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# CLIMATE CHANGE

I worry about climate change. It's the only thing that I believe has the power to fundamentally end the march of civilization as we know it, and make a lot of the other efforts that we're making irrelevant and impossible.

**BILL CLINTON**, former US President

Climate change is the most severe problem that we are facing today, more serious even than the threat of terrorism.

**SIR DAVID KING**, former UK government chief scientific adviser

Climate change: it's here. If we don't react, war, pestilence and famine will follow close behind.

**R.K. PACHAURI**, Chairman, Intergovernmental Panel on Climate Change (IPCC)

If we follow business as usual I can't see how west Antarctica could survive a century. We are talking about a sea-level rise of at least a couple of metres this century . . . What we have found is that the target we have all been aiming for is a disaster — a guaranteed disaster.

**JAMES HANSEN**, US climate scientist and head of NASA  
Goddard Institute for Space Studies

Dawes Glacier calving from the 200-foot-high face: Tongass National Forest, Alaska, USA  
Nancy Nehring, istockphoto



# Our 'large-scale geophysical experiment' . . .

Scientists have long been aware of the Earth's extreme temperature variations, with the last major ice age ending about 10,000 years ago. However, in 1824 Jean-Baptiste Fourier discovered a global warming (or greenhouse) effect and, in 1861, the Irish physicist John Tyndall carried out key research on carbon dioxide (CO<sub>2</sub>) and heat absorption.

In 1896, Swedish and American scientists independently concluded that CO<sub>2</sub> was the likely cause of global warming. By 1957, US oceanographer Roger Revelle was warning that humanity is conducting a 'large-scale geophysical experiment', while colleague David Keeling set up the first continuous monitoring of CO<sub>2</sub> in the atmosphere, confirming year-on-year-rises.

Despite these early signs, it took until 1979 for the first World Climate Conference, organised by the World Meteorological Organisation (WMO), to state that 'continued expansion of man's activities on Earth may cause significant extended regional and even global changes of climate'. This led the WMO and the United Nations Environment Programme (UNEP) to establish a scientific advisory body: the Intergovernmental Panel on Climate Change (IPCC).

The IPCC issued its First Assessment Report in 1990, finding that the planet had warmed by 0.5°C in the past century and would rise further by 0.3°C per decade in the 21st century, accompanied by global mean sea level rises of 6 cm per decade.

- 1979** First World Climate Conference
- 1988** Intergovernmental Panel on Climate Change (IPCC) established
- 1990** 1st IPCC report finds 0.5°C warming
- 1992** UN Framework Convention on Climate Change (UNFCCC) signed
- 1995** 2nd IPCC report predicts significant socioeconomic impacts
- 1997** Kyoto Protocol sets targets for 34 major economies
- 2001** 3rd IPCC report shows rising temperatures and sea levels
- 2005** EU GHG Emission Trading Scheme begins trading
- 2006** Stern Review on Economics of Climate Change published
- 2007** 4th IPCC report shows 90% certainty of human cause of climate change

Convinced that the world needed a global policy response, the UN established the Framework Convention on Climate Change (UNFCCC), which 154 nations (including the US) signed at the Rio 'Earth Summit' in 1992.

In 1995, the IPCC Second Assessment Report confirmed that concentrations of greenhouse gases (GHGs) were continuing to increase, and that the socioeconomic impacts of climate change were significant, while the UNFCCC began negotiations on an international agreement to limit the emission of GHGs. The result was the Kyoto Protocol, adopted in 1997, which: (1) set mandatory targets for emission reductions for the world's 38 leading economies, and (2) proposed three flexible market mechanisms for achieving these reductions through carbon trading. The targets collectively amounted to a 5.2% global reduction in GHGs from these countries against 1990 levels by 2012.

