

The Science and Economics of Climate Change: an update on the predictions

by Nicola Durrant¹

The evidence regarding the science and economics of climate change is growing stronger. Several expert reports addressing future climatic impacts from global greenhouse gas emissions have been published in recent months. The purpose of this summary is to provide a brief overview of the key findings of those reports regarding projected greenhouse gas emissions and the current and future climatic impacts of those emissions.

The international reports evaluated below include the recent *Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report on Climate Change 2007* and the now infamous *2006 Stern Review on the Economics of Climate Change*. Australia specific expert reports including the *Australia State of the Environment Report 2006* and *Tracking to the Kyoto Target 2006* are also assessed.

1. IPCC Fourth Assessment Report

The *IPCC Fourth Assessment Report* was released in February 2007 and makes a number of findings regarding emerging and future changes in the climate system.² The report states that its findings are based on increased scientific certainty regarding the science of climate change compared to previous IPCC assessment reports.

In relation to climate warming, the assessment report concludes that:

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 global mean sea level.³

The assessment finds that the linear warming trend over the past 50 years is approximately 0.13 degrees Celsius per decade, nearly twice that for the last 100 years.⁴ Eleven of the last twelve years rank as the 12 warmest years on record.⁵ The report further predicts a warming of approximately 0.2 degrees Celsius per decade for the next two decades with a warming of around 1.8 to 4 degrees Celsius by 2099.⁶

The assessment identifies a clear link between temperature increases and greenhouse gas emissions and concludes that:

most of the observed increase in globally average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations.⁷

The assessment estimates that sea levels have risen by 0.17 metres during the 20th century.⁸ Those sea levels are predicted to rise again between 0.18 metres to 0.59 metres by 2099.⁹

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2 IPCC, 'Climate Change 2007: The Physical Science Basis: Summary for Policy Makers, Contribution of Working Group I to the Fourth Assessment report of the Intergovernmental Panel on Climate Change' (IPCC Secretariat Geneva, 2007) available at <http://www.ipcc.ch/SPM2feb07.pdf>. This is the first of four reports to be released in 2007 by the IPCC.

3 IPCC, n1, 4.

4 Ibid.

5 Ibid. Records commenced in 1850.

6 Compared to 1999. IPCC, n1, 10, 11.

7 IPCC, n1, 8.

8 IPCC, n1, 5.

9 Compared to 1999. IPCC, n1, 11.

According to the assessment, mountain glaciers and snow cover have declined with decreases in glaciers and ice caps contributing to sea level rise.¹⁰ The Greenland and Antarctica ice sheets are also experiencing increased mass losses.¹¹ Long-term changes identified in the climate system include changes in Arctic temperatures and ice, widespread precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and intensity of tropical cyclones.¹²

The bleak predictions do not stop there. The assessment concludes that continued emissions at or above current rates will, very likely, cause further warming and induce larger changes in the climate system than those observed during the 20th century.¹³ Moreover, past and future emissions are predicted to continue to contribute to warming and sea level rises for more than a millennium to come due to the timescales required to remove the gases from the atmosphere.¹⁴

2. The Stern Review on the Economics of Climate Change

The economic costs of unabated climate change have also been made clear. The *Stern Review on the Economics of Climate Change* was released in October 2006.¹⁵ The terms of reference of that review included examining the evidence on the economic, social and environmental consequences of climate change and the costs and benefits of actions to reduce the net global balance of greenhouse gas emissions.

The Stern Review states that '*Climate change.. is the greatest and widest-ranging market failure ever seen*'.¹⁶ The Review concludes that the stocks of greenhouse gases in the atmosphere are rising and that *this is the result of human activity*.¹⁷ Current levels of greenhouse gases in the atmosphere are estimated to be around 430 parts per million (ppm) carbon dioxide equivalent compared with 280ppm before the Industrial Revolution.¹⁸ The Review estimates that concentrations of 550ppm, double pre-industrial levels, could be reached by as early as 2035.¹⁹ At that level, the Review concludes that there is at least a 77 per cent chance, and up to a 99 per cent chance, of a global average temperature rise exceeding 2 degrees Celsius.²⁰

Some of the predicted impacts of that warming are rising sea levels, increased incidences of floods and declining crop yields. The Stern Review notes that up to 200 million people could become displaced by the middle of the century due to climatic impacts.²¹ The economic cost of that warming (2-3 degrees Celsius) is predicted to be up to 3 per cent of global world output.²² With 5-6 degrees Celsius warming, that cost could be up to 10 per cent of global gross domestic product (GDP) and could involve reductions of up to 20 per cent in consumption per head.²³

