



(Source: PACE-SD EU GCCA Project)

## The Greenhouse Effect

Without the so-called greenhouse gases such as carbon dioxide, methane, nitrous oxide, and water vapor, the earth would be too cold to inhabit. GHG's in the earth's atmosphere absorb and emit heat energy, creating the greenhouse effect that keeps the planet's temperature livable.



Figure 1: Projected impacts of climate change on various sectors  
(Source: Stern, 2006)

The natural green-house effect is essential for life on earth by helping to maintain the average global temperature of 15°C. However, industrialisation, deforestation, and pollution have greatly increased atmospheric concentrations of these same gases. All greenhouse gases help trap heat near the earth's surface and this leads to the rapid warming of the earth's surface that is unprecedented in the history of planet earth.

The Intergovernmental Panel on Climate Change (IPCC) report released in February 2007 concluded that humans have caused most of the current planetary warming. Human induced climate change is often referred to as **anthropogenic climate change**. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture

The atmospheric concentration of CO<sub>2</sub> has increased by more than 30% since pre-industrial times, trapping more heat in the lower atmosphere. The result has been an 'enhanced' greenhouse effect and observed changes to the global mean climate.

Carbon dioxide (CO<sub>2</sub>) is the most common anthropogenic green house gas. As shown in Figure 2, its annual emissions grew by about 80% between 1970 and 2004. The long-term trend of declining CO<sub>2</sub> emissions per unit of energy supplied reversed after 2000. Global atmospheric concentrations of CO<sub>2</sub>, methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) have increased remarkably as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.

## Global Greenhouse Gas Emissions

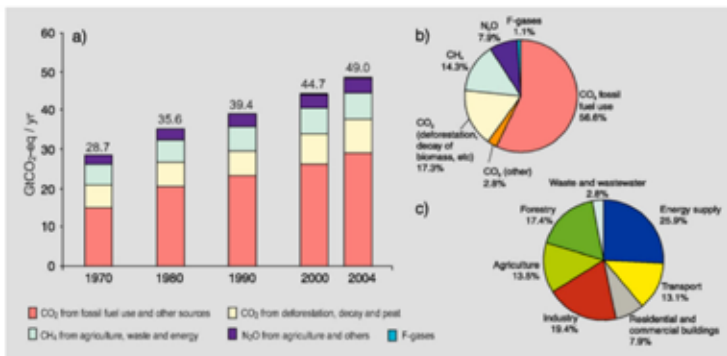


Figure 2: (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004 (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO<sub>2</sub>-eq. (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO<sub>2</sub>-eq. (Forestry includes deforestation.) - Climate Change 2007: Synthesis Report

## ‘Warming of the Climate System is Unequivocal’

As humans continue to emit carbon dioxide into the atmosphere much faster than plants and oceans can absorb it, these gases remain in the atmosphere for years. Even if GHGs emissions were eliminated today, the shift in climate will persist for hundreds and thousands of year to come.

Climate change threatens the basic resources for life limiting access to water, food and land, and affecting terrestrial and marine ecosystems and human health.

### What's the Difference Between Climate and Weather?

The difference between climate and weather is a measure of time. Weather reflects what is happening in the atmosphere are over a short period of time, and climate is how the atmosphere ‘behaves’ over long periods of time. When talking about climate change, it refers to changes in long term averages of daily weather.

The Intergovernmental Panel on Climate Change (IPCC) concludes that the global climate is changing, and the change is linked to human-induced (anthropogenic) GHG emissions:

‘Warming of the climate system is unequivocal’ as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising mean sea level. Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations’ (IPCC, 2007: 4, 8).

Climate change threatens the basic resources for life-limiting access to water, food and land, and affecting terrestrial and marine ecosystems and human health.

### Signs of climate change include:

- Increasing temperatures.
- Changing precipitation patterns.
- Increasing ocean temperatures and coral bleaching.
- Increasing frequency and intensity of natural hazards (cyclones, floods, storms, droughts).
- Changing response by plants and animals such as shifting range.
- Accelerated shrinking of mountain glaciers on every continent.
- Increasing melt rates of Earth’s three Ice Sheets (Greenland, West Antarctic, East Antarctic).
- Rapid reduction of Arctic sea-ice.
- Disintegration of floating ice shelves.
- Rising sea levels.
- Acidification of the oceans (due to elevated CO<sub>2</sub> in the atmosphere).



## Current Global Warming

Global warming is the increase in global average temperature, which causes the circulation of the atmosphere to change, resulting in some areas of the world warming. The earth's climate has changed many times throughout history, yet the rapid warming today is not due to natural processes alone (see Figure 3).

