FASTS Federation of Australian Scientific and Technological Societies

Emissions Reduction Targets and the Great Barrier Reef

November 2009

The State of the Climate

"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 average sea level."[1]

Scientific research from multiple independent sources indicates that the emission of greenhouse gases by human activities is the primary cause of the observed global average warming of 0.7°C over the past century[1]. Australia's land and sea temperatures are currently warming at the global average rate. Furthermore, emissions over the past century have already committed us to a future increase in global average temperature of at least 1°C [1].

The most recent evidence shows that the climate is changing more rapidly than earlier thought likely[2]. This underscores the need for immediate action to both reduce greenhouse gas emissions caused by human activities that are responsible for climate change, and to adapt to the changes we cannot prevent.

"……emissions from industrialised countries in 2020 need to be reduced by at least 25% relative to their 2000 levels."

What target would prevent dangerous interference in the natural and social systems we rely on? This depends not only on scientific assessments but also on the level of risk we are prepared to take. More than 100 nations have endorsed the goal of limiting average global warming to no more than 2°C above the preindustrial temperature[3]. Such an average increase, however, will inevitably lead to significant impacts in many locations and on many sectors. For example, highly sensitive systems such as ice sheets, coral reefs, coastal settlements, alpine ecosystems, and regions of marginal agriculture would be under considerable risk even at this warming scenario.

A stabilisation level of no more than 450 parts per million in the concentration of CO_2- equivalent greenhouse gases in the atmosphere could achieve, at best, an even chance of constraining warming below the 2°C target[4]. To achieve even this 50:50 chance of avoiding 2°C of warming would require global emissions to peak no later than 2020, and then decline to 80-90 per cent below 2000 emissions by 2050. To have a realistic chance of achieving this target, emissions from industrialised countries in 2020 need to be reduced by at least 25 per cent relative to their 2000 levels[5].

1 IPCC (2007) Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis.* Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon S, Qin D, Manning M, Chen Z, Marquis M, Kaveryt KB, Tignor M, Miller HL (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

2 Steffen W (2009) *Climate Change 2009. Faster Change & More Serious Risks.* Department of Climate Change, Commonwealth of Australia, 52pp.

3 Malte Meinshausen, Nicolai Meinshausen, William Hare, Sarah C. B. Raper, Katja Frieler, Reto Knutti, David J. Frame & Myles R. Allen. Greenhouse-gas emission targets for limiting global warming to 2 °C. *Nature* 458: 1158-1162 (2009).

4 England, M.H., A. Sen Gupta and A.J. Pitman. Constraining future greenhouse gas emissions by a cumulative target. *Proceedings of the National Academy of Science* 106: 16539 –16540 (2009).

5 *The Garnaut Climate Change Review: Final Report,* Commonwealth of Australia (2008).

Without implementation of significant reduction and mitigation strategies across the globe, the world is certain to cross the 2°C line[3].

Climate Change Impacts on the Great Barrier Reef

Coral reefs are economically, environmentally, socially and culturally important. The Great Barrier Reef (GBR) contributes $5.4 billion annually to the Australian economy: $5.1 billion from the tourism industry; $153 million from recreational activity; and $139 million from commercial fishing[6]. The 'outstanding universal values' of the GBR, recognised by its inclusion on the World Heritage List in 1981, are now threatened by rapid climate change.

"To achieve a 50:50 chance of avoiding 2°C of warming would require global emissions to peak no later than 2020, and then decline to 80 - 90% below 2000 emissions by 2050."

Coral reefs are in the front line of the effects of climate change because of their sensitivity to both relatively small temperature rises and to acidification of the oceans due to increased levels of dissolved CO_2. To date, atmospheric CO_2 has risen to 390 parts per million, resulting in an increase in temperature of 0.7°C and a rise in ocean acidity of 0.1 unit of pH.

Climate change is already a current threat for the GBR. Significant climate change and subsequent damage has occurred over the past 20 to 30 years.

Unprecedented coral bleaching and extensive mortality due to thermal stress affected over 50 per cent of the GBR in 1998 and 2002, when summer maximum water temperatures were elevated by only 1-2°C[7]. Some parts of the GBR have still not fully recovered.

Ocean acidification is accelerating and, in combination with thermal stress, has already detrimentally affected the growth and skeletal strength of corals on the GBR[8]. Ocean acidification will impact all marine calcifying organisms, potentially disrupting the entire ecology of the world's oceans, resulting in severe socio-economic impacts on fisheries and other marine industries.

Coral cover is already declining on the GBR and globally[9]. Loss of coral cover reduces biodiversity, ultimately affecting ecosystem services such as fishing, tourism, coastal protection and World Heritage values.

Climate change has negatively affected even the most remote and well-managed reefs for the past 25 years. Reefs of the Coral Sea are particularly vulnerable because of their isolation and consequent lower rates of re-seeding from neighbouring reef systems.

Local action can help bolster the resilience of reefs to climate change, and promote their recovery from natural and man-made stresses. It is critically important to prevent the replacement of corals by algae, by reducing polluted runoff from land and by protecting stocks of herbivorous fishes. However, reefs cannot be "climate-proofed" by local actions alone[10].

"More than 100 nations have endorsed the goal of limiting average global warming to no more than 2°C above preindustrial temperature. Many locations including coral reefs would be under considerable risk even at this warming scenario."

The effects of atmospheric concentrations above 450 parts per million CO_2 equivalent and the consequent likely temperature increase of more than 2°C on the GBR will be devastating, particularly given the impacts

6 *Economic Contribution of the GBRMP,* 2006-07, Access Economics (2008).

