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11 October 2019

Prof Mary O'Kane AC
Chair of Rix's Creek South Project (SSD 6300) Panel
Independent Planning Commission (**IPC**)
Level 3, 201 Elizabeth Street
Sydney, NSW 2100

By email: ipcn@ipcn.nsw.gov.au

Dear Prof O'Kane

Rix's Creek South Continuation of Mining Project (SSD 6300) – Submission in relation to additional information from the Department of Planning, Industry and Environment

1. We act for the Hunter Environment Lobby (**HEL**) in relation to the proposed Rix's Creek South Continuation of Mining Project (SSD 6300) (the **Project**).

2. We refer to the statement of the IPC of 4 October 2019, providing that it will accept written comments in relation to the additional information from the Department of Planning, Industry & Environment dated 24 September 2019 (the **Additional Information**) until midday 11 October 2019.

3. In response to the Additional Information, HEL:

   (a) Submits that consent should be refused because of the Project's poor environmental performance and outcomes in both absolute and relative terms, as set out in *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7 (**Rocky Hill Decision**). Further, as highlighted by Preston CJ in the Rocky Hill Decision, now is the "*wrong time*" to approve a project that will result in the creation of significant quantities of greenhouse gas emissions (**GHG emissions**) which, "*will increase global total concentrations of GHGs at a time when what is now urgently needed, in order to meet generally agreed climate targets, is a rapid and deep decrease in GHG emissions. These dire consequences should be avoided.*"[1]

   (b) Submits that, in the alternative, if the IPC determines that consent to the Project should be granted:

      (i) in relation to the IPC's potential consideration of the imposition of a condition limiting export destinations for coal produced by the Project to countries that have signed the Paris Agreement, such a condition would not be appropriate as it does not address the

[1] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7 at [699].

pressing issue of ensuring that global temperature changes are kept within the limits prescribed in the Paris Agreement. This is because the Nationally Determined Contributions (**NDCs**), which are the emissions reduction targets published by the signatories to the Paris Agreement to reduce GHG emissions, are currently insufficient to keep within the global temperature limits prescribed in the Paris Agreement; and

(ii) the only appropriate condition in relation to the Project's GHG emissions would be to require the Project's total GHG emissions to be permanently offset so that the Project is carbon neutral.

4. These submissions are discussed further below.

A. Climate Change Impacts

5. HEL has commissioned independent expert advice from climate science expert Professor Will Steffen in relation to the carbon budget and its application to the Project and relies on his **attached** expert report dated 10 October 2019 (Steffen Report).

6. In his expert advice at [27], Professor Steffen identifies that projected changes in the climate of mid-NSW North Coast region and adjacent inland region (the area of the Project), include:

(a) Average temperatures will continue to increase in all seasons (very high confidence).
(b) More hot days and warm spells are projected with very high confidence. Fewer frosts are projected with high confidence.
(c) Decreases in winter rainfall are projected for East Coast South with medium confidence. Other changes are possible but unclear.
(d) Increased intensity of extreme rainfall events is projected, with high confidence.
(e) Mean sea level will continue to rise and height of extreme sea-level events will also increase (very high confidence).
(f) A harsher fire-weather climate in the future (high confidence).

7. Professor Steffen further opines at [36] that a 4ºC temperature rise would likely lead to a world "that would hardly be recognisable today". Professor Steffen notes that there is a high to very high risk that:

(a) Most of the world's ecosystems would be heavily damaged or destroyed.
(b) Extreme weather events would be far more severe and frequent than today.
(c) The most vulnerable people would increase greatly in number and, as large areas of the world become uninhabitable, migration and conflict would escalate.
(d) The aggregated impacts around the world would significantly damage the entire global economy.

(e) *A cascade of intrinsic tipping points in the climate system could drive ongoing strong warming even as humanity finally took action to reduce its emissions...*

Rocky Hill Decision – acceptance of carbon budget and causation

8. In relation to the climate change impacts of the Rocky Hill Coal Mine project, the Court accepted Professor Will Steffen's expert opinion and found, that "the direct and indirect GHG emissions of the Rocky Hill Coal Project will contribute cumulatively to the global total GHG emissions"[2] and "all anthropogenic GHG emissions contribute to climate change."[3] Significantly, Professor Steffen's evidence was not contested by the Minister for Planning in the Rocky Hill Decision.

9. Professor Steffen adduced evidence on the carbon budget, which is a commonly used approach to determine the rate of emissions reductions required to meet the goals of the Paris Agreement.[4] The carbon budget limits the cumulative amount of total additional CO_2 emissions that are allowed consistent with the 1.5º to 2ºC global temperature rise limits. Professor Steffen stated that there were 215 Gt C (billion tonnes of carbon, emitted as CO_2) left before the carbon budget was exhausted. At the present rate of emissions (~10 Gt C per year), that would mean that the carbon budget would be exhausted in 21-22 years.[5] Accordingly, Professor Steffen opined that fossil fuel combustion must be phased out quickly and no new fossil fuel development (including the Rocky Hill Coal Mine) was consistent with the carbon budget approach.[6] Preston CJ noted the logic of Professor Steffen's opinion but considered the better approach was:

> [553]… to evaluate the merits of the particular fossil fuel development that is the subject of the development application to be determined. Should this fossil fuel development be approved or refused? Answering this question involves consideration of the GHG emissions of the development and their likely contribution to climate change and its consequences, as well as the other impacts of the development. The consideration can be in absolute terms or relative terms.
>
> [554] In absolute terms, a particular fossil fuel development may itself be a sufficiently large source of GHG emissions that refusal of the development could be seen to make a meaningful contribution to remaining within the carbon budget and achieving the long term temperature goal. In short, refusing larger fossil fuel developments prevents greater increases in GHG emissions than refusing smaller fossil fuel developments.
>
> [555] In relative terms, similar size fossil fuel developments, with similar GHG emissions, may have different environmental, social and economic impacts. Other things being equal, it would be rational to refuse fossil fuel developments with greater

[2] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [515].
[3] Ibid at [514].
[4] Australia is a party to both the United Nations Framework Convention on Climate Change and the Paris Agreement. Under the Paris Agreement, each party commits to make its contribution to keeping the global average temperature rise to the 1.5-2ºC range by reducing their GHG emissions through their Nationally Determined Contributions (**NDC**).
[5] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [443].
[6] Ibid at [447].

> environmental, social and economic impacts than fossil fuel developments with lesser environmental, social and economic impacts. To do so not only achieves the goal of not increasing GHG emissions by source, but also achieves the collateral benefit of preventing those greater environmental, social and economic impacts.

10. Moreover, the Court found in relation to causation that:

> [525] There is a causal link between the [Rocky Hill Coal Mine] Project's cumulative GHG emissions and climate change and its consequences. The [Rocky Hill Coal Mine] Project's cumulative GHG emissions will contribute to the global total of GHG concentrations in the atmosphere. The global total of GHG concentrations will affect the climate system and cause climate change impacts. The [Rocky Hill Coal Mine] Project's cumulative GHG emissions are therefore likely to contribute to the future changes to the climate system and the impacts of climate change. In this way, the [Rocky Hill Coal Mine] Project is likely to have indirect impacts on the environment, including the climate system, the oceanic and terrestrial environment, and people.

11. As a result, the Court concluded that the Rocky Hill Coal Project's "*poor environmental and social performance in relative terms*" justified its refusal and that included the "*GHG emissions of the [Rocky Hill Coal] Project and their likely contribution to adverse impacts on the climate system, environment and people*".[7]

The Project – absolute and relative impacts justify refusal

12. As noted above, the cumulative impact of the Rocky Hill Coal Mine Project's direct and indirect GHG emissions on global climate change were relevant considerations in relation to the Court's decision to refuse development consent for the project. Our client submits that the Rocky Hill Decision should be considered by the IPC as a form of highly persuasive guidance[8] in determining applications in relation to fossil fuel development.

13. HEL submits that the environmental impacts of the Project are sufficiently adverse in both absolute and relative terms to justify refusal. In absolute terms, the Project, at 75.6 million tonnes (**Mt**) of run-of-mine (**ROM**) coal over a period of 21 years (3.6 Mt per annum), is more than 3.5 times larger than the Rocky Hill coal mine (21 Mt over 16 years), the aggregate GHG emissions of which Preston CJ found to be "*sizeable".*[9] Accordingly, HEL submits that the environmental impacts arising from the GHG emissions that are an inevitable consequence of the Project warrant rejection in absolute terms.

14. In relative terms, the Project will potentially result in adverse impacts in relation to water, final voids, biodiversity, Aboriginal cultural heritage, air and noise pollution, and social wellbeing and human health, which HEL submits have not been adequately assessed.[10] Further, HEL has commissioned independent expert advice which shows that the purported economic benefits

[7] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [556].
[8] Linda Pearson, 'Policy, principles and guidance: Tribunal rule-making' (2012) 23 *Public Law Review* 16, p. 32
[9] Ibid.
[10] HEL, Submission in relation to the Project, 4 August 2019. See also Hunter Communities Network, Submission in relation to the Project, 5 August 2019.

of the Project have been significantly overstated and the costs have been significantly understated. In this regard, HEL relies on the independent expert report produced by Mr Tim Buckley (dated 11 October 2019), carbon finance and coal demand expert, **attached** (**Buckley Report**). Our client notes that the Additional Information confirms that scope 3 GHG emissions were not modelled by the Proponent in the cost benefit analysis for the Project.[11] On this basis, the Project also warrants rejection in relative terms.

"Wrong time" for the Project

15. In addition, HEL submits that consent to the Project should be refused because Bloomfield Collieries Pty Ltd (**the Proponent**) has not overcome the hurdle of the "wrong time" basis for refusal, established in the Rocky Hill Decision. The "wrong time" basis for refusal effectively requires proponents to demonstrate why the fossil fuel reserves relevant to their project should be allowed to be exploited and burned, over and above other projects, at a time when a rapid and deep reduction in GHG emissions is needed to stay within the global carbon budget, and avoid dangerous climate change. This is particularly so given evidence that predicted GHG emissions from existing (including approved but not yet constructed) fossil fuel projects will already set us on course to exceed the carbon budget.[12]

16. As noted above, HEL has commissioned independent expert advice from Professor Steffen, in relation to the carbon budget and its application to the Project. The Steffen Report is similar to the carbon budget evidence that was before the Court in the Rocky Hill Decision but has been updated as at October 2019. Accordingly, and given the above, HEL submits that the correct approach to assessing the environmental impacts of the Project's scope 3 GHG emissions, in light of the evidence of the carbon budget, is to consider and apply the "wrong time" basis for refusal as developed by Preston CJ in the Rocky Hill Decision. This is because the task before the IPC, that is, determining the merits of a development, is the same as the task before the Land and Environment Court in the Rocky Hill Decision.

