Assessment of selected aspects of the Alpha Coal Project with respect to climate change

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Expert Statement to the Land Court of the State of Queensland
July 2, 2013

Introduction

QUESTIONS FOR THE EXPERT WITNESS, PROF ROGER JONES, IN ALPHA COURT OBJECTION – LAND COURT QUEENSLAND

1. Describe the reduction in greenhouse gas emissions required globally to have an 80% chance of limiting increases in global temperature to 2°C or less.
2. What is the likely contribution of the Alpha Coal Project to global warming and climate change taking account of:
    a. scope 1 and 2 emissions caused by the Alpha Coal Project (mine and railway) over the life of the Project (30 years)
        i. the scope 1 and 2 emissions of the Kevin's Corner mine (if figures available); and
        ii. the scope 1 and 2 emissions of the Galilee Coal Project (if figures available).
    b. scope 3 emissions caused by the use of coal from
        i. the Alpha coal mine (30 mt per annum for 30 years)
        ii. the Kevin's Corner coal mine (30 mt per annum for 30 years)
        iii. the Galilee Coal Project (China First, 40 mt per annum for 65 years)
3. The Cancun Agreement of December 2010, to which Australia is a party, agreed to "*establish clear objectives for reducing human-generated greenhouse gas emissions over time to keep the global average temperature rise below two degrees".* How and to what extent would the emissions in Question 2 above affect the probability of limiting the increase in global temperature to 2°C or less?
4. In your opinion, what environmental and social harm would be caused by the marginal impact of the emissions in Question 2 above.
5. In your opinion, how does protecting the stable carbon stocks in the coal deposits in the Galilee Basin from mining contribute to limiting anthropogenic climate change?
6. In your opinion, is the Alpha Coal Project consistent with the principles of the National Strategy for Ecologically Sustainable Development?
7. In your opinion, how rapidly is China progressing from using coal to renewable energy and what are the implications for global warming?

- Details of my qualifications concerning these issues are set out in Appendix A
- I have read the *Expert Witness Code of Conduct* contained in Schedule 7 of the *Uniform Civil Procedure Rules 2005* and agree to be bound by its terms.

8.

Describe the reduction in greenhouse gas emissions required globally to have an 80% chance of limiting increases in global temperature to 2°C or less.

Strict carbon budgets are required to achieve climate policy goals. The large scale exploitation of fossil fuels without the subsequent management of emissions is incompatible with maintaining such budgets.

1. This issue is best addressed using a carbon budgeting process, which has lower uncertainties for policy outcomes than emission rates. This measure is more closely linked to the heat-trapping capacity of the atmosphere than emission rates, largely because of the long lifetime of greenhouse gases in the atmosphere. Table 1 shows estimates of the total carbon budget taken from the recent literature for an even chance of meeting the policy target of 2°C or less. These are expressed in gigatonnes, or billion tonnes of carbon. The resulting range is ~300–880 Gt C for a 50% chance, but these studies have different internal assumptions that affect the results. For a higher chance of meeting the policy target, the range is 180–590. The Climate Commission's latest estimate of 600 billion tonnes CO_2 (164 Gt C) as a post 2012 ceiling, quoted by Professor Karoly, is based on Meinshausen et al. (2009). The modelling done in this study, using a similar model structure to that of Meinshausen et al. (2009), supports a similar budget.

Table 1. Cumulative carbon emissions to avoid meeting or exceeding a 2°C warming target, measured above a pre-industrial baseline.

Study	*Carbon budget consistent with<2°C warming (Gt C)*	*Conditions*	*Post-2011 CO_2 emissions consistent with <2°C warming (Gt C)*
1. Allen et al. 2009[1]	1000	Even chance 50%, peak warming	480
2. Zickfield et al. 2009[2]	980	Likely (90%–67%), calculated post 2000	460
3. Matthews et al. 2009 (i)[3]	1250	Model-based estimate, 50%	730
4. Matthews et al. 2009 (ii)[3]	1400	Obs.-based estimate, 50%	880
5. Friedlingstein et al. 2011[4]	1300	No probs given	780
6. Rogelj et al. (2013)[5]	1110	Likely (90%–67%)	590
7. Huntingford et al. (2013)[6]	970	Even chance 50%	455
8. Meinshausen et al. 2009[7]	820+	Even chance 50%	302
9. Meinshausen et al. 2009[7]	700+	Likely (90%–67%)	182

Notes: [1]Cumulative carbon emissions for most likely peak warming of 2°C, with 5-95% confidence interval of 1.3°-3.9°C. [2]Cumulative carbon emissions after 2000 of 550 GtC (range 300-770 GtC), for probability of exceeding 2°C in the unlikely range (probability of 0.1-0.33). [3]Model-based estimate (i) is for allowable carbon emissions of 1250 GtC (5-95% range 950-2000 GtC) for 2°C warming; (ii) observationally based estimate of 1400 GtC (range 1000-1900 GtC). [4]Cumulative carbon emissions to 2100 consistent with 2°C warming, no probability range given. [5]Cumulative emissions of 2500 $GtCO_2e$ (680 GtCe) over the 21st century, for all Kyoto gases, for probability of exceeding 2°C in the unlikely range (probability of 0.1-0.33). [6]Cumulative emissions of Kyoto gases over 2000-2500 of 2630 $GtCO_2e$ (717 GtCe) for a 50% probability of holding warming to <2°C, which is estimated to be equivalent to about 2000 $GtCO_2$ (545 GtC) for CO_2 only. [7]Limiting CO_2 emissions to 1440 $GtCO_2$ (392GtC) over 2000-50 gives a 50% probability of warming not exceeding 2°C. Limiting CO_2 emissions to 1000 $GtCO_2$ (273 GtC) over 2000-50 gives a 50% probability of warming not exceeding 2°C.
These estimates are converted to a common base using estimated carbon emissions to 2000 of 430 GtC and over 2001-11 of 90 GtC.