The Stern Review estimates that to stabilise greenhouse gases at 550ppm, current emissions would need to be reduced by 25 per cent by 2050.²⁴ The Review predicts that the annual cost of emissions reductions consistent with a trajectory leading to stabilisation at 550ppm will be approximately 1 per cent of GDP by 2050.²⁵ In comparison, the social cost of carbon emitted today, if we remain on our business as usual trajectory, is approximately \$85 per tonne of carbon dioxide.²⁶ The Review concludes that shifting to a lower emissions trajectory will have global net benefits of around US\$2.5 trillion.²⁷ Indeed, it estimates that markets for low-carbon energy products are likely to be worth at least US\$500 billion per year by 2050.²⁸

10 IPCC, n1, 5.

11 Ibid.

12 Ibid.

13 IPCC, n1, 10.

14 IPCC, n1, 13.

15 Nicholas Stern 'The Economics of Climate Change: The Stern Review' (Cabinet Office, HM Treasury 2006) at http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

16 Stern Review, *ibid* at i.

17 Stern Review, *ibid* at iii.

18 Ibid.

19 Ibid.

20 Ibid.

21 Stern Review, n14, vi.

22 Stern Review, n14, ix.

23 Ibid.

24 Stern Review, n14, xi.

25 Stern Review, n14, xiii.

26 Ibid.

27 Stern Review, n14, xvii.

28 Stern Review, n14, xvi.

3. The Australia SoE 2006

A number of scientific assessments of climatic impacts have also been undertaken in Australia. The *Australia State of the Environment Report 2006* (SoE 2006)²⁹ was prepared by the independent Australian State of the Environment Committee and tabled in the Australian Parliament in December 2006.

SoE 2006 makes the following blunt statements in relation to the existence of climate change:

climate change has always been a reality the question, then, is not 'if' but 'how much'³⁰....

climate change is undoubtedly a threat to Australia's environment. Although Australia's climate is so variable that the extent of change is uncertain, there is clear evidence for some warming and changes to rainfall distribution.³¹

Australia is experiencing climatic changes at a slightly elevated level to the rest of the world. SoE 2006 concludes that Australian temperatures are increasing and are doing so at a more rapid rate than the global average.³² The average temperature across Australia has risen by 0.82 degrees Celsius between 1910 and 2004.³³ Since 1950, that temperature increase has been almost 0.2 degrees Celsius per decade.³⁴ Sea temperatures are also rising and the report concludes that there have been increases in sea surface temperatures of up to 0.28 degrees Celsius since 1950.³⁵

SoE 2006 also notes with concern the increase in *net* greenhouse gas emissions in Australia.³⁶ According to the report, Australia's emissions increased by 2.3 per cent to 564.7 million tonnes of carbon dioxide equivalent from 1990 to 2004.³⁷ The largest source of those greenhouse gas emissions is attributed to the energy sector and, primarily, to the stationary energy and transportation sub-sectors.³⁸

4. Tracking to the Kyoto Target 2006

Australia's emissions are also assessed in the government report *Tracking to the Kyoto Target 2006: Australia's Greenhouse Emissions Trends 1990 to 2008-2012 and 2020* published in December 2006.³⁹

Australia's emission reduction target under the Kyoto Protocol requires a reduction in greenhouse gas emissions to 108 per cent of Australia's reported 1990 levels by 2012. Although Australia has not ratified the Kyoto Protocol, the Federal Government has continually reaffirmed its commitment to meeting that Kyoto Protocol target.⁴⁰ However, *Tracking to the Kyoto Target* predicts that 'business as usual' emissions are projected to reach 125 per cent of 1990 levels by 2010 and 151 percent of 1990 levels by 2020.⁴¹

With the use of so-called *greenhouse measures* the report estimates Australia's emissions to be 109 per cent of 1990 levels in 2010.⁴² Even with those greenhouse measures, emissions are projected to rise to 127 per cent of 1990 levels by 2020.⁴³ The exact nature of those greenhouse measures are not clear from the report but references are made to a number of existing government initiatives including the Greenhouse Gas Abatement Programme, Challenge Plus-Industry Partnerships, Mandatory Renewable Energy Target and the NSW Greenhouse Gas Abatement Scheme.⁴⁴ The report also refers to government funding of low

29 RSJ (Bob) Beeton et al, 'Australia State of the Environment 2006: Independent Report to the Australian Government Minister for the Environment and Heritage, Department of the Environment and Heritage, Canberra' (Australia State of the Environment Committee, 2006), <http://www.environment.gov.au/soe/2006/index.html>.

30 SoE 2006, n28, 31.

31 SoE 2006, n28, 19.

32 SoE 2006, n28, 27.

33 SoE 2006, n28, 25. According to the Australian Bureau of Meteorology *Annual Australian Climate Statement 2006*, issued 3 January 2007, Australian annual mean temperatures have now increased by approximately 0.9°C since 1910. Available at http://www.bom.gov.au/announcements/media_releases/climate/change/20070103.shtml.