17. As the Court stated in the Rocky Hill Decision:

> [526] The approval of the Project (which will be a new source of GHG emissions) is also likely to run counter to the actions that are required to achieve peaking of global GHG emissions as soon as possible and to undertake rapid reductions thereafter in order to achieve net zero emissions (a balance between anthropogenic emissions by sources and removals by sinks) in the second half of this century. This is the globally agreed goal of the Paris Agreement (in Article 4(1)). The NSW government has endorsed the Paris Agreement and set itself the goal of achieving net zero emissions by 2050. It is true that the Paris Agreement, Australia's NDC of reducing GHG emissions in Australia by 26 to 28% below 2005 levels by 2030 or NSW's Climate Change Policy Framework do not prescribe the mechanisms by which these reductions in GHG emissions to achieve zero net emissions by 2050 are to occur. In particular, there is no proscription on approval of new sources of GHG emissions, such as new coal mines.

[11] See [3] of the Additional Information.
[12] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [527], [697], [699].

> [527] Nevertheless, the exploitation and burning of a new fossil fuel reserve, which will increase GHG emissions, cannot assist in achieving the rapid and deep reductions in GHG emissions that are necessary in order to achieve “a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century” (Article 4(1) of the Paris Agreement) or the long term temperature goal of limiting the increase in global average temperature to between 1.5ºC and 2ºC above pre-industrial levels (Article 2 of the Paris Agreement). As Professor Steffen explained, achieving these goals implies phasing out fossil fuel use within that time frame. He contended that one of the implications of the carbon budget approach is that most fossil fuel reserves will need to be left in the ground, unburned, to remain within the carbon budget and achieve the long term temperature goal. The phase out of fossil fuel use by the second half of this century might permit a minority of fossil fuel reserves to be burned in the short term. From a scientific perspective, it matters not which fossil fuel reserves are burned or not burned, only that, in total, most of the fossil fuel reserves are not burned. Professor Steffen explained, however, that the existing and already approved but not yet operational mines/wells will more than account for the fossil fuel reserves that can be exploited and burned and still remain within the carbon budget. This is the reason he considered that no new fossil fuel developments should be allowed.

18. HEL submits that the Proponent has not sufficiently demonstrated why the Project, over other existing and approved coal mine projects, should be permitted to facilitate the exploitation and burning of significant new fossil fuel reserves in light of the global carbon budget and the urgent need to significantly reduce GHG emissions to avoid dangerous climate change.[13]

19. Given the significance of the issue of climate change, our client considers certain reports, a number of which are cited in the expert reports referred to above, should be considered by the IPC in full. Accordingly, we **enclose** 43 reports relevant for the IPC’s consideration (referred to as the **Relevant Documents Bundle**).

Rocky Hill Decision rejection of least cost, leakage, substitution arguments etc

20. In relation to climate change impacts of the Rocky Hill Coal Mine project, the Court further relevantly found, amongst other things:

> [529] The first reason GRL gave was that the increase in GHG emissions associated with the Project would not necessarily cause the carbon budget to be exceeded, because, as Dr Fisher had argued, reductions in GHG emissions by other sources (such as in the electricity generation and transport sectors) or increases in removals of GHGs by sinks (in the oceans or terrestrial vegetation or soils) could balance the increase in GHG emissions associated with the Project.
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> [530] I do not accept this reason. It is speculative and hypothetical…
>
> [531] The second reason given by GRL was based on Dr Fisher’s argument that “the size of the global abatement task calls for making emissions reductions where they count most and generate the least economic and social harm.” (Fisher report [13]). Dr Fisher considered that refusing approval to individual coal mines, such as the Rocky Hill Coal Project, would not achieve this abatement at least cost.
>
> [532] I do not accept this second reason. A consent authority, in determining an application for consent for a coal mine, is not formulating policy as to how best to make emissions reductions to achieve the global abatement task. The consent authority’s

[13] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [697], [699].

> task is to determine the particular development application and determine whether to grant or refuse consent to the particular development the subject of that development application. Where the development will result in GHG emissions, the consent authority must determine the acceptability of those emissions and the likely impacts on the climate system, the environment and people. The consent authority cannot avoid this task by speculating on how to achieve "meaningful emissions reductions from large sources where it is cost-effective and alternative technologies can be brought to bear" (Fisher Report, [13]). Such emissions reductions from other sources are unrelated to the development that is the subject of the development application that the consent authority is required to determine.
>
> …
>
> [534] The third reason GRL advanced for approving the Project was that the GHG emissions of the Project will occur regardless of whether the Project was approved or not, because of market substitution and carbon leakage…
>
> …
>
> [536] I reject this third reason. On carbon leakage, GRL has failed to substantiate, in the evidence before the Court, that this risk of carbon leakage will actually occur if approval for the Rocky Hill Coal Project were not to be granted…
>
> …
>
> [538] The market substitution argument is also flawed. There is no certainty that there will be market substitution by new coking coal mines in India or Indonesia or any other country supplying the coal that would have been produced by the Project…

21. The Rocky Hill Coal Mine proposal was for a coking coal, not a thermal coal, mine.[14] The Proponent asserts that the Project will produce semi-soft coking coal and thermal coal. The substitution argument in relation to coking coal was addressed in the Rocky Hill Decision by Preston CJ as follows:

> [546] The fourth reason GRL advanced for approving the Project is that the GHG emissions associated with the Project are justifiable. GRL contended that the Project will produce high quality coking coal, not thermal coal, which is needed for the main way of producing steel, by the BOF process; steel is critical to our society; and there are limited substitutes for coking coal in steel production.
>
> [547] I find that GRL overstates this argument. It may be true that currently most of the world's steel (around 74%) is produced using the BOF process, which depends on coking coal, and although technological innovations might reduce the proportion of steel produced using the BOF process, for the reasons given by Mr Buckley, there is still likely to be demand for coking coal for steel production during the life of the Project.
>
> [548] The current and likely future demand for coking coal for use in steel production can be met, however, by other coking coal mines, both existing and approved, in Australia...

22. In relation to thermal coal, even more alternative technologies, which do not rely on coal from this Project, are available.

[14] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [546].

Scope 3 GHG emissions must be addressed, export restrictions lack utility, and the Project's total GHG emissions should be offset

23. We understand from the Additional Information[15] that the IPC may be considering imposing a condition limiting export destinations to countries that have signed the Paris Agreement. HEL submits that such a condition would not address the pressing issue of ensuring that global temperature changes are kept within the limits prescribed in the Paris Agreement and that if the IPC was minded to approve the Project, a stronger condition would be required.

24. The NDCs, which are the emissions reduction targets published by the signatories to the Paris Agreement to reduce GHG emissions, are currently insufficient to keep within the global temperature limits prescribed in the Paris Agreement. Equally, the Proponent's statement that the Project will only export its coal products to Japan, Taiwan and the Republic of South Korea[16] does not sufficiently address the significant scope 3 emissions that will result from the Project. Further, any such condition would have little practical effect as all 197 Parties to the UN Framework Convention on Climate Change (**UNFCCC**)[17] (which includes all UN member states) are signatories to the Paris Agreement.

25. HEL submits that if the IPC is minded to approve the Project, it should impose a condition requiring that the Project's total GHG emissions be permanently offset so that the Project is carbon neutral.

26. These submissions are discussed below.

NDCs are currently insufficient to keep within the global temperature limits

27. Local decision making about fossil fuel developments, including the IPC's consideration of the Project, occurs in the context of the global commitment to respond to the threat of climate change. Australia is a signatory to the Paris Agreement, which has at its heart in article 2.1(a) a pledge of:

> Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.[18]

28. This is consistent with, and adds specificity to, the "ultimate objective"[19] of the UNFCCC to stabilise GHG concentrations in the atmosphere "*at a level that would prevent dangerous anthropogenic interference with the climate*

[15] Additional Information, [10].
[16] We note that Japan and the Republic of Korea are signatories to the Paris Agreement. We understand that Taiwan has developed GHG reduction targets enforced under local legislation.
[17] UNFCCC, opened for signature on 4 June 1992, [1994] ATS 2 (entered into force 21 March 1994).
[18] *Paris Agreement*, opened for signature 22 April 2016, [2016] ATS 24 (entered into force 4 November 2016) art 2.1(a).
[19] Philippe Sands and Jacqueline Peel, *Principles of International Environmental Law* (2018), Cambridge University Press, Cambridge, E-book, 301.

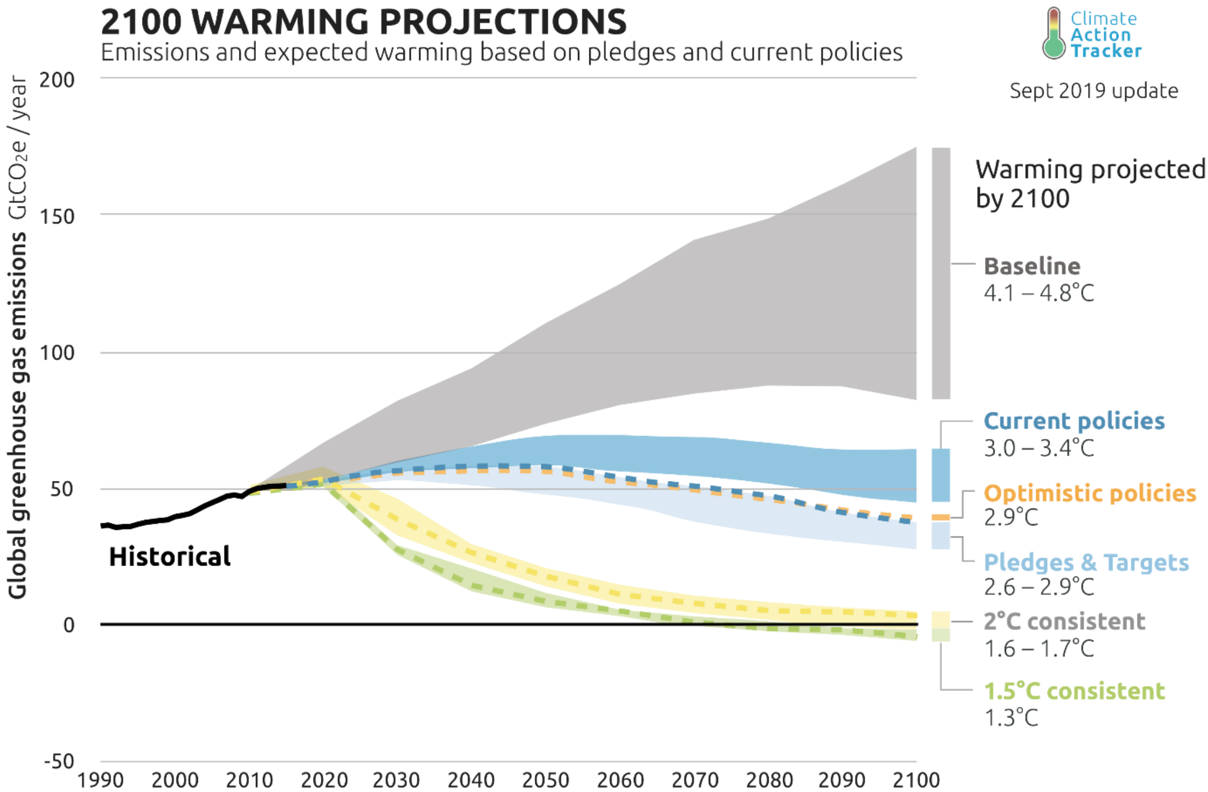
system".[20] This objective "remains relevant for the post-2020 period given the Paris Agreement's declared intent of 'enhancing the implementation of the [UNFCCC], including its objective."[21]

