CSI 013 - Atmospheric greenhouse gas concentrations - Assessment published Mar 2009

Assessment versions

- **Published (reviewed and quality assured):**
  - Assessment published Mar 2009 **[Latest version] [This version]**
  - Assessment published Apr 2008
  - Assessment published Oct 2005
- **Draft (not yet published - not quality assured):**
  - No drafts available.

Methodology, data sources and references

See this indicator specification for methodology, data sources, rationale and more relevant details.

Key policy question

What is the trend in greenhouse gas concentration in the atmosphere? Will it remain below 450 ppm CO2-equivalent giving a 50% probability that the global temperature rise will not exceed 2 degrees Celsius above pre-industrial levels?

Key message

- The global average concentrations of various greenhouse gasses in the atmosphere reached their highest levels ever recorded, and continue increasing. The combustion of fossil fuels from human activities and land-use changes are largely responsible for this increase.

- The concentration in 2007 of the six greenhouse gases (GHG) included in the Kyoto Protocol has reached 436 ppm CO_2-equivalent, which is an increase of 158 ppm compared to the pre-industrial level. Considering all GHGs (incl. ozone and various cooling aerosols), the concentration is 396 ppm CO_2-equivalents, which is 115 ppm higher than in pre-industrial times. The concentration of CO_2 - the most important greenhouse gas- has reached in 2007 a level of 383 ppm, and in 2008 385 ppm. This is an increase of nearly 110 ppm compared to the pre-industrial level.
- Under the IPCC scenarios the overall concentration of the six Kyoto gasses is projected to increase up to 638-1360 ppm CO_2-equivalent by 2100, whereas the concentration of all GHGs may increase up to 608-1535 ppm CO_2-equivalent. The global atmospheric GHG concentration of 450 ppm CO_2-equivalent may be exceeded between 2015 and 2030.

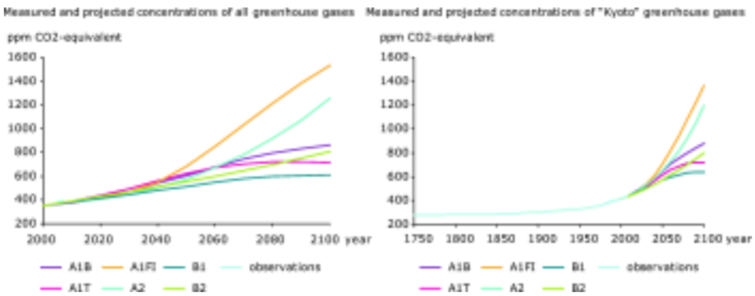

Fig. 1: Observed and projected changed in the overall Kyoto gasses (Fig 1a) and all greenhouse gasses, expressed in CO2-equivalents (IPCC, 2007a, partly based on IPCC, 2001). (Ver. 4.00)

Note: Note there is no historical trend in figure 1a due to the unavailability of long-term data for aerosols and ozone.

Data source: IPCC, 2007a

Downloads and more info

Key assessment

The concentration of greenhouse gases (GHG) in the atmosphere has increased during the 20th century, extremely likely[1] caused mainly by human activities related to the use of fossil fuels (e.g. for electric power generation), agricultural activities and land-use change (mainly deforestation). The increase of all GHG gasses has been particularly rapid since 1950. The first 50 ppm increase above the pre-industrial value of carbon dioxide (CO_2) for example, was reached in the 1970s after more than 200 years, whereas the second 50 ppm was achieved in about 30 years. In the 10 years the highest average growth rate has been recorded for any decade since atmospheric CO_2 measurements began (IPCC, 2007a).