Despite US opposition to the Protocol, momentum continued to build, with the EU launching its Emission Trading Scheme for CO<sub>2</sub> in 2005. In 2007, the UK's Stern Review, prepared by former World Bank Chief Economist Sir Nicholas Stern, warned that tackling climate change will now cost around 1% of global GDP, whereas the cost of not acting could be between 5% and 20%. Shortly thereafter, the IPCC released its Fourth Assessment Report, concluding with 90% confidence that human activity is causing climate change. It seemed the tide was turning, in no small part thanks to former US Vice-President Al Gore, who received an Oscar for his movie *An Inconvenient Truth*, and a Nobel Prize, shared with the IPCC. This seemed to mark the end of denial and the beginning of urgent global action on climate change.

## Intergovernmental Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC) was founded in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP).

The IPCC is made up of: (1) *governments*, which set the work programme and accept, adopt and approve the IPCC reports; (2) *scientists*, who contribute to the IPCC reports as authors, contributors and reviewers; and (3) *people*: as a United Nations body, the IPCC work aims for the promotion of the UN human development goals.

The IPCC has a task force on national greenhouse gas inventories and three working groups, on: (1) scientific aspects, (2) the vulnerability of socioeconomic and natural systems, and (3) options for adapting to and mitigating climate change.

The IPCC has issued four main Assessment Reports: in 1990, 1995, 2001 and 2007.

## FACTBOX

### The IPCC Third Assessment Report in 2001 found that:

- ▶ Global average surface temperatures rose 0.6°C during the 20th century.
- ▶ Sea level rose between 0.1 and 0.2 metres during the 20th century.
- ▶ In the Northern Hemisphere, the increase in temperature in the 20th century was the largest of any century during the past 1,000 years.
- ▶ In the Northern Hemisphere, the 1990s were the warmest decade since records began in 1861, and 1998 was the warmest year since records began in 1861.
- ▶ There have been average decreases of about 10% in the extent of snow cover around the world since the late 1960s and global ocean heat content has increased since the late 1950s.
- ▶ There has been a 40% decline in Arctic sea-ice thickness during late summer to early autumn in recent decades and a slower decline in winter sea-ice thickness.
- ▶ Northern Hemisphere spring and summer sea-ice extent has decreased by about 10–15% since the 1950s.

### The IPCC Fourth Assessment Report in 2007 found that:

- ▶ Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004.
- ▶ Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic (human-induced) GHG concentrations.

The economic implications of these IPCC findings led the 2007 Stern Review to conclude that the global cost of tackling climate change could now be as little as 1% of global annual GDP, but inaction could result in costs of between 5% and 20%.



# The Kyoto Protocol

The Kyoto Protocol is an international policy under the UN Framework Convention on Climate Change (UNFCCC) which commits specified countries to stabilise their greenhouse gas (GHG) emissions.

The Protocol covers six of the most important GHGs: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>).

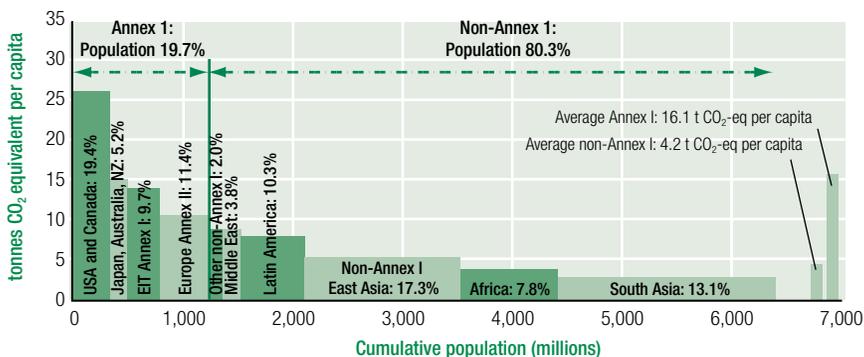
The Protocol was adopted in 1997 and entered into force in 2005. Most notable among those who had not yet ratified was the United States.

The Protocol sets GHG emission reduction targets, to be achieved by 2012, for 38 developed countries (Annex 1 countries). Developing countries (non-Annex 1 countries) do not have targets.