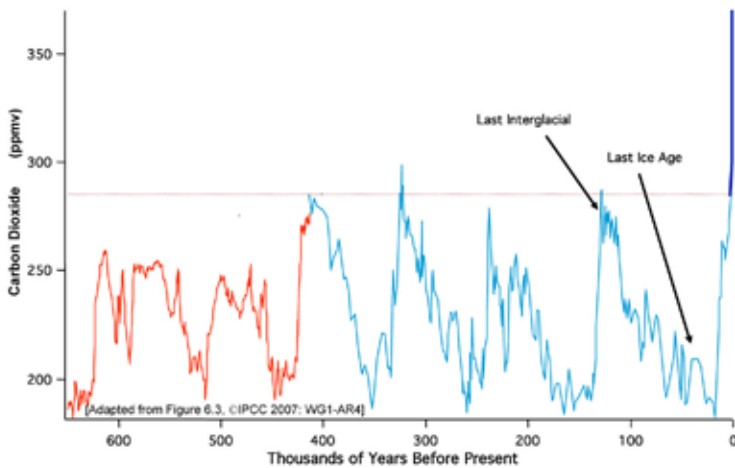
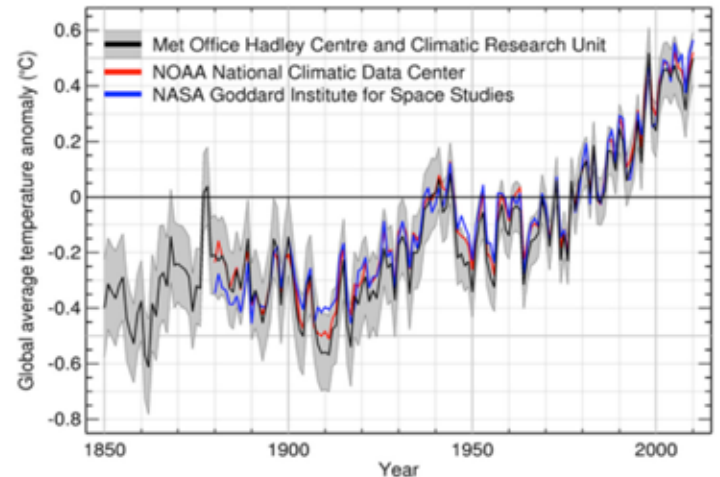


Figure 3: Humans are 'forcing' the system in a new way.  $CO_2$  increases are mainly due to fossil fuel burning.  $CO_2$  has not been this high in more than half a million years.

From the 1850s-2005, the global temperature increased by  $0.76^\circ C$  and the rate of warming over the last 50 years is almost twice that of the last 100 years. Figure 4 demonstrates the changes in global mean surface temperature since 1850.

In summary, the 'natural' greenhouse effect acts like a blanket keeping some of the heat in (making life on earth possible), although much of this is radiated back into space. However, with more GHGs being emitted into the atmosphere, the 'enhanced' greenhouse effect makes the blanket around our globe thicker, trapping more heat and raising the global temperature.

Figure 4:



Global mean surface temperature change (Source: GISS website, 2011)

## Global Warming Projections

Scientists have projected a range of possible global temperatures based on a number of future GHG emission scenarios (see Figure 5).

According to the IPCC (2007), global average temperature is projected to increase by  $1.1^\circ C$  -  $6.4^\circ C$  by 2100 (relative to 1890-1990) — if countries around the world do not act to restrict GHG emissions.

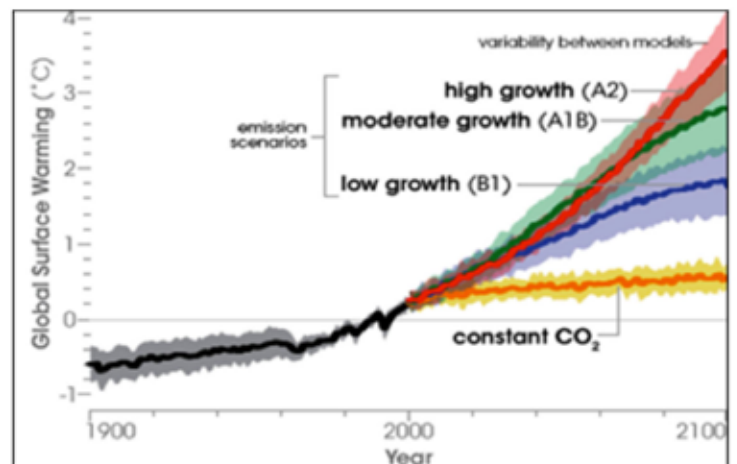


Figure 5: Temperature projections to 2100, based on a range of emission scenarios and global climate models (Source: IPCC, 2007)

## The Human Interference

This factsheet was produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID-FCLP) and the European Union's 'Global Climate Change Alliance (EU GCCA) Project'.

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