

# **Likely impacts of greenhouse gas emissions from the Dual Gas Demonstration Project**

## **Statement by Professor David J. Karoly**

School of Earth Sciences, University of Melbourne, VIC 3010

### **Summary**

Greenhouse gas emissions from burning fossil fuels have caused most of the observed increase in global-average temperature over the last fifty years and will lead to even greater climate change during the remainder of this century, with many adverse impacts on human and natural systems. The greenhouse gas emissions from the proposed Dual Gas Demonstration Project (DGDP) power station will be a significant partial contributor to the future impacts of climate change in Victoria, including sea level rise, increases in bushfires, and increases in heat waves, with associated loss of life, damage to infrastructure and loss of biodiversity. Reducing the emissions of greenhouse gases by not allowing the DGDP power station to proceed would reduce the risk of future climate change and reduce the risk of future sea level rise by a small but important amount, directly related to the avoided emissions.

### **Author's Expertise**

1. I am a Professor of Meteorology in the School of Earth Sciences at the University of Melbourne and hold a Federation Fellowship funded by the Australian Research Council. I have a Bachelor of Science (Honours) degree in applied mathematics from Monash University and a Ph.D. in meteorology from the University of Reading, England. I am a Fellow of the American Meteorological Society and a member of the Science Advisory Panel to the Australian Government's Climate Commission. I have more than thirty years of experience in studying climate variability and climate change, with expertise in identifying the causes of recent observed climate change, and its impacts. My experience includes being Co-Coordinating Lead Author of the chapter on "Detection of Climate Change and Attribution of its Causes" in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2001. In addition, I was a Lead Author on the chapter "Assessment of observed changes and responses in natural and managed systems" in the Fourth Assessment Report of the IPCC in 2007. My summary curriculum vita is attached as Appendix A.

### **Instructions and Purpose of Report**

2. I am responding to a request from the Environment Defenders Office (Vic) Ltd (EDO) to provide my expert opinion on the likely impacts of climate change and the contribution of the proposed Dual Gas Demonstration Project (DGDP) power station to human-caused climate change. This request is in response to the Application for Review by Environment Victoria Inc. to VCAT related to the EPA Works Approval for the Application by Dual Gas Pty Ltd.
3. My instructions, as per a letter from the EDO dated 12 August 2011, were:
  - i. "We are seeking your expert opinion on the likely impacts of climate change, and the contribution of this particular proposal to human-induced climate change.
  - ii. We refer to our Amended Statement of Grounds and Amended Further and Better Particulars. When considering your opinion, we would like you to have regard to ground b in the Statement of Grounds and paragraph 3 of the Further and Better Particulars.

- iii. The State Environmental Protection Policy (Air Quality Management) ('SEPP (AQM)') at tab 9 is the main legal document that governs emission of greenhouse gases by new facilities in Victoria and is the central document that will guide VCAT's decision. The grounds raised in our Statement of Grounds are based on this document."
4. I have read the Practice Note PNVCAT2 on provision of Expert Evidence to VCAT and agree to be bound by it. I declare that I have made all the inquiries that I believe are desirable and appropriate, and that no matters of significance, which I regard as relevant, have to my knowledge been withheld from the Tribunal.