On average, the GHG targets are equivalent to a 5.2% reduction against a 1990 baseline, but they range from an increase of 10% (Iceland) and 8% (Australia) to a decrease of 7% (USA) and 8% (EU).

There are three flexible market mechanisms for carbon trading between 2008 and 2012 under the Protocol: (1) Emissions Trading, (2) Joint Implementation (JI) and (3) the Clean Development Mechanism (CDM).

Negotiations to replace the Kyoto Protocol after 2012 started in Bali in December 2007.



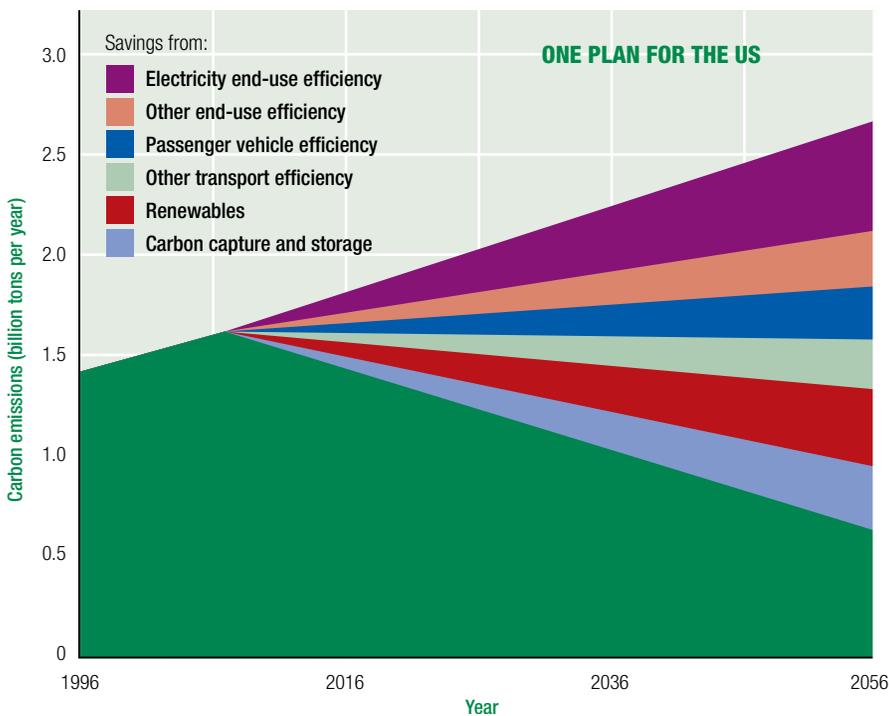
**Notes:** Year 2004 distribution of regional per capita GHG emissions (all Kyoto gases, including those from land use) over the population of different country groupings. The percentages in the bars indicate a region's share in global GHG emissions. EIT = Economies in Transition

**Figure 5 CO<sub>2</sub> emissions by region (2004)**

Source: IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

## FACTBOX

- ▶ From 1996 to 2005, the GHG emissions for Annex I countries (excluding from land use, land use change and forestry) decreased by 2.8%, although they increased by 2.6% since 2000.
- ▶ The UNFCCC estimates that around 2,900 Clean Development Mechanism (CDM) projects under the Kyoto Protocol will generate 2.6 billion Certified Emission Reductions (CERs) by 2012.
- ▶ The EU Emission Trading Scheme (EU ETS) — the world's first large-scale emissions trading programme under the Kyoto Protocol — was launched in 2005, covering around 12,000 installations in 25 countries and 6 industrial sectors.
- ▶ The carbon market grew to US\$30 billion in 2006, three times greater than the previous year. The market was dominated by \$25 billion under the EU ETS.
- ▶ Project-based activities primarily through the CDM and JI grew sharply to a value of about US\$5 billion in 2006. The voluntary market for reductions by corporations and individuals also grew strongly to an estimated US\$100 million in 2006.
- ▶ New Energy Finance estimates that the US will have a \$1 trillion emissions trading market by 2020 if the policy trend towards a cap-and-trade system continues.



