



Climate Change: Effects and Consequences

The Problem

- “Most of the observed increase in global average temperatures since the mid-twentieth century is very likely to be attributed to the increase observed in the concentration of anthropogenic greenhouse gases” (IPCC).
- Effects of climate change are already visible.
- Since the 1990s the problem of climate change has worsened, but not enough has been done in terms of mitigation to combat emissions.

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The Problem

"Most of the observed increase global average temperatures since the mid-twentieth century is very likely to be attributed to the increase observed in the concentration of anthropogenic greenhouse gases" (IPCC)

Direct observations of concentrations of green house gases, mainly CO₂, has been showing an increase since the mid-nineteenth century and this increase has been more rapid in the last decades. The gases that play a key role in climate change are water vapour, carbon dioxide (CO₂) and other "greenhouse gases" (GHG), including methane (CH₄), nitrous oxide and fluorinated gases. The global warming potential of carbon dioxide is less than that of the other greenhouse gases, but the high concentration of CO₂ in the atmosphere, currently at 430 ppm (parts per million) , exceeds by far the natural range of the last 650,000 years and makes it the primary cause of climate change.

The flow of these gases is part of the natural cycles of the planet, but since 1750 and even more so by the second half of the twentieth century, the growth of human activities associated with greenhouse gases, especially CO₂, has led to an increase of the phenomenon of global warming, resulting in increased temperatures.

CO₂ concentrations in the atmosphere are increasing each year and natural absorption and removal of CO₂ is much slower. As a result, climate change is proceeding faster than expected. The green house gasses contemplated in the Kyoto Protocol have increased by 0.5 ppm each year from 1930 to 1950, by 1 ppm from 1950 to 1970 and have more than doubled (2.5 ppm) from 1990 to date. This trend highlights the gravity of the problem.

The main sources of emissions of greenhouse gases associated with human activities are the extraction and use of fossil fuels and land deterioration caused by extensive deforestation of tropical forests (around 13 million hectares lost per year) and the fact that it would appear that the oceans and biological systems on Earth are losing part of their ability to absorb a substantial fraction of emissions.

In view of current trends in population growth, fossil fuel dependency and the development of emerging and less developed countries, a very cagey evaluation of what will happen by the end of the century in a 'business-as-usual' scenario, could be that of reaching 750 ppm of CO₂e (from a current 430 ppm) which in turn would mean (with 50% probability) an increase in temperature of 5°C by mid century.

Although there is no safe level for increased temperatures caused by climate change, the 2007 report of the Intergovernmental Panel of Climate Change (IPCC) concluded that a temperature rise needs to be limited to no more than 2°C (corresponding to 500 ppm in terms of CO₂e concentrations) in order to avoid the highly probable and irreversible effects of climate change. It must be made clear, however, that there is no absolute certainty in the assessment of °C increase in temperature. The climate system is so inherently complicated - because of internal variables like snow cover, clouds or water vapour in the atmosphere - that it is just not possible to link specific numbers on 'x amount of ppm CO₂e = y degrees C of warming. Scientists use the expression "climate sensitivity" to describe the final increase in temperature that would result from a doubling of ppm CO₂e concentrations (compared to the 285 ppm registered in 1850); the models used in the IPCC report therefore assign a certain probability to the result of temperature increase due to certain CO₂e concentrations.

Therefore if we immediately implement a strong reduction of emissions in order to contain concentrations below 500-550 ppm CO₂e, the probability of an increase of 2-3°C would be high anyway, but the probability of an increase of 5°C would only be 7%.

Effects of climate change are already visible

There are areas around the world where the effects of an actual temperature increase of 0.8°C are already dramatic. State-islands with low coasts, such as Tuvalu, already deal with the advancing of the sea; one third of the population of Africa live in areas of chronic drought and it is thought that by 2050, there will be between 350 and 600 million people in that continent suffering water stress. Furthermore, scientist observations indicate that rises in temperature have already affected several biological systems around the world:

- The ice cap has lost 40% of its thickness in 40 years allowing for more sunlight to heat the Arctic Ocean, accelerating the accumulation of heat and putting the vast Greenland ice at risk.
- Species are dying out one thousand times faster than the natural rate: 1 mammal in 4; 1 bird in 8; 1 amphibian in 3 are threatened with extinction.
- Coral reefs that are vital to the welfare of large human populations throughout the tropical world and that contain 25% of ocean species (even though they cover only 0.2% of the ocean floor), are rapidly bleaching in response to an increase in sea surface temperature. During the 1997/1998 El Niño, the most severe global bleaching event ever recorded caused bleaching in over 50 countries, causing the mortality of 16% of the world's coral reefs.