29. As at August 2019, all Parties to the UNFCCC (which includes all UN member states) are signatories to the Paris Agreement. 185 of 197 signatories, including Australia, have ratified the Paris Agreement.[22]

30. Each signatory articulates its commitment to achieving the Agreement through NDCs. Signatories are then expected to implement domestic mitigation measures that will achieve the objectives of their NDCs.[23] Australia's NDC is to "*implement an economy-wide target to reduce greenhouse gas emissions by 26 to 28 per cent below 2005 levels by 2030*".[24]

31. However, it is important to note that meeting current NDCs will not be sufficient to keep within the Paris Agreement temperature limits. Climate Action Tracker,[25] referred to by Professor Steffen as an independent scientific analysis produced by three research organisations tracking climate action since 2009,[26] has calculated that if all Paris Agreement signatories meet their current NDCs, and governments around the world implement their current unconditional pledges and targets to reduce emissions, globally we are on track to reach warming levels of 2.6-2.9°C above pre-industrial levels.[27] The Climate Action Tracker 2100 Warming Projects are reproduced below:

[20] UNFCCC, art 2.
[21] Philippe Sands and Jacqueline Peel, *Principles of International Environmental Law* (2018), Cambridge University Press, Cambridge, E-book, pp. 301-302.
[22] United Nations, 'Paris Agreement - Status of Ratification,' *United Nations Climate Change* (Web Page) <https://unfccc.int/process/the-paris-agreement/status-of-ratification>.
[23] United Nations, 'Nationally Determined Contributions (NDCs),' *United Nations Climate Change* (Web Page) <https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs>.
[24] Australia, 'Australia's Intended Nationally Determined Contribution to a new Climate Change Agreement – August 2015,' *UN Framework Convention on Climate Change INDC* (Web Page) <https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Australia/1/Australias%20Intended%20Nationally%20Determined%20Contribution%20to%20a%20new%20Climate%20Change%20Agreement%20-%20August%202015.pdf>.
[25] Climate Action Tracker, 'Temperatures,' Climate Action Tracker (Web Page) https://climateactiontracker.org/global/temperatures/, updated September 2019.
[26] Steffen Report, [27].
[27] Based on a 66% probability of success



Source: Climate Action Tracker, 'Temperatures' https://climateactiontracker.org/global/temperatures/

32. Locally, the Climate Change Authority has identified that Australia's current NDC does not commit Australia to achieving its fair share of global emission reductions.[28] As the Steffen Report states:[29]

> In its country analysis dated 30 April 2018, CAT identifies that Australia's emissions are set to far exceed its Paris accord Nationally Determined Contributions (NDC) target for 2030 (itself a target which, if followed by all other countries would lead to global warming of over 2°C and up to 3°C). Further, CAT assesses that, if all other countries were to follow Australia's current policy settings, warming could reach over 3°C and up to 4°C.

33. Accordingly, there is a disconnect between the current NDCs and the carbon budget required to keep within the temperature limits that are articulated in article 2.1(a) of the Paris Agreement.

34. However, it must be noted that, as a treaty within the *Vienna Convention on the Law of Treaties* (**VCLT**),[30] the Paris Agreement:[31]

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[28] Climate Change Authority, *Final Report on Australia's Future Emissions Reduction Targets*, 2 July 2015 (Final Report, July 2015) available at<http://climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/Final-report-Australias-future-emissions-reduction-targets.pdf>
[29] Steffen Report, [31].
[30] VCLT, opened for signature on 23 May 1969, [1974] ATS 2 (entered into force on 27 January 1980); Philippe Sands and Jacqueline Peel, *Principles of International Environmental Law* (2018), Cambridge University Press, Cambridge, E-book, pp. 319.
[31] VCLT, art 31.1.

shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty **in their context and in the light of its object and purpose**. [Emphasis added.]

35. Accordingly, the provision for NDCs must be interpreted in the context and in light of the object and purpose of the Paris Agreement, as outlined in article 2.1(a) of the Paris Agreement, without which the Paris Agreement would effectively be rendered nugatory.

36. Moreover, article 2.1(a) must be read in conjunction with article 4.1,[32] which states:

> In order to achieve the long-term temperature goal set out in Article 2, **Parties aim to reach global peaking of greenhouse gas emissions as soon as possible**, recognizing that peaking will take longer for developing country Parties, and to **undertake rapid reductions thereafter in accordance with best available science**, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty. [Emphasis added.]

37. Therefore, article 4.1 "provides an indicative timetable for peaking and decline of greenhouse gases in order to meet the long-term temperature goal of the Agreement".[33] It has two elements: "parties aim to reach 'global peaking' (i.e. maximal emissions output) as soon as possible", and "net zero emissions after 2050; a goal that will not be achievable without a complete phase out fossil fuels".[34]

38. Regarding the complete phase out of fossil fuels, the Steffen Report states:[35]

> No new fossil fuel development is consistent with meeting the Paris accord climate targets. That is… to meet the Paris accord, emissions must be reduced rapidly and deeply… and to do this requires the rapid phase-out of existing fossil fuel mines/wells. It is an obvious conclusion that no new fossil fuel developments can therefore be allowed.

39. Considering the above analysis, it would be wrong for the IPC to assume that the local and global environmental harm caused by burning Australian-mined fossil fuels in other countries, which are signatories to the Paris Agreement, will be appropriately mitigated by those countries' current NDCs. Instead, the IPC should consider the harm to NSW and Australia caused by increasing global GHG emissions, wherever those emissions are generated, under current commitments to curb GHG emissions and in light of Paris Agreement temperature limits and the best available science.

40. Given that current NDCs will not avoid dangerous climate change, the only way that decision makers can be sure that the climate impacts of local fossil fuel extraction projects will be avoided, consistent with meeting the Paris

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[32] Philippe Sands and Jacqueline Peel, *Principles of International Environmental Law* (2018), Cambridge University Press, Cambridge, E-book, p. 320.
[33] Ibid.
[34] Ibid p. 321.
[35] Steffen Report, [58].

Agreement temperature limits, is to prevent or offset GHG emissions from those fossil fuel developments that will contribute to driving warming beyond 1.5-2°C above pre-industrial levels.

41. This approach is consistent with the Rocky Hill Decision, in which the Court found that, in circumstances where there was no specific proposal to offset the Rocky Hill Coal Mine's emissions:

> A consent authority cannot rationally approve a development that is likely to have some identified environmental impact on the theoretical possibility that the environmental impact will be mitigated or offset by some unspecified and uncertain action at some unspecified and uncertain time in the future.[36]

42. In the present case, the Project's environmental impacts, including GHG emission impacts, have been identified. However, there is no specific proposal to offset the Project's emissions. As explained above, while signatories to the Paris Agreement have specified their current NDCs, the effectiveness of the current NDCs remains highly uncertain as they will not achieve the global temperature limits set in the Paris Agreement. Moreover, all future NDCs under the 5-yearly "ratchet" or "ambition" mechanism[37] remain unspecified and uncertain.

43. Accordingly, if the IPC is minded to approve the Project, it should impose a condition requiring that the Project's total GHG emissions be permanently offset.

No practical effect of export destinations being limited to countries that have signed the Paris Agreement

44. HEL submits that the export condition referred to in the Additional Information would be of little practical effect as all UN member states are signatories to the Paris Agreement. Accordingly, it is virtually certain that any Project coal exported to another country will be exported to a signatory to the Paris Agreement. Without further provisions, the proposed condition is practically meaningless and does nothing to change the "business as usual" approach to the mitigation of Scope 3 GHG emissions.

45. Moreover, the fact of a Party's signing or ratification of the Paris Agreement has no impact on that Party's contribution to keeping within the global temperature limits. Rather, it is the Party's implementation of the commitments under the Paris Agreement (including the NDCs, which have already been demonstrated as inadequate) that is material to whether the global temperature limits are exceeded. From the limited detail available in the Additional Information, it appears that the condition under consideration fails to grapple with these nuances and would therefore be ineffective in achieving any mitigation of Scope 3 GHG emissions.

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[36] *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [530].
[37] *Paris Agreement*, opened for signature 22 April 2016, [2016] ATS 24 (entered into force 4 November 2016) art 4(9).

The only appropriate condition regarding the Project's GHG emission is that the Project be carbon neutral

46. HEL submits that if the IPC is minded to approve the Project, the only appropriate condition regarding the Project's GHG emissions is that the Project be carbon neutral. There is no legal or policy reason as to why the IPC should not seek to impose any conditions of development consent requiring permanent offsets of the Project's GHG emissions.

47. If the IPC is minded to impose a condition that the Project be carbon neutral, HEL is willing to make submissions as to the appropriate form of such a condition.[38]

B. Air quality

48. In the Rocky Hill Decision, Preston CJ held that although air quality levels would comply with the relevant non-discretionary development standards in cl 12AB(4) of the Mining SEPP, this did not preclude consideration of the social impacts of the air quality impacts; he relevantly stated:

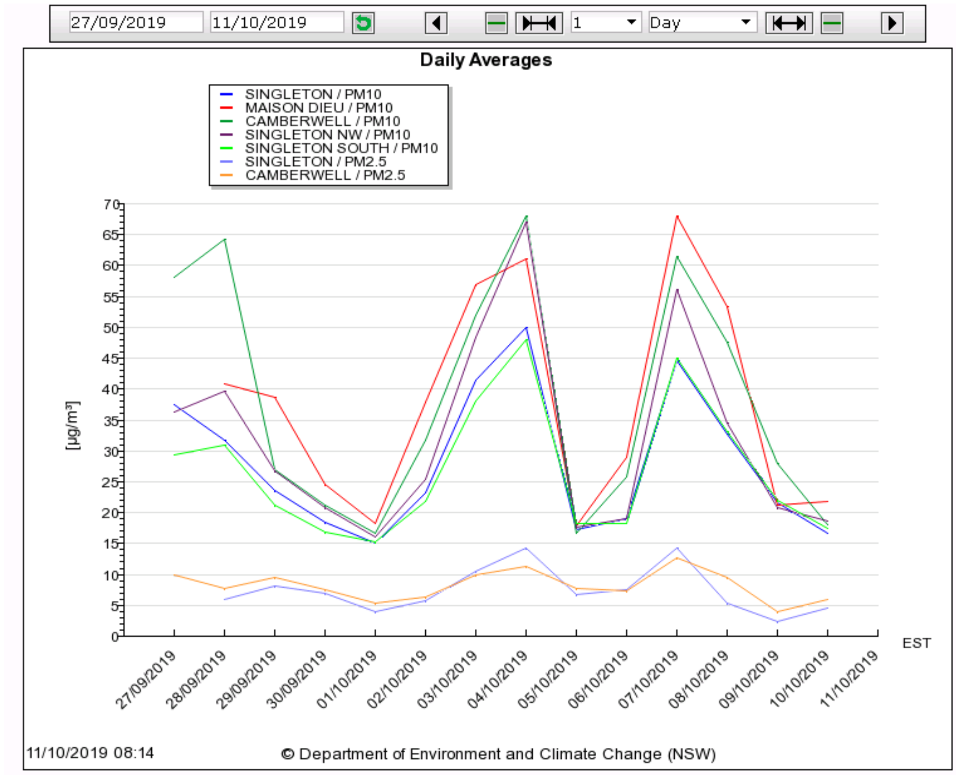
> [268] Nevertheless, the residents' concerns about the mine's potential adverse effects on air quality, and the concomitant threat to their health and the health of their family, may have social impacts. Concerned residents may leave Gloucester and not be replaced by people who are put off by the perceived risk of deteriorated air quality and effects on their health. Uses that depend on Gloucester having, and being seen to have, a clean and green environment will also be adversely affected. These lead to negative social impacts, which are discussed in the next section.
>
> [269] The negative social impacts caused by residents' concerns about the project-related air quality impacts, including the perceived threat to their health and the health of their families, are not impacts that are the subject of the cumulative air quality level development standard in cl 12AB(4) of the Mining SEPP. That development standard does not prevent a consent authority from refusing consent on grounds relating to, or imposing conditions to regulate, project-related air quality impacts that are not the subject of the development standard or social impacts resulting from project-related air quality impacts.

