Carbon Futures

Large and sustained mitigation is required to keep global average warming below 2ºC

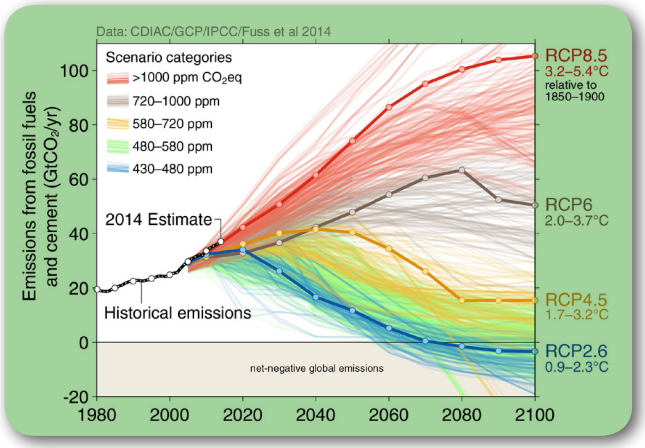

Figure 6: Emissions are on track for 3.2-5.4ºC 'likely' increase in average temperature (since pre-industrial). Source: Fuss et al 2014, CDIAC, IPCC, Global Carbon Budget 2014

- Cumulative emissions of CO_2 largely determine global surface warming by the late 21st century and beyond. Most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped. This represents a substantial commitment created by past, present and future emission of CO_2
- Cumulative emissions since 1870 from all sources will reach 2000 ± 200 billion tonnes CO_2 in 2014, about 75% from burning fossil fuel and cement production and 25% from land-use change
- 90% of 2ºC emissions scenarios reported in the fifth IPCC assessment report have 'negative emissions' (emissions less than zero) in 2100 but the viability of this mitigation option at a large scale is unproven

What is the Global Carbon Project?

The Global Carbon Project (GCP) is a global research platform. It assists scientists in establishing the knowledge base for supporting policy debate and action to slow the rate of increase of greenhouse gases in the atmosphere. The GCP is developing a complete picture of the global carbon cycle, including both its biophysical and human dimensions together with the interactions and feedbacks between them. Multiple organizations and research groups, especially those working on the carbon cycle, contribute to achieving the aims of the GCP. The GCP works under the auspices of the International Geosphere and Biosphere Programme (IGBP) and Future Earth.

This summary was compiled by R Moriarty[1], RM Andrew[2], GP Peters[2], C Le Quéré[1] and the 2014 Global Carbon Budget Team

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Links

www.globalcarbonproject.org/carbonbudget
www.globalcarbonatlas.org
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www.facebook.com/globalcarbonproject

Global Carbon Budget 2014 was published in:

Le Quéré et al (2014) Global Carbon Budget 2014 (in discussion). *ESSDD*, http://dx.doi.org/10.5194/essdd-7-521-2014

Friedlingstein et al (2014) Persistent growth of CO_2 emissions and implications for reaching climate targets. *Nature Geoscience*, http://dx.doi.org/10.1038/ngeo2248

Raupach et al (2014) Sharing a quota on cumulative carbon emissions. *Nature Climate Change*, http://dx.doi.org/10.1038/nclimate2384

Fuss et al (2014) Betting on negative emissions (Commentary). *Nature Climate Change*, http://dx.doi.org/10.1038/nclimate2392

Other references :

Boden et al (2013) CDIAC, http://cdiac.ornl.gov/trends/emis/meth_reg.html
Dlugokencky and Tans (2013) NOAA-ESRL, http://www.esrl.noaa.gov/gmd/ccgg/trends/
Giglio et al (2014) *Journal Geophysical Research Biogeosciences,* doi:10.1002/jgrg.20042
Houghton et al (2012) *Biogoesciences* doi:10.5194/bg-9-5125-2012
Joos et al (2013) *Atmospheric Chemistry and Physics*, doi: 0.5194/acp-13-2793-2013
Keeling et al (1976) *Tellus*, doi: 10.1111/j.2153-3490.1976.tb00701.x
Khatiwala et al (2013) *Biogeosciences*, doi:10.5194/bg-10-2169-2013
Stocker et al (2013) *WGI, AR5, IPCC*, http://www.ipcc.ch/report/ar5/wg1/

GLOBAL CARBON project

Global Carbon Budget
Summary

What is the global carbon cycle?