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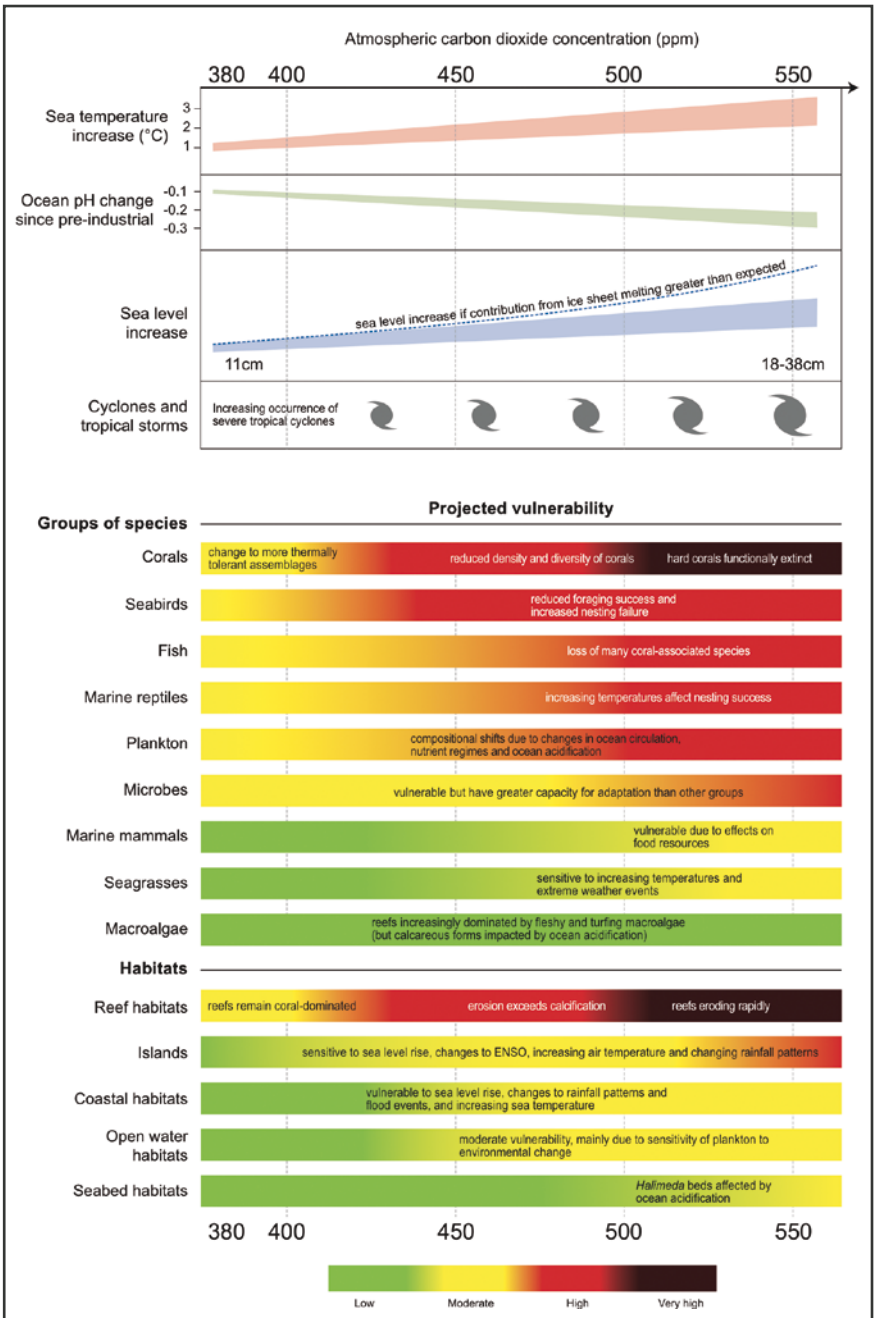
8 De'ath G, Lough JM, Fabricius KE. Declining coral calcification on the Great Barrier Reef. *Science* 323: 116-119 (2009).

9 Bellwood, D.R., T.P. Hughes, C. Folke, and M. Nyström. Confronting the coral reef crisis. *Nature* 429: 827-833 (2004).

10 Hughes TP, Baird AH, Bellwood DR, Card M, Connolly SE, Folke C, Grosberg R, Hoegh-Guldberg O, Jackson JBC, Kleypas J, Lough JM, Marshall P, Nystrom M, Palumbi SR, Pandolfi J, Rosen B, Roughgarden J. Climate change, human impacts and the resilience of coral reefs. *Science* 301: 929-933 (2003).



Projected vulnerability of GBR ecosystem components as a function of atmospheric CO_2 levels (Figure 5.7 of *Great Barrier Reef Outlook Report 2009* [12])

observed so far with only one-third this amount of warming. Bleaching events will increase in severity and frequency, further reducing coral cover. Increasing ocean acidification will continue to hamper coral regrowth. Reef-associated organisms will continue to decline as coral cover dwindles[11]. The Great Barrier Reef Outlook Report 2009 indicates that at CO_2 equivalent concentrations above 450 parts per million, most of the Reef's ecosystem components will be severely threatened[12].

This evidence base supports an emissions reduction target of at least 25 per cent by 2020 in order to stablise atmospheric CO_2 levels below 450 parts per million, and thereby allow the prospect that the GBR can be inherited by future generations of Australians. **Local leadership and concerted global action are both critical to achieving this target.**

11 Graham NAJ, Wilson SK, Jennings S, Polunin NVC, Robinson J, Bijoux JP, Daw TM. Lag effects in the impacts of mass coral bleaching on coral reef fish, fisheries, and ecosystems. *Conservation Biology* 21: 1291-1300 (2007).

12 *Great Barrier Reef Outlook Report 2009.* Great Barrier Reef Marine Park Authority, Townsville, Queensland (2009).

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