2. Current carbon emissions from fossil fuel combustion and land-use land cover change are approaching 10 billion tonnes of C per year, roughly 14 billion tonnes in C-equivalent (accounting for all greenhouses gases in equivalent carbon units). To

stay within a fixed budget in an environment of rising emissions requires rapid transition to peak-and-decline emission pathways. Research shows that the floor – the level where emissions reduce to in future – is a very important aspect of whether temperature targets can be met with any confidence. For example, Huntingford et al. (2012) show that 2°C cannot be reached at 80% confidence if the floor is 6 billion tonnes of C emitted per year, but it is possible if the floor is zero. This requires substantial reductions from the current rates of emissions.

3. Given the lack of feasible mechanisms to remove large volumes of CO_2 from the atmosphere, avoiding warming above the 2°C limit will require leaving the bulk of extractable fossil fuels in the ground. Most of the reductions needed to ensure that the atmospheric carbon budget is met would need to occur within the lifetime of the proposed mine.

What is the likely contribution of the Alpha Coal Project and related projects to global warming and climate change?

Estimated ranges of extra warming for three emission profiles are 0.0001–0.0002 °C for the Alpha Domestic, 0.003–0.007°C for Alpha Total and 0.013–0.032°C for the Three Mine profiles. The total emissions for the alpha mine including combustion would negate Australian climate policy to 2020 maintained through to 2100 and the total emissions from all three mines planned would negate Australia's policy of an 80% reduction from 2000 by 2050.

4. This section addresses the marginal impacts of estimated greenhouse gas emissions (GHGs) from the Alpha Mine Project. Emissions were added to two climate scenarios. The resulting emissions were input into in a simple climate model to calculate the change in mean global warming to 2100. The results are then surveyed for their potential economic and environmental impacts. While GHG emissions are known to have significant externalities, or hidden costs, these are rarely quantified at the project level. Such costs are seldom addressed within the framework of ecologically sustainable development (ESD).

5. Emissions were taken from Dr Chris Taylor's expert witness report and sourced from within the Supplementary EIS for the project. This separates the emissions data into three profiles: 1) emissions subject to Australia's national reporting requirements from the mine and rail projects (Alpha Domestic), 2) emissions resulting from the whole of the Alpha Project mine and rail projects, including international transport and combustion of coal (Alpha Total) and 3) international emissions that would fall under the various countries that import and consume the coal, including bunker fuels used in shipping transport of the Alpha Project, Kevin's Corner Mine and Galilee Projects (Three Mine, Table 2). Scope 1–3 construction and operation emissions of the Kevin's Corner Mine and Galilee Coal Project were not incorporated. Coal combustion rates of these mines were assumed to remain the same as for the Alpha Project.

Table 2. Breakdown of project emissions into domestic emissions linked to the project (Scope 1-3), total emissions from the Alpha Project and domestic emissions from the Alpha project and international emissions from the Alpha, Kevin's Corner and Galilee Coal Project. Slight variations on the project schedule will not materially affect the modelling results through the use of 5-year totals. The amounts are tonnes C-e (Carbon equivalent).

	Australian emissions Alpha Project (Scope 1, 2 & 3)	Total Emissions Alpha Project	Alpha Project plus international transport and combustion
Years 1-2	1,597,503	7,750,809	18,008,370
Years 3-7	2,112,181	50,641,630	131,540,222
Years 8-12	1,526,092	79,742,092	210,128,165
Years 13-17	1,504,490	92,670,734	244,644,864
Years 18-22	1,674,073	101,494,871	267,896,142
Years 23-27	1,934,140	107,026,557	282,215,617
Years 28-30	1,573,778	86,354,284	227,683,387
Years 31-35			57,112,845
Years 36-40			57,112,845
Years 41-45			57,112,845
Years 46-50			57,112,845
Years 51-55			57,112,845
Years 56-60			57,112,845
Total	11,922,256	525,743,549	1,724,793,835

6. The temperature impacts of these emissions were calculated using the MAGICC V5.3 model (Wigley 2008; see also http://www.cgd.ucar.edu). MAGICC consists of a suite of simple coupled gas-cycle, climate and ice-melt models and has been used extensively to compare the global climate implications of different emissions scenarios and explore a range of key scientific uncertainties including Intergovernmental Panel on Climate Change (IPCC) assessments (IPCC, 2007a). The model estimates greenhouse gas concentrations, radiative forcing changes, mean global warming and sea level rise.

7. Two emission scenarios were selected to explore the changes to the global climate system of emissions from the project.
    a. An emissions scenario, MEP2030, that factors the Copenhagen Accord emission reduction pledges into current growth but contains no further policy interventions until 2030, when a minimum emissions path is followed through to 2100 (Jones and Sheehan, 2010). This scenario can be considered

consistent with Australia's current policy position for 2020 targets, but not the current government's reduction target of 80% on 2000 emissions by 2050.

b. A low emissions scenario, MEP2010, where undertakings additional to Copenhagen Accord pledges are implemented to 2020, followed by strong climate policy thereafter. This forms an overshoot scenario that has roughly a 50:50 chance of avoiding mean global warming of 2°C above pre-industrial limits as agreed to in the CoP16 text at the recent Cancun meeting of the UNFCCC. Australia's current policy of 80% reduction in 250 would need to be tightened if Annex 1 countries (developed countries) were expected to reduce further in line with stricter targets.