Carbon dioxide (CO_2) is a greenhouse gas emitted to the atmosphere by human activities, mainly from burning fossil fuels and cement production, and from deforestation and other land-use change. The emitted CO_2 is either absorbed by the ocean and land, or it remains in the atmosphere.

Key messages

- CO_2 emissions from human activities, the main contributor to global warming, are set to rise again in 2014 reaching 40 billion tonnes CO_2
- To keep warming below 2ºC requires that the total amount of CO_2 emitted remains below a fixed 'quota'
- We have already used about $^2/_3$ of the emissions quota to keep warming below 2ºC with a likely (66%) chance – the remaining $^1/_3$ is equivalent to about 30 years (one generation) of CO_2 emissions at current levels
- A large part of all known fossil fuel reserves may need to remain untapped to keep average warming under 2ºC

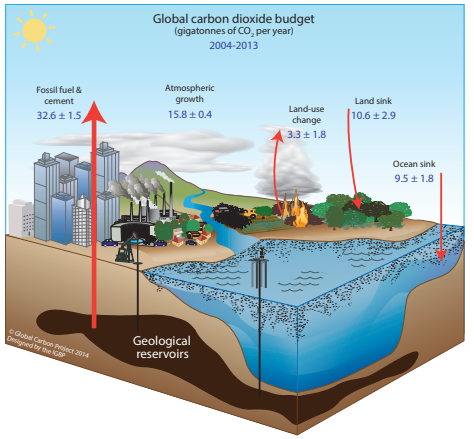

Figure 1: Schematic representation of the perturbation of the global carbon cycle caused by human activities, averaged globally for the decade 2004-2013. Source: Le Quéré et al 2014, Global Carbon Budget 2014

Atmospheric CO_2 Concentration

The concentration of CO_2 in the atmosphere continues to increase

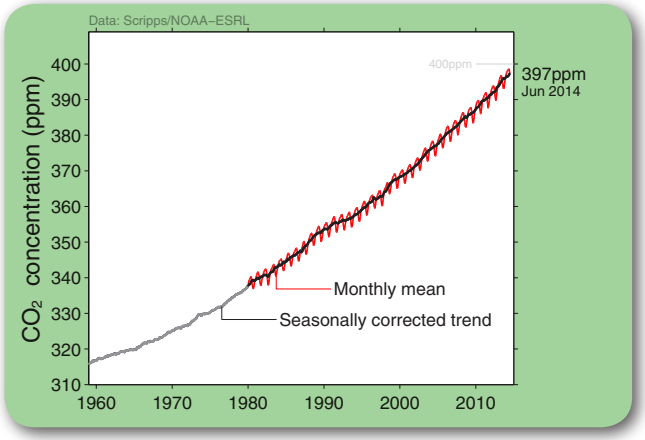

Figure 2: Evolution of globally averaged surface atmospheric CO_2 concentration (in parts per million). Source: NOAA-ESRL after 1980 and Scripps Institution of Oceanography before 1980, Global Carbon Budget 2014

- Atmospheric CO_2 concentration increased by 43% since pre-industrial times, a level unprecedented in at least the last 800,000 years
- Atmospheric CO_2 concentration increased by 2 parts per million (ppm) per year on average in the last decade (2004-2013), equivalent to an increase of 20 billion tonnes CO_2 in 2013 alone
- Daily averages went above 400 ppm for the first time at the Mauna Loa Observatory in May 2013
- CO_2 monitoring at Mauna Loa began in 1958 and constitutes the longest record of direct atmospheric CO_2 measurements