34 SoE 2006, n28, 27.

35 SoE 2006, n28, 31.

36 SoE 2006, n28, 27.

37 Ibid.

38 Ibid.

39 Department of the Environment and Heritage, 'Tracking to the Kyoto Target 2006: Australia's Greenhouse Emissions Trends 1990 to 2008-2012 and 2020' (Australian Greenhouse Office, 2006).

40 Tracking to the Kyoto Target, n38, 3.

41 Tracking to the Kyoto Target, n38, 1,19.

42 Tracking to the Kyoto Target, n38, 16.

43 Tracking to the Kyoto Target, n38, 1,19.

44 Tracking to the Kyoto Target, n38, 17.

emissions technologies and renewable energy.⁴⁵ The initiatives of the *Asia Pacific Partnership on Clean Development and Climate* are not specifically promoted in the report.⁴⁶

5. The Shifting Sands of Climate Policy

As the emerging evidence on the science and economics of climate change has drawn public attention, developments have occurred in both international and domestic climate policy.

On the home front, the Australian Prime Minister's *Nuclear Energy Taskforce* issued its report in December 2006. That report concludes that reducing Australia's greenhouse gas emissions requires a full spectrum of initiatives and *its goals cannot be met by nuclear power alone*.⁴⁷ However, it estimates that the emissions reductions from nuclear power could be 8 to 17 per cent of national emissions in 2050.⁴⁸ It also notes that nuclear power is likely to be between 20 and 50 per cent more costly to produce than power from a new coal-fired plant at current fossil fuel prices.⁴⁹ Therefore, the Taskforce concluded that for nuclear power and renewable energy sources to become competitive in Australia, *the costs of greenhouse gas emissions must be an explicit cost of production*.⁵⁰ Potential mechanisms to price those emissions include carbon taxes, permit trading and emissions charges.⁵¹

The Australian Prime Minister has also recently established a joint government business *Task Group on Emissions Trading* to consider a possible future carbon emissions trading system.⁵² The Task Group is charged with reviewing the possible nature and design of a workable *global emissions trading system* that is designed to *maintain Australia's competitive advantages* in terms of fossil fuel and uranium reserves.⁵³ The Task Group is scheduled to report to the Prime Minister in March 2007.

There have been significant developments in international climate policy. On 15 February 2007, politicians from approximately 20 countries, including the US, China and India, agreed that *'the evidence that man is changing the climate is now beyond doubt'* and resolved to stabilise global greenhouse gas concentrations at between 450ppm and 550ppm. The resolution calls for agreement to a post-2012 framework, by 2009, which imposes emission reduction targets on both developed and developing countries.⁵⁴ The resolution calls for negotiations on this framework to be undertaken at the G8 meeting in June 2007 and United Nations Climate Change meeting in November 2007.

Meanwhile, the European Parliament has resolved to base all of its internal policies on achieving a 30 per cent reduction in greenhouse gas emissions, below 1990 levels, by 2020 and has challenged the world to follow suit.⁵⁵ If adopted globally, these reductions should achieve atmospheric greenhouse gas concentrations of around 450ppm and limit global warming to 2 degrees Celsius. Whether the world will rise to the challenge is something that only time will tell.

45 Tracking to the Kyoto Target, n38, 19.

46 In October 2006, the *Asia Pacific Partnership on Clean Development and Climate: Policy and Implementation Committee* endorsed a set of projects and activities contained in eight sector-based Action Plans from the Cleaner Fossil Energy Task Force, Renewable Energy and Distributed Generation Task Force, Power Generation and Transmission Task Force, Steel Task Force, Aluminium Task Force, Cement Task Force, Coal Mining Task Force and Building and Appliances Task Force. Copies of these Action Plans are available at <http://www.asiapacificpartnership.org/ActionPlans.htm>.

47 Commonwealth of Australia 2006, *Uranium Mining, Processing and Nuclear Energy — Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, December 2006, 2.

48 Ibid.

49 Ibid.

50 Ibid.

51 Nuclear Energy Taskforce, n47, 61.

52 The Prime Ministerial Task Group on Emissions Trading, Issues Paper, February 2007 <http://www.dpmc.gov.au/emissionstrading/index.cfm>.

53 Issues Paper, *ibid*, 1.

54 G8 + 5 Climate Change Dialogue: GLOBE Washington Legislators' Forum Statement, 14-15 February 2007 available at http://www.globeinternational.org/docs/content/washington_statement.pdf. The UN has also called for an emergency summit of world leaders to negotiate a new, global, post-Kyoto framework which includes Australia, the US and developing countries. To ensure continuity with existing emissions reduction obligations under the Kyoto Protocol any new framework must be operational by the end of 2012.

55 The proposed EU Energy Plan includes the goal of reducing emissions by at least 20% by 2020 (less than the 30% target adopted by the EU Parliament on 14 February 2007). The EU aims to limit global temperature increases to no more than 2°C above pre-industrial levels. http://ec.europa.eu/energy/energy_policy/index_en.htm.