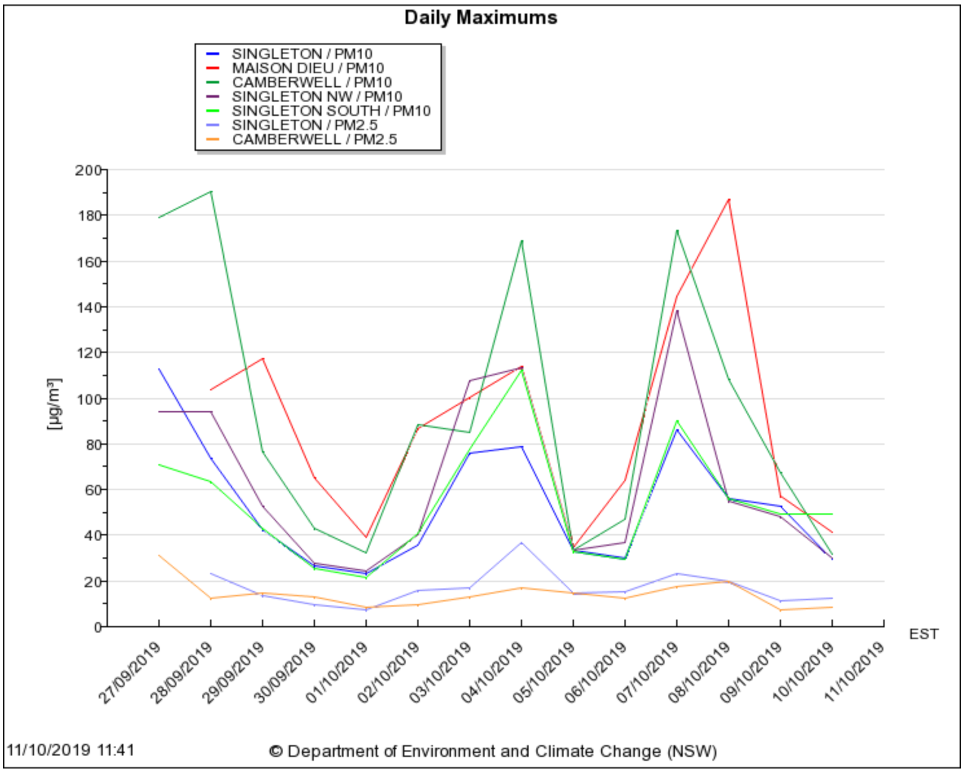
49. HEL has raised significant concerns in relation to the air quality impacts that will arise from the Project, most recently in their submission to the IPC dated 4 August 2019. HEL rejects the conclusion of the Department and NSW Health that concerns in relation to air quality have been captured in the draft conditions of consent.

50. HEL reiterates its view that there is no safe level of PM10 or PM2.5 pollution yet the Upper Hunter Air Quality Monitoring Network regularly reports dust levels higher than even the agreed national standard in the vicinity of the Project. This has been made clear by the extensive exceedances reported

[38] The Rocky Hill case identified two key options for offsetting GHG emissions, namely emissions reduction technologies or establishing sinks such as by reafforestation. However, in HEL's submission, the IPC could only be confident that the Project could achieve carbon neutrality if the proponent was required to implement appropriate emissions reduction mechanisms or technologies for the permanent offset of the equivalent of all Scope 1, 2 and 3 GHG emissions that will be produced as a consequence of the Project.

over the last two week period, as demonstrated in the figure below. HEL also notes the high levels of daily maximums shown in the second figure below.





Source: NSW Government Air Quality Monitoring Data
https://www.environment.nsw.gov.au/aqms/search.htm

51. It is clear from the submissions to the Department and the IPC throughout the assessment process that there is strong community concern about the health and social impacts arising from the poor air quality. Multiple submissions to the IPC speak to the significant levels of stress and anxiety in the community about the health and nuisance impacts of dust (see for example Dr Bob Vickers presentation to the IPC on the air pollution issues associated with the Project[39]).

52. Residents' concerns about potential impacts on their health are supported by the fact that many properties have acquisition criteria under the various development approvals in the area, including the Project. HEL submits that relocating communities to facilitate new coal developments should not be considered an acceptable social impact.

53. Given the acknowledged high background levels of particulate matter experienced in the area of the Project[40] and existing exceedances of guideline levels, any concerns in relation to additional dust sources are reasonable.

Conclusion

54. HEL submits that the above analysis of the Project, in light of the Rocky Hill Decision, demonstrates that the environmental impacts of the Project are sufficiently adverse in both absolute and relative terms to justify refusal.

55. In our client's view, the IPC cannot be satisfied, on the basis of the information available to it, that the risks and impacts of the Project can be effectively mitigated by the conditions of any consent, such that approval of the Project is in the public interest.

56. As such, our client respectfully submits that the IPC should determine the Project application by refusing to grant consent.

57. Please do not hesitate to contact the solicitor responsible for this matter, Natalie Vella, on ph: (02) 9262 6989 or email natalie.vella@edonsw.org.au.

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[39] Available at: https://www.ipcn.nsw.gov.au/resources/pac/media/files/pac/projects/2019/06/rixs-creek-south-continuation-of-mining-project-ssd-6300/public-meeting/presentations/dr-bob-vickers-presentation.pdf.

[40] See for example the Proponent's Revised Response to Submissions, Appendix H-1 Air Quality Specialist Response available at: https://majorprojects.accelo.com/public/f2be9fa9917d4d5508b3015fc39b1c1f/Rix's%20Revised%20RTS%20SSD_6300%20Rev_1_Appendix%20H.pdf.

Yours sincerely,
EDO NSW

Elaine Johnson
Principal Solicitor

Natalie Vella
Senior Solicitor

Our Ref: 1927228

Tim Buckley, Director of Energy Finance Studies Australasia
October 2019

Institute for Energy Economics and Financial Analysis
IEEFA.org

Rix's Creek South Continuation of Mining Project (SSD 6300)

IEEFA's expert opinion to the NSW Independent Planning Commission

The Institute for Energy Economics and Financial Analysis (IEEFA) provides the following expert advice in relation to the Rix's Creek Continuation of Mining Project (Rix's Creek Extension) in response to the KPMG Submissions providing an Economic Assessment of the Cost Benefit Analysis.

The IEEFA conducts public interest research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy.

This advice was prepared at the request of the EDO NSW, acting on behalf of the Hunter Environment Lobby Inc. EDO NSW has provided me with a copy of the *Uniform Civil Procedure Rules 2005* (UCPR), and the Expert Witness Code of Conduct contained in Schedule 7 of the UCPR. I have read and agree to be bound by these rules and code of conduct.

A copy of my curriculum vitae, including my relevant qualifications, is attached (Appendix A).

Tim Buckley

11 October 2019

Executive Summary

Coal mining is an industry that makes a significant contribution to the Australian economy, both through the direct investment and employment it creates, and through the significant contribution it makes to Australia's export balance.

But it is also an industry that exists on the basis of using a very finite public asset for private gain. Profits are maximised by internalising benefits, and externalising costs onto the environment and public. The cost-benefit analysis (CBA) provided by KPMG extenuates this imbalance; talking up the benefits (as outlined in this advice), and minimising the cost externalities to the people of NSW.

1. THE COST-BENEFIT ANALYSIS LACKS CREDIBILITY

   KPMG uses an outdated carbon price from March 2017 (a near record low and a quarter of the current price in October 2019) and then pro-ratas NSW's population as a share of the world total to take what would otherwise be a total scope 3 carbon emissions cost of $832m and reduce it to a NSW share of $0.46m. In my opinion, the global cost of this project's scope 3 emissions are 1,808 times the cost included in KPMG's CBA.

   KPMG assumes the Rix's Creek Extension Project will generate $159m of corporate tax, an entirely unrealistic assumption, based on 100% equity financing. We provide two NSW case studies showing the actual corporate cash tax paid by Australian coal mining firms is minimal, largely due to the ongoing use of significant interest expense deductions, a factor KMPG assumes to be zero.

   A logical assessment would likely derive a negative incremental net cost of the Rix's Creek Extension Project from the additional rehabilitation workload involved, particularly with regard to the perpetual costs of the final void. Instead, KPMG finds a net financial *benefit* to the proponent of $16m from the Rix's Creek Extension Project, ignoring the final void cost issue completely.

2. COAL'S STRUCTURAL DECLINE HAS ALREADY STARTED

   South Korea, Japan and other key Australian export markets are already in a state of volume decline - technological obsolescence is building and eroding the coal market. The 40-50% coal price decline over 2018/19 means the revenue and royalty projections included in the CBA are likely materially overstated (Section 1).

   Global forecasts by the International Energy Agency (IEA) show the seaborne coal market will more than halve within two decades as the world acts on the Paris Agreement (Section 2).

3. INCREASING GLOBAL CAPITAL FLIGHT FROM COAL

Over 110 globally significant financial institutions have put in place increasingly strict coal divestment and/or coal lending restrictions. Since the start of 2019, there has been a new coal investment / lending / insurance announcement almost every week from a globally significant financial institutions, including QBE Insurance, Suncorp and Commonwealth Bank in Australia.

The last month alone has seen FirstRand of South Africa, the African Development Bank, the European Investment Bank and Axis Capital (a major Lloyds insurer) all announce new coal exclusion policies.

Equally telling, we have seen the key Australian financial regulators likewise warning of the need for financial institutions to properly manage the growing financial system risk resulting from the inevitable response to global warming. The Australian Prudential Regulation Authority (APRA),[1] the Australian Securities & Investment Commission (ASIC), the Reserve Bank of Australia (RBA) and the Australian Securities Exchange (ASX) have all raised new polices and highlighted the financial risks, including the massive, growing taxpayer burden of disaster funding of clean-up and recovery[2] (Section 3).

