table 2.2

400 billion tonnes

Maximum cumulative CO₂ emissions available globally after year 2011 for limiting total human-induced warming to less than 1.5°C with a probability of >66%. As a reference total fossil carbon available in 2011 was 3670–7100 GtCO₂ (reserves) and 31300–50050 GtCO₂ (resources).⁹

0,06%

Estimated annualised reduction of consumption growth over the century relative to annualised consumption growth in the baseline that is between 1.6 % and 3 % per year, for a mitigation scenario that reach atmospheric concentrations of about 450 ppm CO₂eq by 2100. This number excludes co-benefits such as reduced air pollution, improved health and avoided cost of more severe climate change impacts.¹⁰

215 billions tonnes of ice

Average annual rate of ice loss from the Greenland ice sheet over the period 2002 to 2011 compared to 34 billions of tonnes per year over the period 1992 to 2001.¹¹

Zero by 2070

Year 2070 is estimated to be the year for fossil fuel emissions to have reached zero globally in RCP 2.6 scenarios for staying below two degrees global warming.¹²

800 000 years

Minimum number of years since atmospheric concentrations of carbon dioxide, methane, and nitrous oxide was as high as they are today according to IPCC.¹³

90%

Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010 (high confidence), with only about 1% stored in the atmosphere.¹⁴

⁹ (IPCC Synthesis Report, SPM, Table 2.2)

¹⁰ IPCC WG III, SPM

¹¹ IPCC, WGI

¹² IPCC WG I, Figure TS.19

¹³ IPCC, WGI

¹⁴ IPCC Synthesis Report

65 million years

The current rate and magnitude of ocean acidification are at least 10 times faster than any event within the last 65 Million years (High Confidence; Ridgwell and Schmidt, 2010) or even 300 Million years of Earth history (*medium confidence*; Hönsch et al., 2012).¹⁵

3 times more people

...at risk by the end of the 21st century to a 20th-century 100 year river flood annually in a RCP 8.5 emission scenario compared to a RCP 2.6.¹⁶

0 – 2%

Estimated reduced median agricultural yield per decade due to climate change for the rest of the century, as compared to a baseline without climate change.¹⁷

7 000 000 000¹⁸

Number of people that will be directly or indirectly impacted by climate change in and after the 21st century. Level of impact depends on degree of climate action over the coming years. Number is excluding, but should include all people in future generations.

¹⁵ IPCC WG II, Technical Summary, page 423

¹⁶ IPCC, WG II

¹⁷ IPCC, WGII

¹⁸ 7 271 434 000 specifically, according to Worldometer population clock as at October 2014

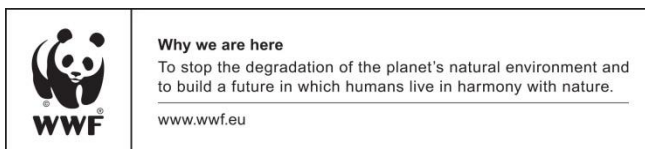
Science has spoken.

There is no ambiguity in their message.

Leaders must act.

Time is not on our side.

UN Secretary General Ban Ki-moon
Copenhagen, 2 November 2014



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