Compared with the pre-industrial era (before 1750), concentrations up to 2007 of CO_2, methane (CH_4) and nitrous oxide (N_2O) have increased by 38%, 155%, and 15%, respectively. The CO_2 concentration further increased in 2008 until 385ppm (=+39%)[2] (http://www.esrl.noaa.gov/gmd/ccgg/trends/). The CO_2 increase is nearly entirely caused by human activities (of which about 2/3 caused by fossil fuel use, 1/3 due to land-use change), whereas humans are directly responsible for two third (mainly fossil fuel exploitation, rice agriculture, biomass burning, landfills) and one third (as fuel combustion, biomass burning, fertilizer use and some industrial processes) of the increase in CH_4 and N_2O, respectively. The present concentrations of CO_2 (385 parts per million, ppm) and CH_4 (1782 part per billion, ppb) have not been exceeded during the past 420 000 years (for CO_2 probably not even during the past 20 million years); the present N_2O concentration (321 ppb) has not been exceeded during at least the past 1 000 years. The fluorine-containing Kyoto Protocol gases (HFCs, PFCs and SF_6) are very effective absorbers of radiation and as such even small amounts can affect significantly the climate system. Their concentrations have increased by large factors (between 1.3 and 6.4, depending on the gas) between 1998 and 2007. As such their role in the total climate forcing is rapidly increasing in the past years. The Montreal Protocol gases (CFCs, HCFCs, and CH_3CCl_3) have peaked in 2003 and are now beginning to decline due to natural removal processes (IPCC, 2007a). Finally, the contribution of stratospheric ozone to the climate system is decreasing in the recent decades (although it is unclear whether this is indicative for a recovery of the global ozone layer), whereas assessments of long-term trends in tropospheric ozone are difficult due to the scarcity of representative observing sites with long records and the large spatial heterogeneity (IPCC, 2007a).

The overall concentration of the six Kyoto GHGs (i.e. CO_2, CH_4, N_2O, HFC, PFC, SF_6) has increased from 278 pre-industrial up to 436 CO_2-equivalents in 2007, thus an increase of 156 ppm. Considering all long living greenhouse gasses (i.e. the Kyoto Gasses plus the CFCs & HCFCs, that are included in the Montreal Protocol), a level of 463 ppm CO_2-equivalents has been reached for 2007. Adding, finally, ozone and various aerosols, the GHG concentration has reached a level of 396 ppm CO_2-equivalents in 2007. Thus, aerosols are important for the global climate, since they have in general a strong cooling affect - although some aerosols enhance the warming. In total aerosols are compensating for about 70% of the climate forcing by CO_2. Note that these aerosols have a relative short lifetime, the emissions will be reduced due to non-climate related policy measures and as such their importance for the future climate will diminish. Likewise, the Montreal Protocol gases (CFCs, HCFCs, and CH_3CCl_3) as a group contributed significantly (about 18%) to the current warming. Also their contribution is likely to decrease in the near-term future due to policy measures (IPCC, 2007a).

The IPCC (2001, 2007a) showed various projected future greenhouse gas concentrations for the 21st century, varying due to a range of scenarios of socio-economic, technological and demographic developments (Figure 1, Table 1). These scenarios assume no implementation of specific climate-driven policy measures. Under these scenarios, the overall concentration of the six Kyoto gasses is projected to increase up to 638-1360 ppm CO_2-equivalent by 2100, whereas the concentration of all GHGs (incl. aerosols) may increase up to 608-1535 ppm CO_2-equivalent by 2100 (Fig. 1). Note the importance of the non-Kyoto gasses (especially aerosols) is projected to strongly decrease, resulting in decreasing differences between only-Kyoto and all-GHG projections, with the exception of the A1FI scenario (where especially Montreal gasses and ozone remain high).

The IPCC projections show that a global atmospheric GHG concentration of 450 ppm may exceeded between 2010-2015 (in case of Kyoto gasses only) or between 2020-2030 (all GHGs). A level of 550 ppm CO_2-equivalent may become exceeded a decade later (Figure 1). Substantial global emission reductions are therefore needed to remain below these targets or return back to these levels after an overshoot.

Table 1: Projected changes in atmospheric GHG concentration (considering either Kyoto gasses only or all GHGs)

		A1B	A1T	A1FI	A2	B1	B2
Kyoto only	2020	489	478	484	484	475	470
	2050	645	613	707	653	571	575
	2100	877	722	1360	1196	638	800
all GHGs	2020	416	442	417	407	416	432
	2050	605	622	686	575	515	555
	2100	861	717	1535	1256	608	808

Source: IPCC, 2001, 2007a

[1]Defined as >95% probability (IPCC, 2007)

[2]2008 concentration levels are yet not available for the other greenhouse gasses.

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General metadata

Responsability and ownership

EEA Contact info
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Ownership

- DG ENV
- EEA
- Eurostat

EEA Management Plan
MP 2009 2.1.2 (note: EEA internal system)

Identification

CSI code
013
Specification
link: ISpecification20041007131717
version id: 2009/02/10 09:39:40.486 GMT+1
First draft created
10 Feb 2009
Publish date
20 Mar 2009
Last modified
20 Mar 2009

Classification

DPSIR
S
Typology
A
EEA themes

- climate