IEEFA notes the critically important message delivered in July 2019 by BHP's Chief Executive Officer (CEO) Andrew Mackenzie in his landmark speech "Confronting Complexity: Evolving our approach to climate change". BHP has acknowledged the threat Australia and the world faces, with Mackenzie concluding: "But we must also face the challenges that come with these benefits. Because the world's dependence on fossil fuels carries risks with it that could be existential."[3] NSW needs to prepare for an inevitable transition, and the first thing to do is to stop investing in even more fossil fuel capacity.

[1] APRA Executive Board Member, Geoff Summerhayes - Speech to the International Insurance Society Global Insurance Forum, 21 June 2019
[2] Australian Financial Review, Northern insurance crisis requires action: APRA, 7 October 2019
[3] BHP, Confronting Complexity: Evolving our approach to climate change, 23 July 2019.

Section 1: The Cost-Benefit Analysis is Overstated

In IEEFA's view, the KPMG cost-benefit analysis (CBA) for the Rix's Creek Extension Project overstates benefits and understates costs in terms of:

I. **Carbon Emissions**: KPMG reduces the incremental A$892m of current carbon emissions values (scope 3) to just $0.46m. KPMG and Hansen Bailey use an outdated carbon price sourced from March 2017 at A$9.60, a figure that is a quarter of the current EU carbon price of A$38/t.

II. **Corporate Tax**: KPMG assumes the project to be entirely equity financed, ignoring the reality that proponents almost always use a mix of debt and equity. By assuming a fictional capital structure, KPMG creates a $159m NPV of Australian corporate tax. Historic precedent suggests a number of close zero is a lot more realistic, and I illustrate this with reference to NSW's two largest listed miners, Yancoal Australia and Whitehaven Australia.

III. **Coal Price Declines**: KPMG assumes a US$73.80/t thermal and US$111.10/t soft coking coal price and an exchange rate of US$0.75, giving an A$98/t & A$148/t price respectively. IEEFA notes the collapse of coal prices over 2019, and I reference the comments by industry leaders including the CEOs of Cerrejon and Nextera Energy who warn a structural decline is underway, consistent with the IEA SDS modelling (refer Section 2). Sustained coal price weakness erodes project revenues and therefore the coal royalties due to the NSW Government.

IV. **Mine Rehabilitation and the Uncosted Final Void**: KPMG models that extracting 24Mtpa of additional run-of-mine (ROM) coal will *reduce* the net present value (NPV) of mine rehabilitation by $16m. KPMG uses the logic that the time value of money means that deferring cleaning up the massive environmental disturbance of the Rix's Creek mine combined with the Rix Creek Extension Project for up to two decades is a value-creating outcome. Combined with the uncosted nature of leaving a huge final void of increasing toxicity and salinity in perpetuity, KPMG finds this somehow boosts the NSW economy by $16m. The final void rehabilitation costs avoided leave unfunded costs likely to be several $100m to NSW rate payers – a key coal mining failure in terms of the intergenerational equity principle that is assigned a zero cost in KPMG's CBA.

The entire CBA fails to mention or quantify the compounding or cumulative effects of extensive coal mining activity across the Hunter Valley.

Scope 3 Carbon Costs

The severe, multiple climate risks to NSW's critically important agriculture and tourism sectors are in their own right significant enough to warrant the precautionary stance of leaving untapped coal/carbon reserves in the ground. Multiple economic experts have reported at length on this risk.[4]

KPMG references the European Union's Emissions Unit Allowance (EUA) pricing as a guide to the cost of carbon and methane emissions from this project. EU EUA's are currently trading at €23.37 per tonne (t) – Figure 1.1. The EUA prices have risen dramatically over the last two years, reflecting a significantly tighter carbon emissions framework as the European Union becomes increasingly concerned about the need to rapidly transition their economy to limit carbon emissions.

Figure 1.1: European Union's Emissions Unit Allowance (€/t)

Source: https://markets.businessinsider.com/commodities/co2-emissionsrechte, 9 October 2019

KPMG uses an EUA of A$9.60/t (in 2018 dollars) taken from March 2017 (the near all time low of the EUA pricing). Converting the 7th October 2019 EUA €23.37/t at the current exchange rate gives a current EUA price of A$38.09/t, four times the current cost KPMG uses for Rix's Creek. Hansen Bailey's August 2019 update carries the same March 2017 EUA price forward, despite updating their other inputs.

[4] The Australia Institute, "Great Barrier Bleached: Coral bleaching, the Great Barrier Reef and potential impacts on tourism", June 2016.

Referencing the Bloomfield Group's Hansen Bailey updated 5 August 2019 assessment of scope 1 & 2 emissions at 990,613t (Table 5), this gives a current value of A$38m for the entire project, or $12m current value for the cumulative 1.1Mtpa run-of-mine (ROM) extension, using the near record low EUA price of March 2017.

The Hansen Bailey updated scope 3 assessment of carbon emissions gives a cumulative 71.4Mt for the entire project, or 21.8Mt from the Rix's Creek Extension share. At the current €23.37 or A$38/t value, this puts a current value of A$832m for the extension – 1,808 times that of Gillespie Economics (Figure 1.2).

Using a significantly out-of-date carbon price and other questionable assumptions, the Hansen Bailey / Gillespie Economics analysis has come up with a NSW community cost of scope 3 carbon emissions from this project proposal of just A$0.46m.

Figure 1.2: Total Value of Carbon Emissions – A$832m vs A$0.46m!

	Total project	Extension
EU EUA (€/t) as at 7 Oct 2019		€ 23.37
Euro/A$		1.63
EUA in A$/t		$38.09
ROM Coal (Mtpa)	3.6	1.1
Share of Total		31%
Scope 1&2 Carbon Emissions - cummulative	1.0	0.3
Value (A$m, current dollar)	38	12
Scope 3 Carbon Emissions - cummulative	71.4	21.8
Value (A$m, current dollar)	2,721	832
Scope 3 Gillespie Economics cost to NSW (A$m)		0.46
Scope 3 IEEFA cost to NSW (A$m)		831.51
Difference (times)		1,808

Source: Hansen Bailey / Gillespie Economics, 5 August 2019, IEEFA calculations

In isolation, just the incremental current market value of carbon emissions imposed on the global community from the Rix's Creek Extension Project of A$832m exceeds the net production benefits of $614m that KPMG calculates,[5] even without considering the overestimate of other net benefits that we detail elsewhere in this section. This gives the Project a negative CBA.

[5] KPMG, Rix's Creek Extension Project – Economic Assessment, 13 March 2018

The financial, legal, and fiscal risks and costs of climate change have been well articulated by the RBA, APRA and in our legal system. Access to financial capital (debt, equity and insurance) for coal mining is increasingly problematic (refer Section 3) and a recent study by Ernst & Young (EY) found that mining companies are increasingly under investor pressure to secure a social licence to operate, including taking responsibility for scope 3 emissions.[6]

[6] The Australian Financial Review, Scope 3 accountability inevitable for miners, says EY, 2 October 2019

Corporate Tax Leakage Risk

New investment in regional Australia is important but where coal mining is concerned, the benefits are short lived, illusionary and mostly privately gained and invariably almost corporate tax free. Various planning approvals are predicated on the reported benefits that will accrue to the Australian Government from increased corporate taxes. Many approvals rely on proponent-created "models" that assume 100% equity financing of every coal project, including KPMG's analysis for the Rix's Creek Extension Project, yet the standard industry practice is to use substantial debt leverage to legally minimise tax expense and hence maximise the proponent's return on equity invested.

It has been well documented that Australia's largest coal mining and coal-fired power plant owners pay little if any corporate tax in Australia.[7] Yet KPMG assumes this project is 100% equity financed, without citing how this assumption was justified. KPMG calculates a net present value of A$159m in company tax benefit for Australia, and taking 32% of this, allocates a A$50.9m benefit to NSW. IEEFA provides two real world examples that if applied to Rix's Creek would see this benefit to NSW reduced by up to 100%.

The Australian coal sector firms legally avoid paying most of their corporate tax obligations by using weaknesses in the thin-capitalisation, related party transactions and transfer pricing rules of the Australian tax system. BHP paid the Australian Taxation Office (ATO) A$529m in November 2018 in settlement of its Singapore tax haven marketing hub practice,[8] yet the 2018 Senate Inquiry into Multinational Tax Avoidance by mining companies highlighted BHP's offshore actions as likely just the 'tip of the iceberg'.[9]

We analyse the financial accounts of Yancoal Australia and Whitehaven Coal - the two leading NSW Stock Exchange listed coal mining firms' - financial performance over the last six years to illustrate that corporate tax expenses are matched or dwarfed by the interest expense deductions that KPMG assumes away to zero. And we illustrate that corporate cash tax paid (as opposed to the corporate tax accounting expense) is either minimal or precisely zero for the two leading Australian coal mining firms. The accumulation of previous year losses means the Australian government receives cash tax that is at best a minor fraction of the reported tax expense. I therefore question KPMG's assumption that the Rix's Creek Extension Project will see the proponent pay an additional $159m of corporate tax.

Figure 1.3 provides an extract of the consolidated financial results of Yancoal Australia over the six calendar years 2013-2018. On revenues of a cumulative $13 billion, Yancoal booked interest expenses totalling a cumulative $1,240m, many multiples of the corporate tax expense of $55m. Cash tax paid was a cumulative $15m over the six years,

[7] MichaelWest.com.au, "Sneaky coal giant Glencore drops off the Top40 Tax Dodgers", 28 December 2018.
[8] The Australian Financial Review, "BHP to pay ATO $529m in tax settlement over Singapore marketing hub", 19 November 2018.
[9] Parliament of Australia, "Corporate Tax Avoidance report - Part III: Much heat, little light so far", 30 May 2018.

just a quarter of the tax expense, due to continued use of accumulated past year tax loses carried forward. Cash tax paid over this six-year period was 0.1% of total revenues.

Figure 1.3: Yancoal Australia: Revenue, Interest vs Tax (2013-2018, A$m)

Year to December	2013	2014	2015	2016	2017	2018	Total 2013-2018
Revenue (A$m)	1,530	1,432	1,319	1,238	2,601	4,850	12,970
Interest expense	-125	-165	-162	-209	-287	-293	-1,240
Corporate tax expense	282	-83	63	85	-82	-320	-55
Corporate tax paid	2	0	-17	0	0	0	-15
Cash tax paid / revenue	-0.2%	0.0%	1.3%	0.0%	0.0%	0.0%	0.1%

Source: Yancoal Australia Annual Reports, IEEFA calculations

Figure 1.4 provides an extract of the consolidated financial results of Whitehaven Coal over the six financial years to June 2019. On revenues of a cumulative $9.2 billion, Whitehaven booked interest expenses totalling a cumulative $335m, almost equal to the corporate tax expense of $361m. Cash tax paid was a cumulative zero over the six years, thanks to continued use of accumulated past year tax loses carried forward.