8. Total Kyoto-basket emissions for both scenarios are shown in Figure 1 as carbon-equivalent emissions (Gt C, the conversion factor to CO_2 is 3.667). Kyoto emissions are listed under the Kyoto Protocol and cover CO_2, CH_4, nitrous oxides and the Montreal protocol gases. The two scenarios are overshoot scenarios that peak and overturn during the 21st century.

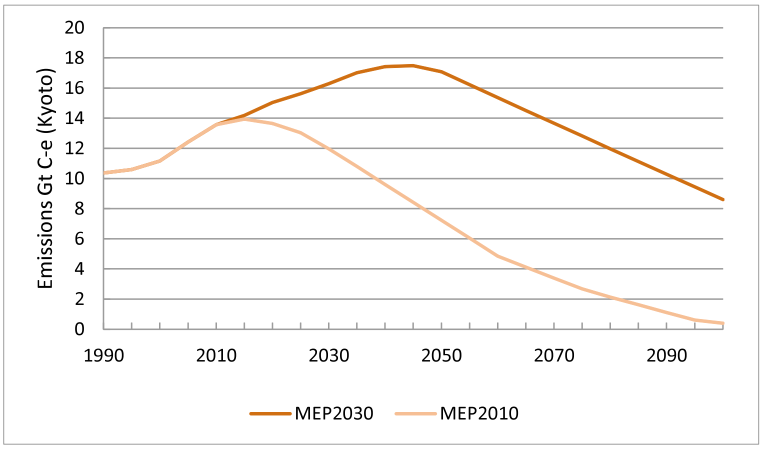

Figure 1. Kyoto basket emissions in Gigatonnes carbon equivalent (Gt C) for the Garnaut reference, MEP2030 and MEP2010 emission scenarios.

9. The MEP2030 scenario emission peak in around 2045 and the MEP2010 emissions peak in 2015. The latter is based on a range of very optimistic policy initiatives including maximum uptake of Copenhagen pledges; such as achieving 30% reductions in EU countries by 2020, meeting President Obama's US energy targets, China's achievement of projected reductions in energy intensity, and immediate and effective uptake of the Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) scheme allowing countries such as Indonesia and Brazil to achieve deforestation targets. Australia is written into this scenario with a 2020 target of 25% reduction from 2000 emissions and approximately 95% reductions in 2050.

10. Figure 2 shows mean global warming from a pre-industrial baseline for MEP2030 and MEP2010. Also shown are the ranges of uncertainty due to different estimates of climate sensitivity. Climate sensitivity is the mean atmospheric global warming at

equilibrium at 2xCO_2, or 560 ppm CO_2. Each emission scenario was run for three different climate sensitivities, 1.5°C, 3.0°C and 6.0°C, which measure the rough 5% limits and median of a range of sensitivity estimates in the literature (Meehl et al., 2007). While the median is generally accepted the extremes are not well constrained, especially at the upper end.

11. MEP2030 is still warming in 2100, showing a median temperature 3.0°C. The MEP2010 scenario peaks at 1.9°C between 2053–2063, providing a slightly better than 50:50 chance of avoiding 2°C all other things being equal (Considerable unquantified carbon cycle uncertainties remain). Figures 2 and 3 demonstrate the delay between emissions and warming: for the low scenario, emissions peak in 2015, concentrations in around 2045 and warming around 2055–2060. The higher the rate and quantity of emissions, the longer the delay between the peaks in emissions and temperature. Higher climate sensitivity also increases this delay.

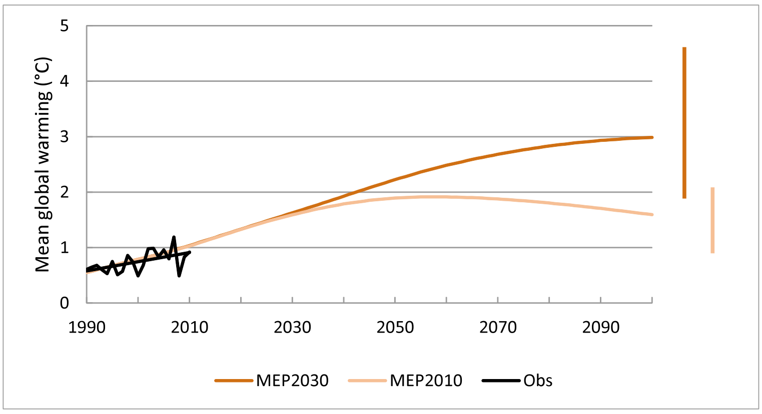

Figure 2. Mean global warming from pre-industrial temperature for the MEP2030 and MEP2010 emission scenarios showing the estimate with median climate sensitivity and range of uncertainty for 2100. Observations are from the GISS data set.

12. Marginal increases in temperature measured at 3°C climate sensitivity peak between 2050 and 2065, declining minimally to 2100 (These are shown for the MEP2010 scenario in Figure 3). The increases are slightly higher for the lower emission scenario and range of 0.0001–0.0002 °C for the Alpha Domestic, 0.003–0.007°C for Alpha Total and 0.013–0.032°C for the Three Mine profiles. The reason for this is due to the saturation effect at higher levels of greenhouse gases in the atmosphere, so the temperature sensitivity to marginal changes in emissions is slightly higher at lower concentrations. At higher atmospheric concentrations of GHGs, the marginal effect of each tonne is less, but the damage it causes is usually greater, because the amount of climate change is larger.