CO_2 Emissions

CO_2 emissions from human activities are set to rise again in 2014

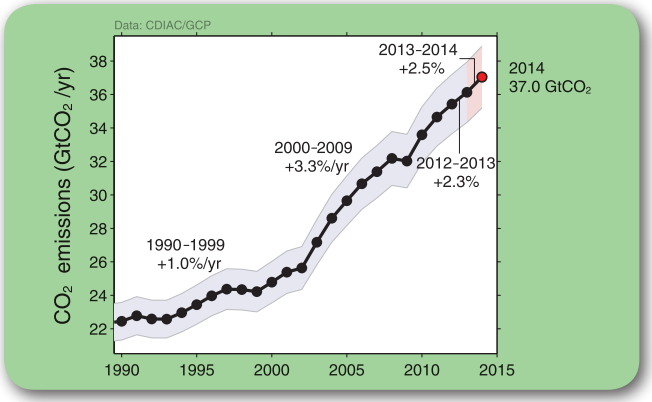

Figure 3: Global CO_2 emissions from burning fossil fuel and cement production to 2013, with a projection for 2014. The uncertainty of ± 5% is shown by the grey shading. Source: CDIAC, Global Carbon Budget 2014

- Global emissions of CO_2 from burning fossil fuels and cement production reached 36 billion tonnes CO_2 in 2013 and are projected to reach 37 billion tonnes CO_2 in 2014, 65% above 1990 levels
- The four biggest emitters were China (28% of the global total), USA (14%), EU28 (10%), and India (7%) in 2013
- Global emissions of CO_2 from deforestation and other land-use change were about 3.3 billion tonnes CO_2 in 2013

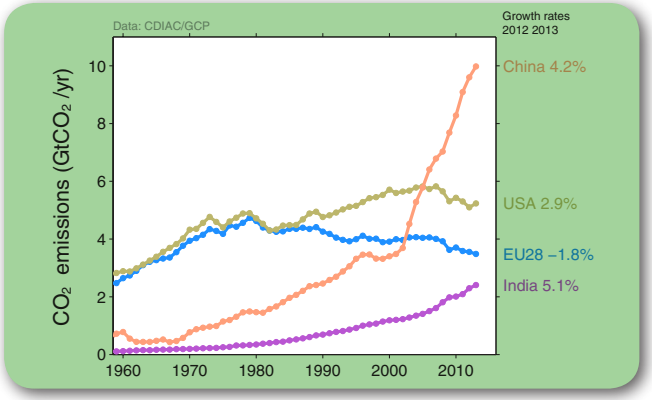

Figure 4: Top four emitters in 2013 accounted for 58% of global emissions that year. Source: CDIAC, Global Carbon Budget 2014

Natural CO_2 Sinks

Emissions are partitioned between the atmosphere, land and ocean

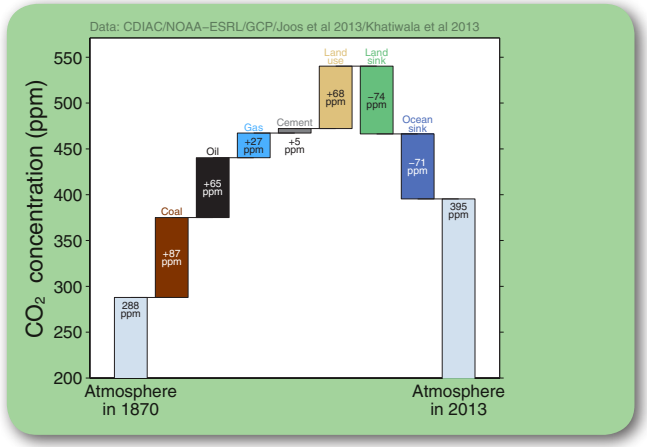

Figure 5: Cumulative contributions to CO_2 emissions from fossil fuels, cement and land-use change, and their partitioning among the land, ocean and atmosphere from 1870 to 2013. Source: based on data from CDIAC, NOAA-ESRL, Houghton et al 2012, Giglio et al 2013, Joos et al 2013, Khatiwala et al 2013, Global Carbon Budget 2014. Figure concept from Shrink That Footprint

- The ocean carbon sink has absorbed about 30% of emitted anthropogenic CO_2 causing ocean acidification. Further uptake of CO_2 by the ocean will increase ocean acidification
- The land carbon sink is particularly sensitive to climate and is the primary cause of the large interannual variability observed in atmospheric CO_2
- Climate change will affect carbon cycle processes in a way that will exacerbate the increase of CO_2 in the atmosphere
- All components of the carbon cycle have grown since 1959 except CO_2 emissions from land-use change

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