Figure 1.4: Whitehaven Coal: Revenue, Interest vs Tax (2013-2018, A$m)

Year to June	2014	2015	2016	2017	2018	2019	Total 2014-2019
Revenue (A$m)	755	763	1,164	1,773	2,257	2,488	9,200
Interest expense	-58	-73	-67	-51	-42	-43	-335
Corporate tax expense	18	141	-7	-70	-234	-208	-361
Corporate tax paid	21	36	-42	0	0	-15	0
Cash tax paid / revenue	-2.8%	-4.7%	3.6%	0.0%	0.0%	0.6%	0.0%

Source: Whitehaven Coal Annual Reports, IEEFA calculations

KPMG assumes that Rix's Creek will pay the Australian government $159m of corporate tax (on an NPV basis), a 12.5% share of total cumulative revenues of $1,272m (on an NPV basis). By comparison, Yancoal paid just 0.1% of revenues as corporate tax (less than a one-hundredth of the rate KPMG assumes), and Whitehaven Coal paid zero percent of revenues in total over the last six years.

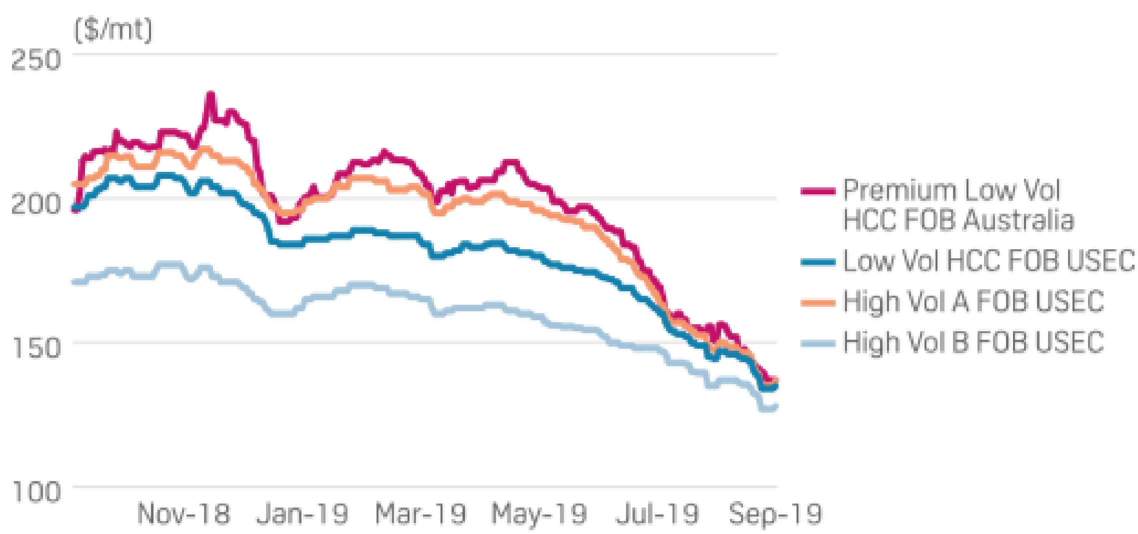
Coal Price Assumptions Are Under Threat

Commodity prices are extremely difficult to forecast and KPMG relied on credible industry forecasts of the long term nominal price estimate for thermal coal of US$73.80/t and for soft coking coal of US$111.10/t. While these forecasts were entirely reasonable 18 months ago, we note the global coal market is in a state of technology driven flux, and dramatically increasing oversupply at a time of increasing cost competitiveness of zero emissions alternatives is undermining pricing. Coking coal prices have dropped more than 40% to-date in 2019, and thermal coal prices have halved since the start of 2018 to US$64/t.

IEEFA notes the October 2019 observations of Guillermo Fonseca, CEO of Cerrejon of Chile (one of the largest and historically most profitable export thermal coal mines in the world) noted the likely sustained weakness in coal prices going forward. Having relatively recently completed a US$1.3bn capital investment to expand capacity to 40Mtpa, Fonseca announced a major cut to production expectations to just 26Mpta because of the unexpectedly rapid decline in global coal prices, stating: "Accepting that prices are going to stay there, the decision was taken to reduce the size of the mine. The mine will be reduced between 15% and 18% as a result of what we're seeing."[10]

The price of hard coking coal has also unexpectedly dropped 40% to-date in 2019 to US$138/t, as showing in Figure 1.5. The soft coking coal of Rix's Creek would receive a significant discount to the premium pricing of hard coking coal price, generally trading at a US$10-20/t premium to the 6,000kcal thermal coal price – Figure 1.6.

Figure 1.5: Seaborne Hard Coking Coal Prices (US$/t)

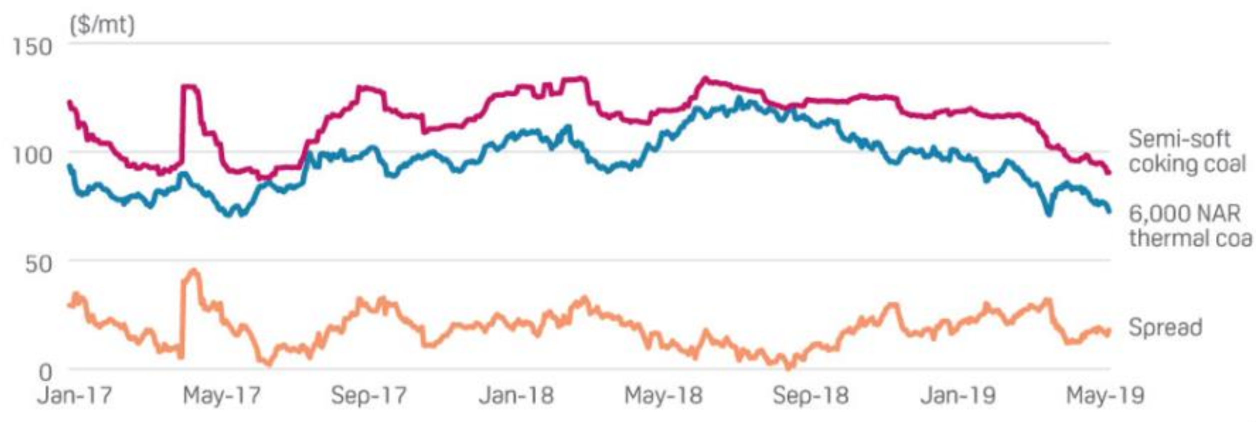


Source: S&P Global Platts, 27 September 2019

[10] Reuters, Coal mine Cerrejon to reduce output amid low prices, possible court ruling, 8 October 2019

James Robo, CEO of Nextera Energy, the largest and most successful power utility in the U.S., gave an investor presentation in October 2019 in which he forecast that renewable energy would entirely force all coal-fired power generation out of the U.S. market by 2030, even with the removal of investment subsidies for renewables post 2020.[11]

Figure 1.6: Seaborne Soft Coking Relative to thermal Coal Prices (US$/t)



Source: S&P Global Platts, June 2019

Figure 1.6 shows the KPMG assumption of a US$38/t spread premium for soft coking coal over thermal coal is not supported by the pricing trends over the last three years. IEEFA notes the average US$20/t spread in this period.

As such, IEEFA would argue that there is material downside risk to the revenue projections the CBA relies on, both in terms of the benefit the proponent is likely to receive, and also the flow-on negative implications for KPMG's estimate of $104m (present value) of coal royalties likely to flow to the NSW Government.

[11] *NextEra Energy, Investor Presentation, October 2019*

Coal Mine Rehabilitation Deferral Gives a $16m Net Benefit while Water Treatment of the Final Void in Perpetuity is Uncosted

KPMG's CBA perversely includes a $16m net financial benefit to the proponent of delaying rehabilitation works for up to two decades while the Rix's Creek Extension Project is undertaken, despite the additional 21Mt of coal extracted, as well as almost 200Mt of extra overburden being removed over the 21 year Project.[12]

The cumulative impact of final voids from coal mining across NSW is unknown, with the latest research estimating there are at least 45 voids of a cumulative 6,050 ha planned or approved by the NSW Government as of June 2016, covering a total area greater than all of Sydney Harbour.[13]

In Germany, a special purpose government vehicle will fund an estimated annual €220m cost in perpetuity needed to finance the measures for a permanent management of coal mine- and groundwater decontamination in the former Saar, Ruhr and Ibbenbüren coalfields.[14]

Australia has over 50,000 abandoned, unrehabilitated mine sites, and the Australian taxpayer has to fund the containment and eventual clean-up of these sites.[15] While mining industry lobby groups proclaim there is no issue, and the KPMG CBA includes a hypothetical net benefit to NSW from the massive disturbance of 212 ha of land and removal of over 220 million tonnes of overburden and coal, the more than 200 year history of mining in Australia suggests otherwise to IEEFA.

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[12] IEEFA calculates the 200 million tonnes of additional overburden using the KPMG strip ratio of 5.75 bank cubic metres (BCM) per tonne of ROM coal (16.1BCM per 2.8Mtpa of ROM, as referenced in Table 1 of "Rix's Creek South Continuation of Mining Project Final Assessment report by KPMG, and converting a BCM of overburden at the IEEFA estimated rate of 1 BCM = 2 tonnes.
[13] Energy Resource Insights, The Hole Truth: The mess coal companies plan to leave in NSW, June 2016.
[14] IMVA Mine Water and Circular Economy, Mine Water Management in the Ruhr coalfield, 2017
[15] The Conversation, What should we do with Australia's 50,000 abandoned mines?, 23 July 2014

Opportunity Costs of Land Use – a net $0.2m cost

KPMG's CBA finds that there is a $0.6m cost of locking up 213 ha of agricultural land for several decades, and then largely offsets this community cost by adding a $0.4m gain on residual value of grazing land returned post mining and post rehabilitation. That coal mine rehabilitation can be undertaken so as to return land to a productive agricultural grazing use equivalent to its pre-mining quality is largely hypothetical. The Australia Institute report of April 2017[16] found there are almost no examples of successful end of mine life rehabilitation completed, none that have been independently verified. According to the government statistics, almost all end of life coal mines in Australia have been left in care and maintenance rather than fully rehabilitated.

The Singleton and Lake Macquarie Councils have both testified in October 2019 to the Federal government *'Jobs for the Future in Regional Areas'* inquiry[17] about their growing concerns over coal mining combined with associated coal fired power plants having too much control over large parts of the shire, limiting the effectiveness of the shire to transition from coal and diversify the "single engine economy", as reported in the regional press.[18] This points to the growing need for the NSW planning process to consider the cumulative impact on land use, the economy, employment, health, noise, water use and pollution et al of so many coal mines in a condensed area.