13. The Alpha Total temperature increase is slightly larger than the calculated benefits of Australia's currently planned policy to 2020 maintained until 2100 (0.0038°C) and the Three mines temperature increase is comparable with the benefits of Australia's entire climate policy to 2050, maintained to 2100 (0.02°C)

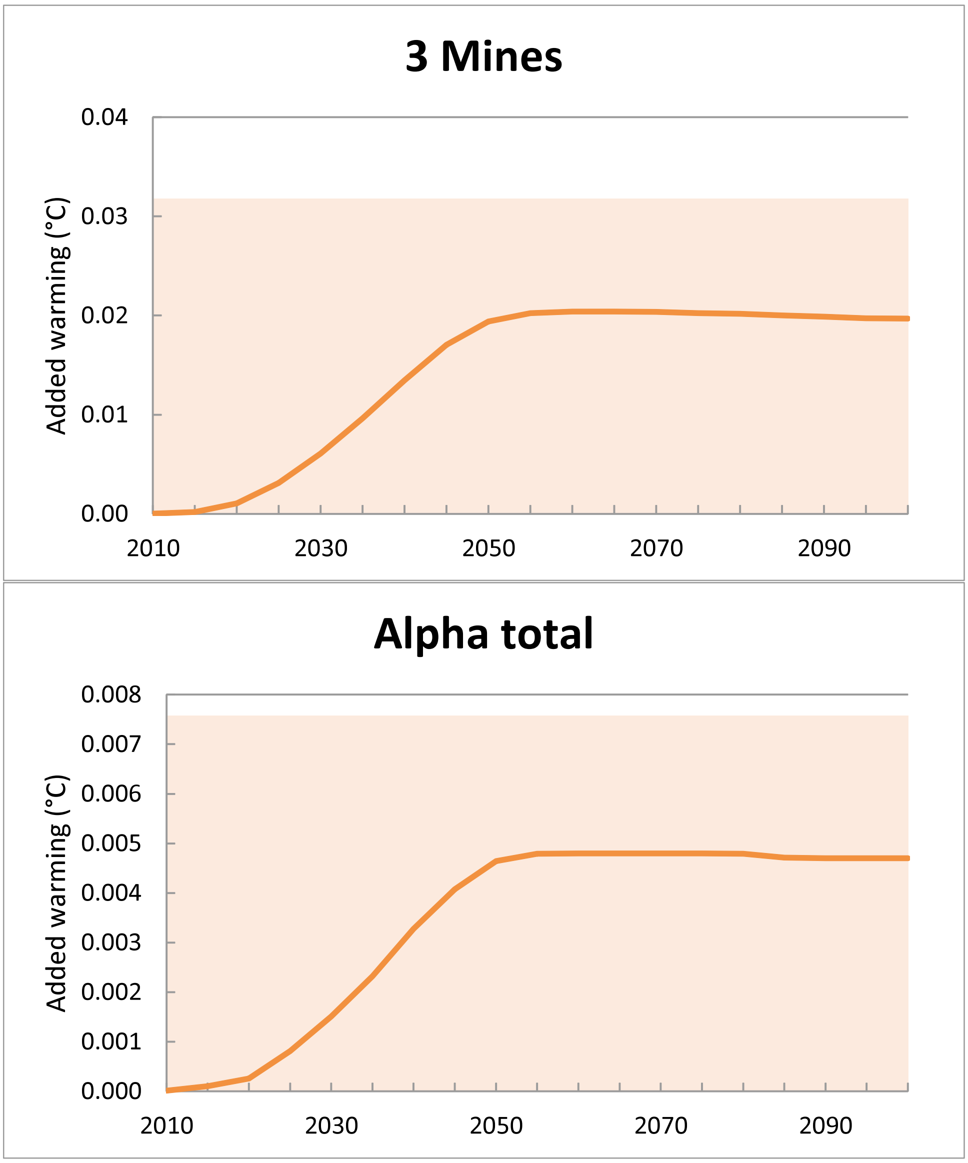

Figure 3. Increase in temperature due for the Alpha total emissions and three mines emissions under the MEP2010 scenario. The central bold lines are at 3°C climate sensitivity, the limits describe climate sensitivity of 1.5°C at the lower limit and 6°C at the upper limit.

How and to what extent would the emissions described above affect the probability of limiting the increase in global temperature to 2°C or less?

The three emissions profiles from the project, namely Alpha Domestic, Alpha Total and Three Mines, total 0.012, 0.526 and 1.725 billion tonnes of C emitted, respectively. These represent up to 0.007%, 0.29% and 0.96% of the total remaining budget respectively.

14. In terms of their contribution to emission rates over time, because meeting the policy target of 2°C requires reductions in annual global emissions, in the MEP2010, scenario, the three mines would peak at around 5% of total global emissions in 2040 and the Alpha mine total emissions at almost 2% of total global emissions. This shows that although current emissions look quite small compared to the current and

unsustainable levels of emissions, in future cases where transformation of the energy system is occurring, they can become quite large.

15. The contribution of the Alpha total emissions is about 0.3% of remaining emissions and total temperature and of the Three mines is close to 1%. If Australia followed the same path as the world in achieving policy consistent with avoiding 2°C, then the Alpha domestic emissions would be around 1% of national emissions in 2040.

In your opinion, what environmental and social harm would be caused by the marginal impact of the emissions detailed above?