The area of the dry tropics is particularly vulnerable where the supply of food for millions of people will be put at risk by climate change. For some of the poorest countries there is the real risk of being pushed into a downwards spiral of increasing vulnerability and poverty: there could be 200 million refugees from climate change by 2050. According to the IPCC, Less Developed Countries (LDC) are going to suffer more from climate change than developed countries. Climate change effects are global but also unequal since people living in More Developed Countries (MDC) have greater responsibilities: in 2006 the CO₂e pro-capita emissions of a citizen of the United States was nearly 20 times higher than an African citizen and more than 4 times higher than a Chinese citizen.

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Energy policy is essential for achieving the objectives of combating climate change. Since the 1990s the problem of climate change has worsened, but not enough has been done in terms of mitigation to combat emissions. The latest edition (2009) of the Climate Change Performance Index (CCPI) indicates that no country is really making great strides to combat the greenhouse effect. This index, presented by Germanwatch, along with environmental organizations that are part of Climate Action Network Europe, compares the performance and policies on combating global warming of the 57 countries that are responsible for 90% of emissions. The index takes into account the results achieved in reducing emissions in absolute terms, but also the trend (which counts for 30% of the score) and the domestic and international policies of each country in the fight against global warming (20%). The top three countries in the table are Sweden, Germany and France. These countries, together with Greece and the United Kingdom, are the ones that already achieved their Kyoto target in 2006. Saudi Arabia, Canada and the U.S occupy the last positions in the table.

It is expected that a new green deal announced by Obama will help the United States, currently the country emitting more CO₂ in the world, to definitely improve its ranking for next year. Significant progress is being made by emerging economies including China and India. China remains the world second emitter, but has a very good score in terms of measures taken. India has been recognized for the low level of per capita emissions, and policies of mitigation measures and greater attention to renewable energy and efficiency.

Policy Relevance

Mitigation and adaptation: the terms "mitigation" and "adaptation" are two important terms that are fundamental in climate change policies. While mitigation tackles the causes of climate change, adaptation tackles the effects of the phenomenon.

Mitigation: If we want to preserve the state of the planet, it is necessary and urgent to act now. All of us, citizens, associations, governments and private companies can and must engage in the fight against climate change. Even small steps at an individual level, when applied on a large scale, give great results in environmental terms. Our commitment is not only necessary towards avoiding environmental disasters but represents the opportunity for a cultural and economic change in order to pursue a more equitable and sustainable development model.

Adaptation: Many governments around the world have already implemented adaptation strategies. For example, climate change is considered in the design of infrastructure projects such as coastal defences in the Maldives and the Netherlands, and the Confederation Bridge in Canada. Other examples include prevention of glacial lake outburst flooding in Nepal, and policies and strategies such as water management in Australia and government responses to heat waves in, for example, some European countries.

1992 UNFCCC (United Nations Framework Convention on Climate Change): In Rio de Janeiro, during the "Earth Summit", the United Nations Conference on Environment and Development (UNCED), adopted the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), the first international treaty setting the objective of reducing greenhouse gas emissions to fight global warming. The Convention came into force in 1994 and currently has 189 member countries. The developing countries have no immediate restrictions with respect to this Convention. The ratification of the Treaty obliges the governments of industrialized countries to pursue a "non-binding target" towards reducing atmospheric concentrations of greenhouse gases. The member countries meet every year in the Conference of Parties (COP).



1997 The Kyoto Protocol: At the conference COP3 in Kyoto, the member countries of the UNFCCC negotiated the international treaty called the Kyoto Protocol, requiring that the industrialized countries alone reduce emissions of anthropogenic greenhouse gas by 5.2% on average, compared to 1990 emissions, in the period 2008-2012. The coming into force of the Treaty was linked to two conditions: the ratification of at least 55 nations, and the ratification by those nations producing at least 55% of emissions. These conditions occurred in February 2005 with the ratification of Russia. Currently, 182 countries have ratified the Protocol. The United States has not yet ratified the Treaty. India and China have ratified the protocol, but as developing countries they are not yet required to reduce their emissions.