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[16] The Australia Institute, Dark side of the boom, 15 April 2017
[17] Parliament of Australia, Jobs for the Future in Regional Areas
[18] The Newcastle Herald, Singleton and Lake Macquarie councils have asked a federal jobs inquiry to help unlock mining's grip on Hunter land, 8 October 2019

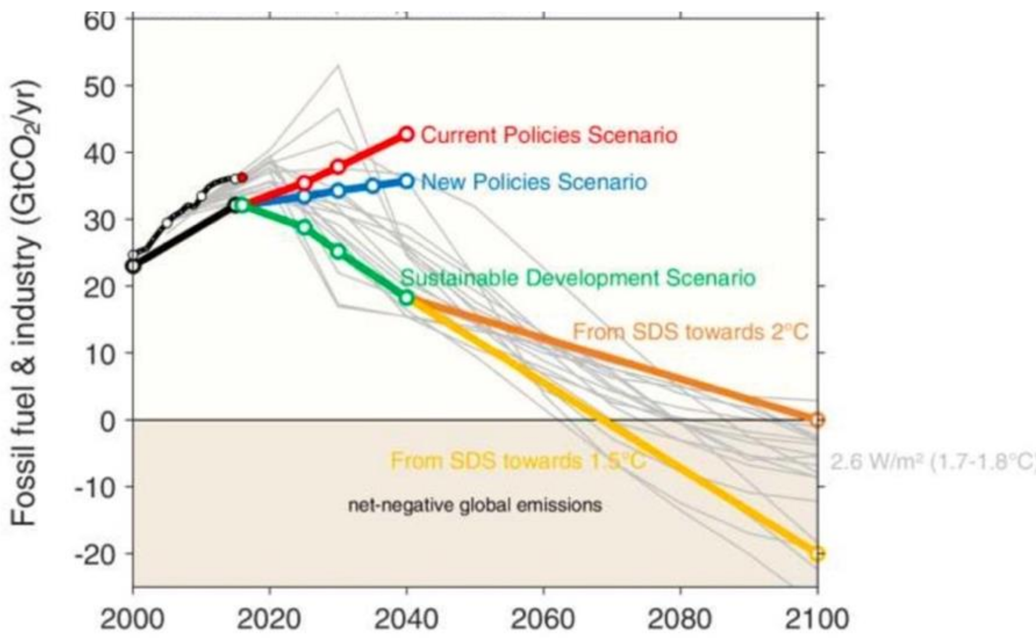
Section 2. Coal's Structural Decline

Each year, the International Energy Agency (IEA) releases the World Energy Outlook (WEO) which, among other things, models global energy demand using various scenarios. The scenarios are not predictions, rather tools to assess risks. The scenarios respond to global Paris Agreement targets aimed at keeping temperature rises to well below 2°C while collectively pursuing efforts to limit increases to 1.5°C.

Should the world successfully limit climate change to well below 2°C of warming, fossil fuel extraction must rapidly decrease towards zero net emissions, starting immediately. Thermal coal demand is the most negatively exposed commodity in this scenario. All countries must instead accelerate reliance on sustainable, affordable and renewable non-fossil sources of energy to avoid catastrophic climate change.

IEEFA sees the IEA's Sustainable Development Scenario (SDS) as the most likely reflection of the world's energy future. Global financial institutions exiting coal are generally committing[19] to the IEA's SDS or an even more ambitious transformation as outlined in the Beyond 2°C Scenario when they set Paris Agreement compliant targets.

Figure 2.1: Possible Carbon Emissions Pathways Reflecting IEA Scenarios



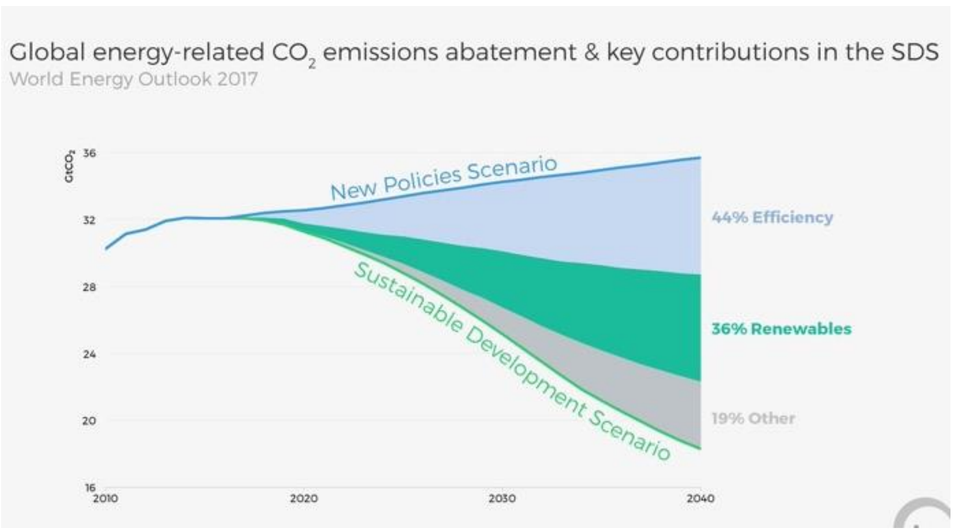
Source: Glen Peters, IEA WEO 2017, SS database (IIASA)P.[20]

[19] See IEEFA, Over 100 Global Financial Institutions Are Exiting Coal, With More to Come Every Two Weeks a Bank, Insurer or Lender Announces New Restrictions on Coal, 27 February 2019.
[20] Centre for International Climate Research (CICERO), Beyond Carbon Budgets and Back to Emissions Scenarios, Glen Peters, September 2018.

The **Sustainable Development Scenario** (SDS) presents a realistic, desirable scenario whereby nations work together to successfully limit climate change including a transformation of the energy market. Under the SDS, the planet's 'carbon budget' will be exhausted as early as 2023 under a 1.5°C target and by 2040 under a 2°C objective.

The SDS projects a significant decline in thermal coal demand, with global trade plummeting 65% by 2040. The SDS falls short of meeting the Paris Agreement's target with any certainty, given the IEA now questions its own presumption that coal carbon capture and storage (CCS) is commercialised at scale by 2030. IEEFA sees this as an improbable assumption given the IEA state the breakeven for power CCS is a US$60/t price on carbon emissions.[21]

Figure 2.2: Global Energy-Related CO2 Emissions Abatement Tools are Energy Efficiency and Renewable Energy



Source: International Energy Agency.[22]

The **Beyond 2°C Scenario** (B2DS) sets out a rapid decarbonisation pathway aligned with international goals. To achieve net-zero emissions by 2060, technological innovation is heavily invested in and deployed across the energy system consistent with a 50% chance of limiting average future temperature increases to 1.75°C. The B2DS falls within the Paris Agreement range of ambition.

The **New Policies Scenario** (NPS) models emissions continuing to rise until 2040 with global temperatures likely increasing more than 2.7°C by mid-century. The NPS assumes countries collectively will *not* take significant action to act on carbon emissions in line with 'ratchet-up' commitments in the Paris Agreement. Under the NPS, global coal trade declines 5% by 2040.

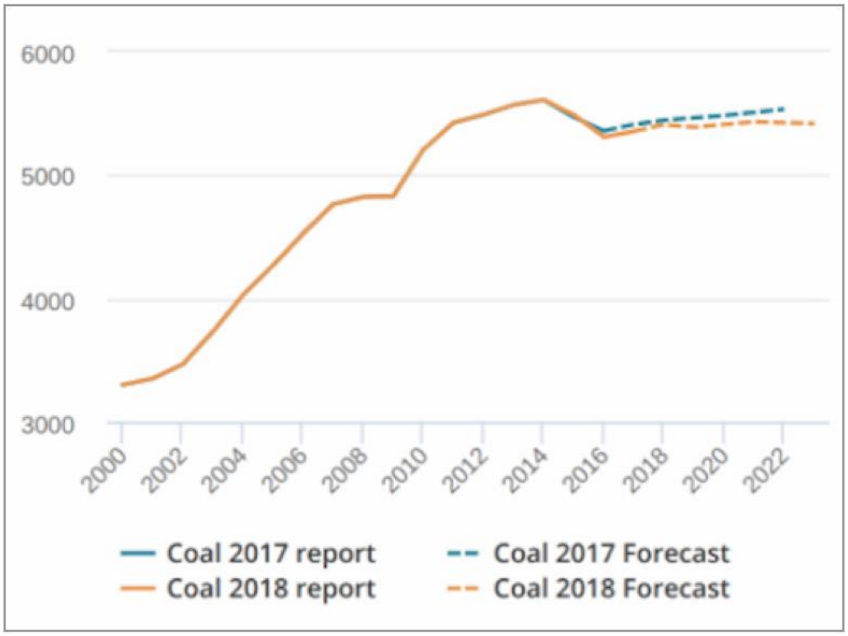
The **Current Policies Scenario** (CPS) assumes no effective concerted action on climate with the globe's carbon dioxide levels continuing to increase and the global warming target of 1.5°C exceeded by 2022. By definition, the CPS is consistently out-of-date as policies and measures since mid-2018 are not included.

[21] IEA, Carbon capture, utilisation and storage
[22] International Energy Agency World Energy Outlook 2017.

Reviewing IEA's coal forecasts to 2040

The IEA acknowledges that global coal use likely peaked five years ago in 2014 while modelling a stagnant near-term outlook to 2022 (See Figure 2.3).

Figure 2.3: IEA Global Coal Demand Actual and Estimates 2018 vs 2017 (Mtce)



Source: OECD / IEA

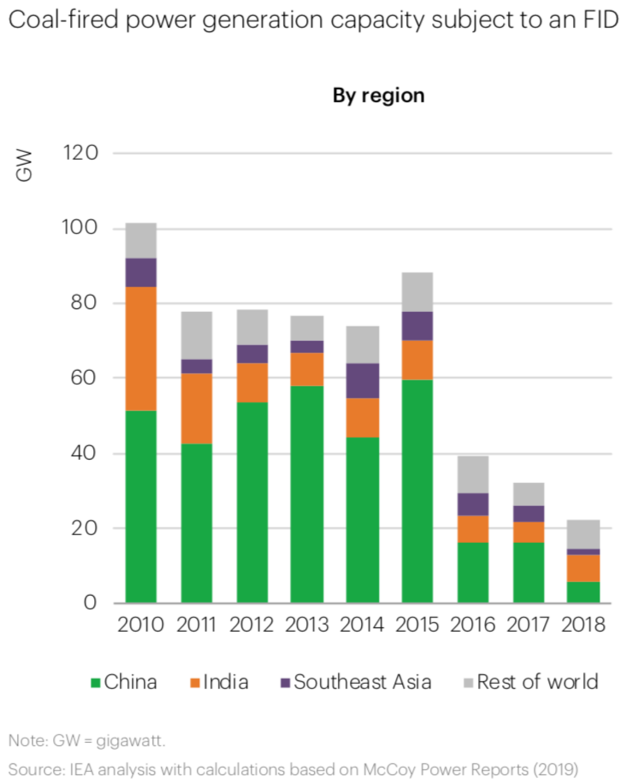
IEEFA notes the global seaborne thermal coal market is *not* likely to reverse the inevitable technology, cost and policy driven direction of a slow, steady and ultimately terminal decline in volumes by 2050, consistent with the IEA forecasts under a Paris aligned outlook.

Rather than sinking more capital into expanding redundant additional coal mining capacity, Australia would be better placed investing in new low emissions industries of the future while best transitioning the Australian economy and limiting our collective exposure to stranded assets.

Investors have responded by dramatically curtailing coal-fired power plant expansion plans (Figure 2.4). The momentum away from thermal coal is building and, with the arrival of a higher price on carbon emissions, zero emissions hydrogen-based virgin steel is likewise progressing towards commercialisation and widespread deployment within the 21 year life of the Rix's Creek Extension Project,[23] whilst the increased global availability of steel scrap from recycling likewise will continue to progressively erode the virgin steel market, along with its need for coking coal.