The emissions would cause a net social cost felt in Australia and the rest of the world that has not been factored into the business case for the project. Irreversible environmental costs are also factor. Two critical thresholds for ecological impacts: the thermal bleaching of coral and risk of species extinction are also analysed for their marginal impacts. The area of the Great Barrier Reef in square kilometres ranges from marginal to over 150 km^2 for the total emissions of the Alpha project depending on the scenario and the underling state of the reef. The global impact is measured by a 14-fold increase on those numbers. For species risk, Australian vertebrates would face a marginal change in risk ranging from <1 to 15 species across the various scenarios as a result of the project. Assuming a similar risk profile for Australian insects and plants, these results would scale up by factors of 12 and 3, respectively. For global vertebrates, insects and plants, these results would factor up by scales of 8, 167 and 37. Risks are greater for multiple mines.

16. There are three ways to measure the marginal impacts of a specific action affecting emissions, whether it is due to policy measures, development projects or events that lead to measurable changes in emissions. They are:
    a. **Aggregated economic impacts**: Impacts aggregated at the global scale and measured economically. These impacts can range from market impacts to total economic value (Nordhaus and Boyer, 2000). For the latter, supporting, option and existence values are also assessed, leading to higher totals than direct economic impacts (Watkiss, 2011). Catastrophe and risk, sometimes risk as insurance, have also been factored into some analyses (Stern and Treasury, 2007; Garnaut, 2008).
    b. **Social cost of carbon**: Marginal impacts measured as the social cost of carbon defined as the net present value of the incremental damage due to a small increase in carbon dioxide emissions (Watkiss et al., 2005; Tol, 2009).
    c. **Key vulnerabilities and tipping points**: Changes in the likelihood of exceeding critical thresholds, where the measure of criticality may be biophysical, social or economic. Critical thresholds include loss of large ecosystems, loss of ice sheets such as the Greenland and West Antarctic Ice Sheets, climate-driven loss of security in a significant region (e.g., a multi-national river basin subject to flood and or drought) or harm to a key economic region such as a coastal megacity (Lenton et al., 2008).

17. Tol (2009) identifies two methods of aggregating impact costs: those based on the economic consequences of physical impacts aggregated across sectors and regions,

and statistical approaches where the current distribution of impacts related to climates are projected into the future. He identifies fourteen such studies. The sample mean of those studies is positive at lower temperatures, only becoming negative at 2.2°C warming measured from 1990.

18. The finding of positive economic impacts at this level of climate change is controversial (e.g., Hallegatte, 2007; Sterner and Persson, 2008; Ackerman et al., 2009). For example, warming of 2.2°C (2.75°C above pre-industrial) warming has been identified by the (IPCC, 2007b) as placing up to 30% of species at risk of extinction, and disrupting 15% of ecosystems and large-scale destruction of coral reefs, upon which 30 million people depend entirely and another 500 million have some level of dependence (Wilkinson, 2008). Recent findings updating the sensitivity of ice sheets to melting also indicate significant vulnerability as this level (The Copenhagen Diagnosis, 2009). Garnaut's (2008) assessment of the 550 ppm CO_2 scenario that reached 2°C by 2100 also found a negative economic impact, both globally and for Australia.

19. Warren et al. (2006) and Watkiss (2011) outline some of the reasons for the disparities between scientific and economic evidence: the science has advanced significantly and many of these findings have not carried over into economic assessment. This includes prospective benefits and costs of climate change. Adaptation is difficult to factor into damage costs on a broad scale. Many damages are associated with extreme events that are highly localised in time and space and difficult to factor into simplified economic functions. Aggregated costs with very different vulnerabilities and exposures between regions are difficult to account for. The view of the research community, though by no means unanimous, is that damages are under-estimated, and are likely to outweigh the positive influences that are also unaccounted for.

20. Nine global cost (benefit) studies in the literature have contributed to 223 estimates of the social costs of carbon (Tol, 2009). These estimates vary widely because of the range of underlying emission scenarios driving the damages, rates of economic growth, assumptions as to welfare distribution and pure and applied rates of time preference. The median estimates from the entire population ranged from \$15–\$74 in US\$ 1995 per tonne C depending on how the distribution was assessed and the mean ranged from \$88–\$127 per tonne C (Watkiss, 2011). Converted into US\$ 2010 dollars and tonnes CO_2, those ranges are US\$6–US\$27 and US\$33–US\$47 per tonne of CO_2, respectively. However, these costs are calculated from 1990 to 2000 baselines, so will not reflect the social cost of carbon emitted today, where damages are somewhat greater.

21. Significant biophysical impacts were assessed using methods outlined by Jones and Yohe (2008) and Sheehan et al. (2008). Here, two functions based on the exceedance of critical thresholds for thermal bleaching on the Great Barrier Reef (GBR) and extinction risk to individual species (Sheehan et al., 2008) were investigated. Temperature from baseline scenarios was multiplied with an impact function and

subtracted from those with mining emissions profiles to measure the marginal difference over time.

22. Critical coral bleaching occurs when bleaching too frequent to allow full recovery. The marginal impacts on critical coral bleaching on the GBR are highest at low temperatures because of the sensitivity of the reef to small increases in warming, whereas at higher temperatures, the marginal impacts are less because most of the reef is heavily damaged (Wooldridge et al., 2005). In the warmest scenarios, the marginal impact falls to zero because the GBR is judged to be totally damaged. Corals 'live on the edge' because there is a biological price to pay to maintain tolerance to thermal bleaching. Historical rises in temperature have brought them close to bleaching thresholds and only small rises are needed to take them beyond that limit.