**Note:** The US share of emissions could, in this Natural Resources Defense Council scenario, be achieved by efficiency gains, renewable energy and clean coal.

**Figure 6 'Princeton Wedges': technologies to stabilise climate change**

Source: Daniel A. Lashof and David G. Hawkins, Natural Resources Defense Council, in Robert H. Socolow and Stephen W. Pacala, 'A Plan to Keep Carbon in Check', *Scientific American*, September 2006

## BOOKS

Al Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It* (Bloomsbury, 2006)

Jeremy Leggett, *The Carbon War: Global Warming and the End of the Oil Era* (Penguin, 2000)

James Lovelock, *The Revenge of Gaia: Earth's Climate Crisis and the Fate of Humanity* (Basic Books, rev. edn, 2007)

George Monbiot, *Heat: How to Stop the Planet from Burning* (Penguin, new edn, 2007)

## REPORTS

*A Call for Action* (US Climate Action Partnership, 2007)

*Cambridge Climate Leaders Reference Guide* (University of Cambridge Programme for Sustainability Leadership, 2007)

*Carbon Down, Profits Up* (The Climate Group, 3rd edn, 2006)

*Climate Change 2007: 4th Assessment Report (Physical Science Basis)* (IPCC, 2007)

*Climate Change and the Greenhouse Effect* (The Hadley Centre, 2005)

*The Climate Change Challenge: Scientific Evidence and Implications* (The Carbon Trust, 2005)

*Getting Ahead of the Curve: Corporate Strategies that Address Climate Change* (Pew Center on Global Climate Change, 2006)

*Limiting Global Climate Change to 2 Degrees Celsius: The Way Ahead for 2020 and Beyond* (European Commission, 2007)

*Pathways to 2050: Energy and Climate Change* (World Business Council for Sustainable Development [WBCSD], 2005)

*Stern Review on the Economics of Climate Change* (Nicholas Stern and HM Treasury, UK, 2007)

*World Energy Outlook 2006* (IEA, 2006)

## WEBSITES

**BBC, section on climate change:**  
[www.bbc.co.uk/climate](http://www.bbc.co.uk/climate)

**Carbon Trust:** [www.carbontrust.co.uk](http://www.carbontrust.co.uk)

**Cool Mayors for Climate Protection:**  
[www.coolmayors.org](http://www.coolmayors.org)

**Corporate Leaders Group on Climate Change:** [www.cpi.cam.ac.uk/bep/clgcc](http://www.cpi.cam.ac.uk/bep/clgcc)

**E3G:** [www.e3g.org/index.php/programmes/climate](http://www.e3g.org/index.php/programmes/climate)

**EU Greenhouse Gas Emission Trading Scheme:** [ec.europa.eu/environment/climat/emission.htm](http://ec.europa.eu/environment/climat/emission.htm)

**Institute for Public Policy Research (ippr):**  
[www.ippr.org.uk/research/teams/?id=86&tid=86](http://www.ippr.org.uk/research/teams/?id=86&tid=86)

**Intergovernmental Panel on Climate Change (IPCC):** [www.ipcc.ch](http://www.ipcc.ch)

**Kyoto Protocol:** [unfccc.int/kyoto\\_protocol/items/2830.php](http://unfccc.int/kyoto_protocol/items/2830.php)

**Princeton Stabilization Wedges:**  
[www.princeton.edu/~cmi/resources/stabwedge.htm](http://www.princeton.edu/~cmi/resources/stabwedge.htm)

**Stern Review:** [www.hm-treasury.gov.uk/sternreview\\_index.htm](http://www.hm-treasury.gov.uk/sternreview_index.htm)

**Stop Global Warming:**  
[www.stopglobalwarming.org](http://www.stopglobalwarming.org)

**Tyndall Centre for Climate Change Research:** [www.tyndall.ac.uk](http://www.tyndall.ac.uk)

**Together.com:** [www.together.com](http://www.together.com)

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