## **Evidence**

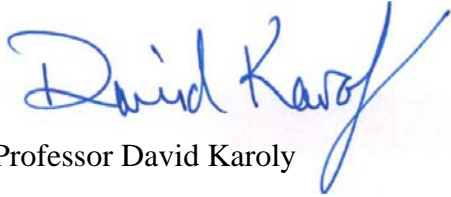
5. This statement addresses the connection between human-related emissions of greenhouse gases into the atmosphere, the associated global climate change observed over the last century and projected future climate change, and some of the impacts of human-caused climate change. A peer-reviewed book chapter on this topic written by me was published in 2009<sup>i</sup>. This statement describes the causal link between greenhouse gas emissions from the proposed DGDP power station and some likely future impacts from those emissions, particularly in Victoria.
6. In preparing my statement, I have considered:  
the Amended Statement of Grounds and the Amended Further and Better Particulars from Environment Victoria, 11 August 2011;  
the Dual Gas Demonstration Project EPA Works Approval Application, 1 Sept 2010;  
the Dual Gas Demonstration Project Triple Bottom Line Analysis, 28 March 2011;  
and the Dual Gas Greenhouse Gas Emission Summary Report, Sept 2011, prepared by Alex Blatchford<sup>ii</sup>;  
together with materials listed in the References.
7. Comprehensive assessments of climate change are prepared by the IPCC, an independent agency established in 1988 by the World Meteorological Organization and the UN Environment Program. These objective assessments consider the latest scientific, technical and socio-economic literature produced worldwide relevant to the risk of human-induced climate change, its observed and projected impacts, and options for adaptation and mitigation.
8. The Fourth Assessment Report of the IPCC was written by hundreds of scientists, reviewed by thousands of scientists and more than a hundred governments, then approved unanimously by all the governments and released in 2007. This four volume assessment is available from the IPCC web site [www.ipcc.ch](http://www.ipcc.ch). The next assessment report from the IPCC is not due to be completed until 2014. Independent assessments by the Australian Academy of Science, the US National Academy of Sciences and the US Climate Change Science Program reached the same conclusions as the IPCC.
9. The IPCC conclusions on climate change science in 2007 were<sup>iii</sup>:
  - "Warming of the climate system is unequivocal";
  - "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations";
  - "The best estimate of the increase in global average surface temperature in the 2090s

relative to the 1990s for a high emission scenario is 4.0°C (likely range is 2.4°C to 6.4°C”);

- “Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized”.
10. The IPCC conclusions in 2007 on the impacts of climate change were<sup>iv</sup>:
- “Anthropogenic warming over the last three decades has likely had a discernible influence at the global scale on observed changes in many physical and biological systems”
  - “Some systems, sectors and regions are *likely* to be especially affected by climate change”
  - “Some people (such as the poor, young children and the elderly) can be particularly at risk”
11. Specific impacts of climate change in Australia noted by the IPCC in 2007 include<sup>iii</sup>:
- “By 2020, significant loss of biodiversity is projected to occur in some ecologically rich sites, including the Great Barrier Reef and Queensland Wet Tropics.”
  - “By 2030, water security problems are projected to intensify in southern and eastern Australia”
  - “By 2030, production from agriculture and forestry is projected to decline over much of southern and eastern Australia due to increased drought and fire.”
12. Earlier this year, the Climate Commission, established as an independent body by the Australian Government, released its report *The Critical Decade*<sup>v</sup> on climate science, risks and responses for Australia. The key messages from that report are:
- “There is no doubt that the climate is changing. The evidence is overwhelming and clear.”
  - “We are already seeing the social, economic and environmental impacts of a changing climate.”
  - “It is beyond reasonable doubt that human activities – the burning of fossil fuels and deforestation – are triggering the changes we are witnessing in the global climate.”
  - “This is the critical decade. Decisions we make from now to 2020 will determine the severity of climate change our children and grandchildren experience.”
- The Prime Minister, the leader of the Opposition and the leader of the Greens in the Australian Parliament all accepted these key conclusions on climate change science when this report was released<sup>vi</sup>.
13. The Climate Commission recently released a report on specific climate change impacts in Gippsland, Victoria<sup>vii</sup>. Key conclusions are that “higher temperatures will increase the likelihood of large and intense fires” and “rising sea levels will exacerbate existing vulnerability of coastal towns and infrastructure in the Gippsland region”.
14. One of the systems likely to be most affected by climate change is low-lying coastal areas, due to the threat of sea level rise and increased risk from extreme weather events<sup>iii</sup>. A comprehensive assessment of climate change risks to Australia’s coasts was prepared by the Department of Climate Change in 2009<sup>viii</sup>. Key findings were that:
- “Between 27,600 and 44,600 residential buildings in Victoria may be at risk of inundation from a sea-level rise of 1.1 metres and storm tide associated with a 1-in-