23. Figure 4 shows the results for the Alpha total emissions profile using the MEP2010 and MEP2030 emission scenarios. Coral reef habitats cover approximately 20,000 km^2 of the Great Barrier Reef Marine Park and World Heritage Area of 348,000 km^2 (Fabricus et al., 2007). Globally, reefs cover 284,300 km^2 (Spalding et al., 2001). The results show the area of the GBR in square kilometres critically bleached as a result of the total emissions from the Alpha Project, ranging under 10 km^2 at high climate sensitivity (and high temperatures) to up to 170 km^2 at low levels of warming. Ranges for the three profiles in 2050 and 2100 are shown in Table 3.

24. The lower chart shows how increasing warming actually leads to less marginal damage over time because most of the reef is already modelled as being critically damaged and will no longer support coral ecosystems.

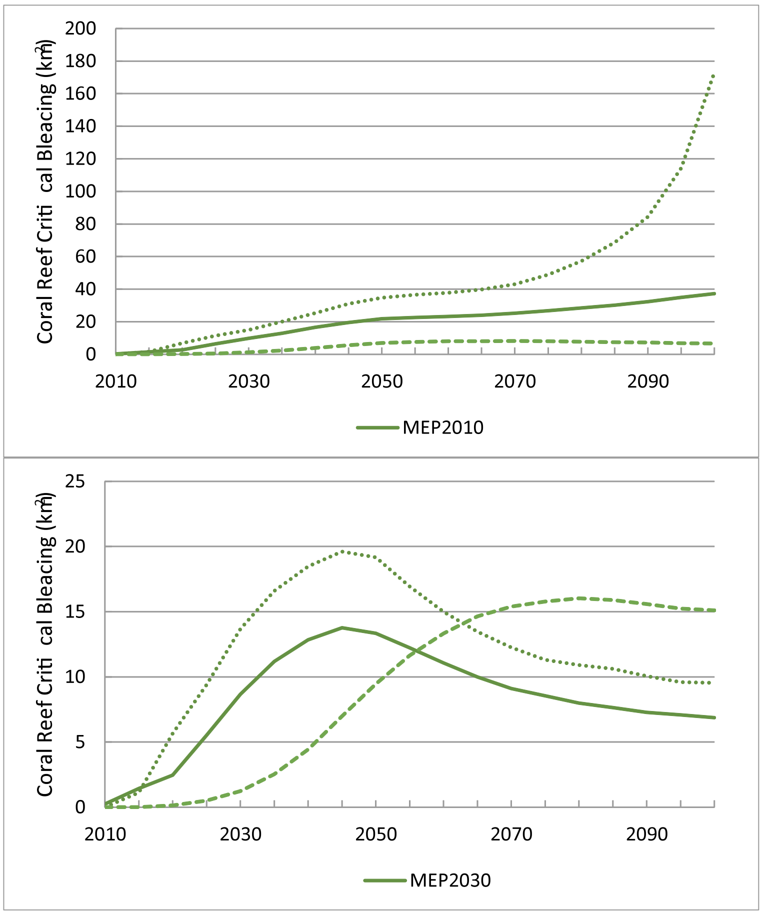

Figure 4. Extra area of Great Barrier Reef above critical bleaching thresholds 2010–2100 (km2) for Alpha total emissions under the MEP2010 and MEP2030 scenarios at low, medium and high climate sensitivity. The dotted line is low climate sensitivity, bold line median climate sensitivity and the dashed line is high climate sensitivity. Global estimates are a factor of 14 higher.

Table 3. Results for increased critical coral bleaching (km2) and species at risk in 2050 and 2100 for three emissions profiles applied to two emission scenarios (MEP2030, MEP2010).

		Alpha domestic			Alpha total			3 Mines		
	Year	**Low**	**Median**	**High**	**Low**	**Median**	**High**	**Low**	**Median**	**High**
Coral (km^2)										
MEP2010	2050	0.1	0.5	0.2	34.7	21.8	7.0	142.9	90.6	29.3
	2100	6.9	0.6	0.2	173.2	37.2	6.7	661.6	154.0	28.4
MEP2030	2050	0.6	0.3	0.2	19.2	13.3	9.5	50.2	35.4	25.5
	2100	0.0	0.2	0.4	9.5	6.9	15.1	32.3	22.8	48.2
Species										
MEP2010	2050	0.0	0.1	0.2	0.8	2.4	7.0	3.4	10.1	29.3
	2100	0.0	0.0	0.2	0.5	1.6	6.7	2.0	6.6	28.4
MEP2030	2050	0.0	0.1	0.2	1.0	3.3	9.5	2.7	8.8	25.5
	2100	0.0	0.2	0.4	1.1	6.2	15.1	3.8	20.6	48.2

25. Critical thresholds calibrated for the GBR are probably valid world-wide as shown in the spatial similarity of recent bleaching events and the biological understanding of the bleaching process (Ove Hoegh-Guldberg, pers. comm.), so a factor of 14 will communicate likely global impacts. Averaged across all scenarios, global impacts as a

result of the Project would exceed 100 km^2 of coral reef during 2020–2030. Coral reefs are valued at \$100,000 to \$600,000 per km^2 globally for their ecosystem services (UNEP-WCMC, 2006).