The post Kyoto Road Map

- December 2007, Bali: (COP13), the Bali Road Map and the Action Plan were defined highlighting the steps needed to reach a new international treaty on climate by the end of 2009 in view of the end of the first phase of the Kyoto Treaty in 2012. The emerging countries at this meeting, particularly India and China, began to actively participate in reduction commitments at an international level.
- 2008, Bangkok, Bonn, Accra and Poznan: Work on the new agreement. The Poznan meeting was held in an atmosphere of impending economic crisis but important decisions were taken. The meeting was mostly about setting a work plan in order to reach an agreement in 2009 in Copenhagen.
- 2009, Copenhagen (UNFCCC, COP15): A crucial meeting for the approval of a new international treaty on climate for post-2012. In anticipation of this conference, the European Commission is preparing its proposal. Developed countries must play a global leadership role and reduce emissions by 30% by 2020 compared to 1990 levels. By 2020, the developing countries, except for the poorest, should reduce the growth of collective emissions to 15-30% below what it would be if the situation remained unchanged, in particular through measures of mitigation of tropical deforestation .

European Policy: The 20-20-20 climate package: The European Union has set itself up as a leader of international action against climate change: the 15 EU members in 1997 were given a target of reducing emissions by 8% higher than Kyoto. The European Programme on Climate Change (ECCP) was launched in 2000 and ratified in 2002. The objective of this program was to understand the strategy to be adopted at a European level in implementing the Kyoto Protocol. The mechanism of Emissions Trading Scheme (ETS) was created in this Programme. In 1996 the EU adopted the target of a maximum 2°C increase in average global temperature, and on the basis of this objective, the European climate package of 20-20-20 was launched in 2007: 20% of energy production from renewable sources by 2020, 20% improvement in energy efficiency and a reduction of at least 20% of CO² emissions. These goals were confirmed in December 2008. The strategy provides for a stabilization of global emissions of greenhouse gases by 2020 and then a reduction of at least 50% below 1990 levels by 2050. Until now, from 1990 to 2006, global emissions of the 27 EU Member States have decreased by 10.8%, while for the “older” members, the decrease was 3%.

Good Practice

Hamburg – European Green Capital 2011

The Award is given to the 'greenest' city in Europe based on the city's state of the environment as defined by its performance relative to each of the defined indicators.

Hamburg was awarded the title "European Green Capital 2011" by the EU Commission in Brussels in February 2009. Hamburg has set ambitious climate protection goals such as reducing its CO₂ emissions by 40% by 2020 and by 80% by the year 2050. CO₂ emissions per person have been reduced by about 15% when compared to 1990, with annual energy savings of some 46,000 MW, a major achievement for a big city. Contacts: Klaus de Buhr, European Affairs, Ministry of Urban Development and Environment phone +49 40 428402584 email: klaus.debuhr@bsu.hamburg.de

City Signatories of the "Covenant of Mayors"

The Covenant consists of the formal commitment of the cities involved to go beyond the EU 20-20-20 energy objectives. In order to justify how they will achieve these objectives, cities must submit a sustainable energy action plan within the year following adhesion.



More than 400 European municipalities have, on their own initiative, committed to this ambitious target. Reducing 20% of Covenant city CO₂ emissions nowadays is equivalent to reforesting a surface area larger than the whole of Hungary each year, or eliminating more than 35 million cars from the streets or closing down 20 coal-fired 50MW power plants. Programme website : <http://www.eumayors.eu/>

Data Indicators

- Between 1990 and 2008 the increase of emissions from fossil fuels was 27% in the U.S and 150% in China.
- Tropical deforestation, estimated at around 13 million hectares per year, is adding 6.5 billion tons of CO₂e into the atmosphere each year.
- 50% of CO₂ emissions come from energy use, 18% from land use and deforestation, 13% from agriculture, 3% from waste, 3% from industrial processes, 4% from losses and 9% from other combustion processes (*Climate Analysis Indicators Tool*, CAIT).

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- The European website of the Covenant of Mayors initiative, <http://www.eumayors.eu/>
- To learn more on EU data and trends on climate change visit the EEA website <http://themes.eea.europa.eu/indicators/keymessages?thetheme=climate>