- 100 year storm.”
- “The current replacement value of the residential buildings at risk is between \$6.5 billion and \$10.3 billion.”
15. Other climate change impacts in Victoria affecting the beneficial uses of the air environment by human and natural systems<sup>ix</sup> include:
- Increased frequency of hot extremes and heat waves, leading to health impacts and increased loss of life from heat stress. More than twice as many people died due to heat-related illness in the heat waves in January and February 2009 than died in the terrible Black Saturday bushfires in February 2009.
  - Reduced water availability and increased frequency of droughts, affecting agricultural production.
  - Reductions in snow cover duration in the Victoria alpine areas, affecting alpine ecosystems and leading to likely extinction of some alpine species this century. The reduced snow cover will also significantly reduce the financial viability of Victorian ski resorts.
16. Given the long time for the earth system to remove additional greenhouse gases from the atmosphere, all anthropogenic emissions of greenhouse gases into the atmosphere bear a partial responsibility for future climate change and the impacts of such climate change, including sea level rise. The important role of cumulative emissions of carbon dioxide and other long-lived greenhouse gases from human activity in determining the increase of global mean temperature has been highlighted in the ‘budget approach’ described in the recent *Critical Decade* report<sup>v</sup> and in the updated *Garnaut Review 2011*<sup>x</sup>. In this budget approach, the total emissions of carbon dioxide from human activity, including burning fossil fuels, industrial activity and land clearing, can be added over time and shown to cause a resulting temperature rise. For example, cumulative emissions of less than one trillion tonnes of carbon dioxide from burning fossil fuels over the period 2000 to 2050 are required to give a less than 25% probability of global average temperature exceeding two degrees Celsius above pre-industrial levels<sup>v,x</sup>.
17. The proposed Dual Gas Demonstration Project power station will be a major coal-fired power station in south-eastern Australia, providing a small but significant fraction of the electricity used in Victoria. It will have average annual emissions of 3.0 to 3.2 million tonnes of carbon dioxide equivalent<sup>ii</sup>. This would be approximately 5% of Victoria’s total annual greenhouse gas emissions associated with electricity generation in 2009<sup>xi</sup> or about 3% of Victoria’s total annual greenhouse gas emissions in 2009<sup>xi</sup>. Over the projected 30-year life of the DGDP power station, it is expected to emit 90 to 96 million tonnes of carbon dioxide equivalent.
18. As noted in the Summary Report<sup>ii</sup> describing the greenhouse gas emissions from the DGDP power station, the average greenhouse gas emissions intensity from the proposed power station for Case 4 would be 0.45 tonnes of carbon dioxide equivalent per megawatt-hour of electricity generated, a reduction of more than 40% if it used natural gas rather than brown coal as its fuel source. Hence, it cannot be considered to be best practice for a low emission power station in Victoria.
19. Given the direct link from human-caused emissions of greenhouse gases to climate change and sea level rise, the greenhouse gas emissions from the DGDP power station will be a significant partial contributor to the future impacts of climate change in

Victoria, such as sea level rise, loss of biodiversity, increases in heat waves and increases in bushfires. Reducing the emissions of greenhouse gases by not allowing the DGDG power station to proceed would reduce the risk of future climate change and reduce the risk of future sea level rise by a small but important amount, directly related to the avoided emissions.