26. Critical thresholds for species at risk of extinction work in a similar way. The critical threshold for a particular species is when its climatic envelope – the climate in which it is distributed – either moves away from its current distribution or moves to a totally unsuitable location; i.e., offshore or for montane species disappears off the top of the mountain. A species is at risk when the envelope moves sufficiently that it cannot respond by migrating, acclimatising, changing its behaviour or when it is outcompeted by more successful species who move into its range.

27. The curve used here is based on Australian studies but is similar to global studies, such as those surveyed by Thomas et al. (2004). For Australian vertebrates, 8,128 described species (Chapman, 2009), the marginal changes range up to 8 species at risk as a result of Alpha total emissions. For Alpha domestic emissions, the impact is small at up to 0.05 species and for the three mines, the range is between about 2 and 28 species. For the MEP2030 scenario, these are almost double.

28. Assuming a similar risk profile for Australian insects and plants, these results would scale up by factors of 12 and 3. For global vertebrates, insects and plants, these results would factor up by scales of 8, 167 and 37. Note: this is for named or accepted species only; estimated numbers of species would be larger.

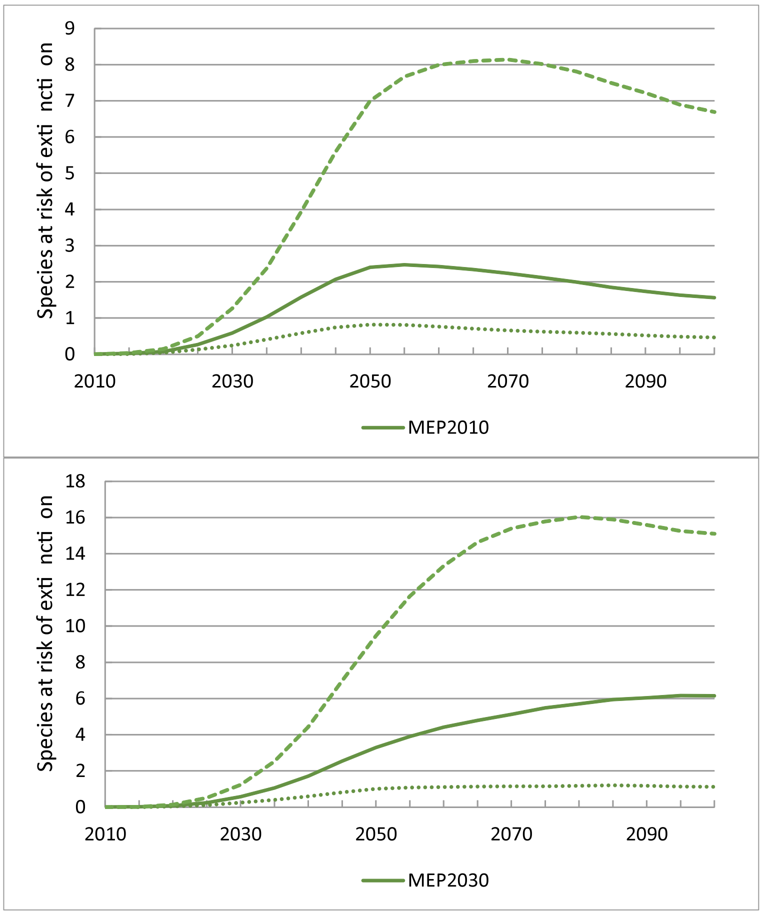

Figure 5. Number of species at risk of extinction 2010–2100 total emissions under the MEP2010 and MEP2030 scenarios at low, medium and high climate sensitivity. The dotted line is low climate sensitivity, bold line median climate sensitivity and the dashed line is high climate sensitivity.

In your opinion, how does protecting the stable carbon stocks in the coal deposits in the Galilee Basin from mining contribute to limiting anthropogenic climate change?

Coal deposits that are readily available and for which there currently are markets, if all exploited, will lead to unsustainable levels of warming.

29. If fully priced for life cycle costs and benefits over the life of the project and beyond, the projects currently being proposed for the Galilee Basin would become much less economic, especially over the longer term. Given that climate change has been identified as market failure, these failures will continue if future damages remain unallocated, either within the market itself, or via policy, if market failure is likely to continue. Protecting stable carbon stocks via policy rather than the market, if their full life cycle cannot be adequately addressed, is both economically and environmental sustainable.

In your opinion, is the Alpha Coal Project consistent with the principles of the National Strategy for Ecologically Sustainable Development?

The Alpha Coal Project is not consistent with the principles of the National Strategy for Ecologically Sustainable Development, but that can be said for the whole of the fossil fuel mining industry. Policy has yet to confront this issue in the way that it has some others (e.g., salinity and catchment management).

30. The *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992) provides a useful working definition for policy development in Australia: *'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'*.

31. ESD is a difficult and complex concept that can be defined within a specific discipline but has had less success in bridging disciplines and being put into practice. One major reason why the take-up of ESD has been limited is because of lack of agreement on what sustainability means (Harding, 2006). According to Harding (2006) Ecological Sustainable Development is a particularly Australian term, dating back to the ESD process in the early 2000s, where the term ecology was used as a counter-balance to the existing dialogue on economically sustainable development. In 2011, the latter seems to dominate public discourse in Australia.

32. The four main principles of ESD in Australian policy are (Harding, 2006):
    - intergenerational equity
    - the precautionary principle
    - conservation of biological diversity and ecological integrity, and
    - internalisation of environmental costs taking into account improved valuation and incentive mechanisms.

33. Anthropogenic climate change is central to the issue of ESD. The development of the UN Framework Convention on Climate Change was a key outcome of the UN Conference on Environment and Development in Rio de Janeiro in 1992. ESD principles are firmly embedded in Article 2 of the Convention: *The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.*

34. Even though plans are underway to limit Scope 1 and 2 emissions from the project, and reductions in emissions from Scope 2 electricity production are evident, these savings are much smaller than the total emissions that would be released by combustion of the product.

35. The coal is of good quality and relatively low in methane content. However, there is no evidence presented that this project will replace other, more polluting sources, leading to an overall more sustainable outcome. Equally, evidence could be put that cleaner sources of energy may become relevant if the externalities are taken more fully into account.

36. This statement has assessed the likely externalities of the added greenhouse emissions occurring as a result of the Project proceeding as proposed, concluding that it will have a measurable effect on the global environment and on future society which will be subject to the resulting losses. Even though the uncertainties are large, my opinion is that most of the uncertainty is under-estimating the negative impacts of climate change. Not taking account of these externalities is inconsistent with a range of applications of ESD in environmental and development policy.

37. The MEP2010 scenario, which is consistent with a slightly better than the 50:50 chance of meeting the policy target of 2°C shows that the Alpha total and Three mines total emissions could be almost 2% and 5% of total global emissions by about 2040. The likelihood that such projects would remain viable given this strategy, even if carbon capture and storage was commercially available and widespread, seems low. On the other hand, they seem quite suited to futures that are clearly unsustainable.

38. A project that addressed the principles of ESD more comprehensively would internalise environmental costs taking into account improved valuation and incentive mechanisms. This would require a great deal of support from both national and international policy frameworks to ensure that this task could be achieved as cheaply as possible. This statement does not take any strong position on which energy sources would be the winners and losers in such a scenario, but supports a more stringent approach to the considerable externalities that currently exist.

In your opinion, how rapidly is China progressing from using coal to renewable energy and what are the implications for global warming?

China is currently driving the global market in renewables, and is also beginning to stabilise its coal consumption, both of which will have significant and deep implications for Australia.

39. The renewable sector is the fastest growing energy sector in China, and according to Dr Jiang Kejun, Director of the Energy Research Institute in China, targets for both wind and solar are periodically being re-set as they are being met well before allocated time. Coal use in China is stabilising and recent increases were due to a slight pause in the growth of renewables during the GFC. However, the tight linkage between economic growth and coal, the most significant link in the recent growth of China's economy has been broken (Sheehan, 2008). Analysts often misjudge Chinese policy because they equate it with China in the west, but both economic and environmental targets set at the provincial level are hard targets and are very rarely left unmet.

40. Although the conventional coal economy still dwarfs the renewables sector, the greatest amount of innovation affecting both product and price is happening in renewables. The Centre for Strategic Economic Studies has been working on emissions profiles for China and these have been built into both our MEP2030 and MEP2010 scenarios. We consider that current trends in China mean that emissions profiles consistent with those in MEP2010 are feasible. Greater doubts can be attached to other countries' roles in achieving such targets, including the USA and Australia.

Confirmation

I Roger Jones can confirm the following statements:

- Factual matters stated in the report are, as far as I know, true;
- I have made all enquiries considered appropriate;
- I genuinely hold all opinions stated in the report;
- The report contains reference to all matters I consider significant; and
- I understand my duty to the court and have complied with that duty.

Professor Roger Jones
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Appendix A: Qualifications for Roger Jones relevant to this statement

A.1. I am currently Professorial Research Fellow at the Centre for Strategic Economic Studies, Victoria University, Melbourne. This is an interdisciplinary role where I work in the intersection between science, economic and policy concentrating on all aspects of climate-related risk.

A.2. I am currently Co-ordinating Lead Author for the IPCC Working Group II Chapter *Foundations of Decision-making* for the forthcoming Fifth Assessment Report. In the IPCC Fourth Assessment Report I was CLA for the chapter *New Methods and Characterisation of the Future* and in the Third Assessment Report was Lead Author on the chapter *Developing and Applying Scenarios*.

A.3. Acted as chief scientific advisor to the Garnaut Review (2007–08) on behalf of CSIRO, providing information on science, uncertainty and risk management to the author team, preparing climate scenarios for impact assessment and reviewing the emission scenarios developed by Federal Treasury in their modelling. The physical impact measures utilised in this statement were also used by the Garnaut team to illustrate the benefits of avoiding biophysical losses through emissions management.

A.4. Have managed and conducted the following assessments integrating science and economics: *Sectoral costing analysis of identified impacts of climate change* for the Australian Greenhouse Office (unpublished report, 2003–04), *Regional and Sectoral Vulnerability to Climate Change in Victoria* (2008), *Climate change impacts, risk and the benefits of mitigation* for the CSIRO Energy Futures Forum (2005–06). Have been invited to present at two OECD workshops: *The Benefits of Climate Change I* and *II* in 2003 and 2006 both of which produced refereed papers.

A.5. Pioneered the technique of integrating bottom-up assessments of impacts at the local scale into top-down assessments of climate change, allowing the marginal benefits of climate change policy on local impacts to be assessed. This adds a biophysical dimension to economic analysis in areas that can be measured but are extremely difficult to cost.

A.6. The following publications are relevant to the Statement:

Jones, R.N. and Sheehan, P. (2010) Containing global warming after Copenhagen: one-shot and learning-by doing approaches, Centre for Strategic Economic Studies, Victoria University, Melbourne.

Jones, R. and Webb, L. (2009) Regional and sectoral vulnerability to climate change in Victoria. Report prepared for Victorian Department of Treasury and Finance, Melbourne, Victoria, 113 pp.

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