Professor David Karoly

## References

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- <sup>i</sup> Karoly, D.J. (2009) The blame game: Assigning responsibility for the impacts of anthropogenic climate change. In *Climate Change and Social Justice*, J. Moss (Ed.), Melb. Uni. Press, 25-37.
- <sup>ii</sup> Dual Gas Greenhouse Gas Emission Summary Report, Sept 2011. Prepared by Alex Blatchford, HRL Developments Pty. Ltd.
- <sup>iii</sup> IPCC, *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., et al. (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007.
- <sup>iv</sup> IPCC Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K. and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 2007.
- <sup>v</sup> *The Critical Decade: Climate science, risks and responses*. The Climate Commission, DCCEE, Australia, 2011. Available from [http://climatecommission.gov.au/wp-content/uploads/4108-CC-Science-WEB\\_3-June.pdf](http://climatecommission.gov.au/wp-content/uploads/4108-CC-Science-WEB_3-June.pdf)
- <sup>vi</sup> ABC PM radio program, 23 May 2011  
<http://www.abc.net.au/pm/content/2011/s3224472.htm>
- <sup>vii</sup> *The Critical Decade: Impacts for Gippsland, Victoria*. The Climate Commission, DCCEE, Australia, 2011. Available from [http://climatecommission.gov.au/wp-content/uploads/Gippsland\\_impacts.pdf](http://climatecommission.gov.au/wp-content/uploads/Gippsland_impacts.pdf)
- <sup>viii</sup> *Climate change risks to Australia's coast – A first pass national assessment*. Australian Government Department of Climate Change, Canberra, 2009.
- <sup>ix</sup> *Climate Change in Victoria: 2008 Summary*. Department of Sustainability and Environment, Victoria.
- <sup>x</sup> Garnaut, R. (2011) *The Garnaut Review 2011: Australia In The Global Response To Climate Change*. Cambridge Univ. Press, 222pp.
- <sup>xi</sup> *State and territory greenhouse gas inventories 2009*. Department of Climate Change and Energy Efficiency, Canberra, Australia.

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**Appendix A: Summary CV**  
**Professor David J. Karoly, University of Melbourne**

**Qualifications:** BSc (Hons), Applied Mathematics, Monash Univ., 1976  
PhD, Meteorology, Univ. of Reading, England, 1980

**Current Appointment:** Professor and ARC Federation Fellow, School of Earth Sciences, University of Melbourne, 2007 – present.

**Relevant employment history**

Williams Chair Professor of Meteorology, University of Oklahoma, Norman, OK (2003-07)  
Professor of Meteorology and Head, School of Mathematical Sciences, Monash University, Melbourne (2001-02)  
Director, Cooperative Research Centre for Southern Hemisphere Meteorology, Monash University, Melbourne (1995-2000)

**Awards**

Clarence Leroy Meisinger Award, American Meteorological Society (1993)  
Norbert Gerbier-MUMM International Award, World Meteorological Org. (1998)  
Fellow, American Meteorological Society (1998)  
R.H. Clarke Lecture, Australian Meteorological and Oceanographic Society (2000)  
Hamer Oration in Good Government, Melbourne (2009)

**Number of refereed publications (last 5 years):** total 40 (4 books, 6 chapters, 30 journal)

**Number of refereed publications (career):** total 111 (7 books, 14 chapters, 90 journal,)

**Internationally,** Professor David Karoly is recognized as one of the two or three leading global experts on the dynamics of the large-scale atmospheric circulation in the Southern Hemisphere and its variability. He is also recognized as a world leader in the detection and attribution of climate change, particularly at regional scales. He was Co-Coordinating Lead Author for the chapter on detection of climate change and attribution of causes in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), published in 2001. For the IPCC Fourth Assessment published in 2007, he was a Lead Author for a chapter in Working Group II, a Review Editor for a chapter in Working Group I and a member of the Core Writing Team for the Synthesis Report. During 2003-06, he was a member of the US National Research Council's Climate Research Committee. Prof. Karoly was also a Lead Author in the chapter on stratospheric changes and climate in the WMO/UNEP *Scientific Assessment of Ozone Depletion: 2010*. Currently, he is a member of the World Climate Research Programme (WCRP) Joint Scientific Committee and the WCRP Working Group on Coupled Modelling.

**Nationally,** Professor David Karoly leads a research group comprised of 4 research fellows and 6 PhD students at the University of Melbourne, supported by his ARC Federation Fellowship. He is active in outreach and communication on climate variability and climate change to government, business and community groups. He is a member of the Science Advisory Panel to the Australian Climate Commission and a member of the Australian government's High Level Coordination Group on Climate Change Science. He was Chair of the Premier of Victoria's Climate Change Reference Group in 2008-09.