[23] International Mining, HYBRIT hydrogen storage facility finds financial backing, 3 October 2019

Figure 2.4: IEA Global Coal Power Plants Reaching Final Investment Decision Sign-off



Source: IEA, May 2019

As per the IEA, if the world delivers on an SDS or B2DS path consistent with limiting average warming to 2°C, global coal demand will drop by more than half to 2040 (-57%) (Figure 2.5).[24] This dramatic decline in both coking and thermal coal demand makes the Rix's Creek Extension Project capacity unnecessary and would in IEEFA's view challenge the project viability well within its planned life of operation.

Figure 2.5: IEA Global Coal Use 2014-16 vs Forecast 2040: NPS vs SDS (Mtce)

	2014	2015	2016	2017	NPS 2040	NPS Chg vs 2017	SDS 2040	SDS Chg vs 2017
Total Coal (Mtce)	5,680	5,531	5,225	5,360	5,441	1.5%	2,282	-57.4%
Coking Coal (Mtce)	1,016	994	956	960	806	-16.0%	579	-39.7%
Thermal Coal (Mtce)	4,374	4,254	3,979	4,134	4,412	6.7%	1,609	-61.1%
Coking Coal % of total Vol.	17.9%	18.0%	18.3%					

Source: IEA WEO 2017 page 644-645, WEO 2018 pages 520-521, IEEFA calculations

[24] As measured in millions of tonnes of coal equivalent (Mtce), an adjustment to standardise coal use by energy content.

Under the SDS, which is a possible 2°C outcome, traded seaborne thermal coal demand declines 65.1% against 2017 levels (Figure 2.6).

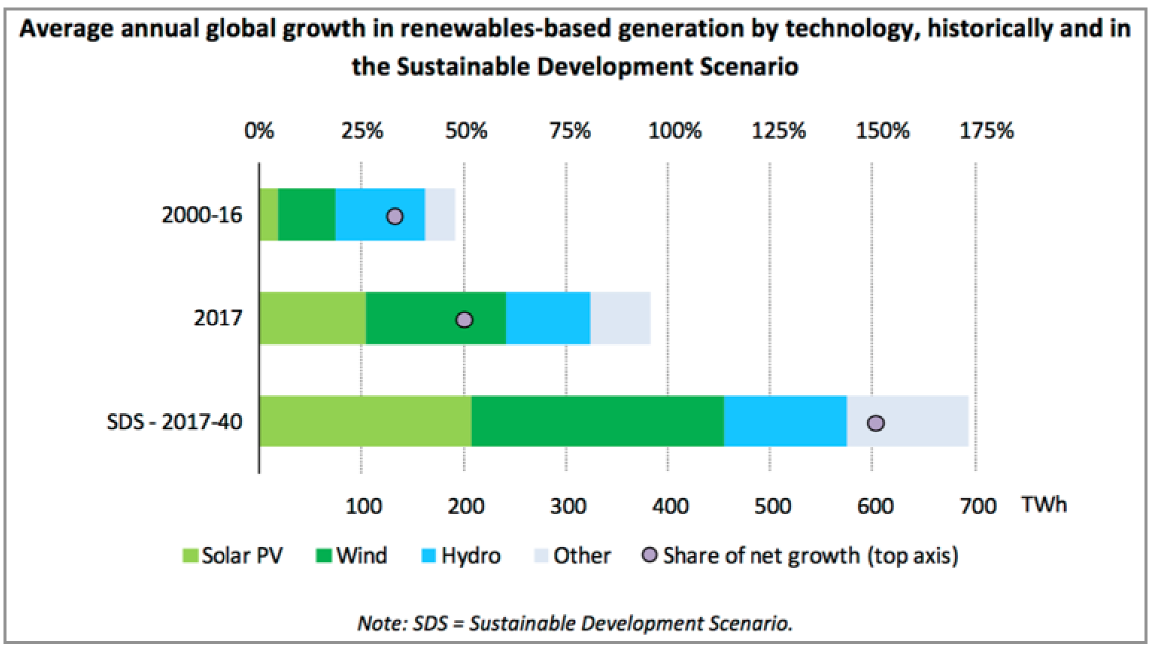
Figure 2.6: IEA Global Seaborne Coal 2014-17 vs 2040: NPS vs SDS (Mtce)

Mtce	2014	2015	2016	2017	NPS 2025	NPS 2040	NPS Chg vs 2017	SDS 2040	SDS Chg vs 2017
Thermal	801	761	756	805	736	760	-5.6%	281	-65.1%
Coking	284	293	292	302	320	346	14.6%	250	-17.2%

Source: IEA WEO 2016 page 206, WEO 2017 page 207, COAL 2017, NPS page 134, WEO 2018 p.218

The SDS models electricity generation from zero emissions technologies more than doubling through to 2040 relative to the record high set in 2017 (Figure 2.7).

Figure 2.7: The IEA SDS Forecasts Renewable Energy will supply 150% of net growth in electricity demand globally over 2017-2040



Source: IEA WEO2018

Section 3. Increasing Global Capital Flight from Coal

Financial Institutions Pivot Away from Coal, Towards lower Cost, Lower Emissions Alternatives

There is an accelerating global shift away from financing thermal coal and coal-fired power plants, matched with the rapid cost declines of renewable energy technology and the very clear message of the *United Nation's Intergovernmental Panel on Climate Change* (UN IPCC) highlighting the need to virtually cease global coal use by 2050.

Global investors managing US$32 trillion released a policy statement in December 2018 calling for a global price on carbon and an accelerated coal phase-out:

> *"Expert analysis shows that to meet the Paris Agreement goals of limiting the increase in global temperatures by 2°C, while striving to limit the increase to 1.5°C, a coal phase-out is needed by 2030, in the OECD countries and in the European Union; by 2040, in China; and by 2050, in the rest of the world."* [25]

Australian banks have all moved to recognise the global financial risks of climate change, making strong commitments to reduce funding for thermal coal mining and coal-fired power plants.

Westpac ruled out financing new thermal coal basins in April 2017.

Commonwealth Bank reported in August 2019 that it would: "ensure our business lending policies support the responsible transition to a net zero emissions economy by 2050… continuing to reduce our exposures to thermal coal mining and coal fired power generation, with the view to exiting the sector by 2030 subject to Australia having a secure energy platform; only providing financing activity to new oil, gas or metallurgical coal projects if supported by an assessment of the environmental, social and economic impacts of such activity, and if in line with the goals of the Paris Agreement".

Macquarie Group has flown under the radar to-date and made no public commitment to exit coal. Yet its actions speak louder than words and Macquarie has made renewable infrastructure investing one of its four global pillars of growth, and in September 2019 committed to invest in 20GW of renewable energy over the coming five years. Landmark renewable energy and storage deals across Europe and Asia show the momentum of global infrastructure investing towards decarbonisation.

Global coal divestment, policy exclusions and lending restrictions have all been progressing, with global financial institutions pivoting to boost lending to renewable energy infrastructure and other low emissions alternatives.

Today, over 110 globally significant financial institutions have divested from thermal coal, including 45% of the top 40 global banks and 24 globally significant insurers.

[25] IGCC, "Briefing Paper on the 2018 Global Investor Statement to Governments on Climate Change", December 2018.

Since the beginning of 2019, 30 coal restriction policies have been announced, including:

- January 2019 - **Export Development Canada** revealed its new Climate Change Policy: "No new financing for coal power plants, thermal coal mines or dedicated thermal coal-related infrastructure – regardless of geographic location."
- January 2019 - **Barclays Bank** UK expanded on its April 2018 exclusion of project finance for coal mining to also exclude coal plants.
- January 2019 – **Varma of Finland** announced cessation from investing in coal.
- January 2019 - **Nedbank of South Africa** withdrew financing for two major coal-fired power plant projects in South Africa.
- February 2019 - **VIG of Austria** ceased coal insurance.
- March 2019 – **MAPFRE** of Spain and **UNIQA** of Austria excluded coal insurance.
- March 2019 – **State Development & Investment Corporation** is the first leading Chinese financial institution to completely exit the coal industry.
- March 2019 - **BNP Paribas Asset Management** (€537bn AuM) announced a new coal exclusion policy.
- March 2019 – **QBE Insurance** announces its progressive exit from coal, globally.
- April 2019 – **DBS, UOB** and **OCBC of Singapore** each announce they will cease coal-fired power plant financing.
- April 2019 - Mitsubishi UFJ Financial Group (**MUFG**) is planning to establish quantitative targets for restricting both domestic and overseas coal project financing.
- April 2019 – **Hannover Re** tightened its existing coal fired power plant insurance criteria citing increased coal based risks.
- July 2019 – **Suncorp** of Australia and **Chubb** of the U.S. announced it would no longer provide insurance for new thermal coal projects.
- August 2019 - **FirstRand Bank** announced a formal coal exclusion policy.
- October 2019 – **Axis Capital** announced plans for a new coal exclusion policy.

While initial measures vary in effectiveness, IEEFA has found the trend is for financial institutions to ratchet up the strength of coal exclusion, restriction or investment policies once they are in place. With environmental and reputational concerns certainly driving factors for capital fleeing coal, investors are also increasingly aware that coal industry forecasts are increasingly dour.

About IEEFA

The Institute for Energy Economics and Financial Analysis conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the Author

Tim Buckley

Tim Buckley, IEEFA's director of energy finance research, Australasia, has over 30 years of financial market experience covering the Australian, Asian and global equity markets from both a buy and sell side perspective. Tim was a top-rated Equity Research Analyst and has covered most sectors of the Australian economy. Tim was a Managing Director, Head of Equity Research at Citigroup for many years, as well as co-Managing Director of Arkx Investment Management P/L, a global listed clean energy investment company that was jointly owned by management and Westpac Banking Group.

Appendix A
Resume - Tim Buckley

Director, Energy Finance Studies, Australasia at IEEFA
31 Inverallan Ave Pymble, Sydney 2073
Mobile 0408 102 127 email tbuckley@ieefa.org

Employment History

Director, Energy Finance Studies, South Asia / Australasia
Institute for Energy Economics and Financial Analysis (IEEFA) (June 2013 – present)

- Publishing of financial analysis into energy projects that impact on the global transition to a low carbon economy, analysis of energy efficiency and renewables and evaluation of the associated risks to stranded assets in the fossil fuel sector, particularly the seaborne thermal coal market for Australia.
- Primary market of focus is the Indian Electricity Sector.
- Presenting on global energy transformation at numerous energy finance conferences across China, India, Bangladesh, Singapore, Japan, U.S., Germany and Australia.

Arkx Investment Management - Managing Director (Jan 2010 – Aug 2013)

- Co-founder and Joint Portfolio Manager for the *Arkx Global Clean Energy Fund*, Australia's first wholesale global listed equities fund dedicated to investing in low carbon technology opportunities. Arkx was part owned by Westpac Banking Group.
- Undertook investment research analysis into global listed company stock selection through to portfolio construction and maintenance. Maintained financial models on 100 of the world's leading firms most leveraged to the move to a low carbon future.

Shaw Stockbroking – Head of Equities (Feb 2008 –Jan 2010)

- Headhunted from Citi to take on a newly created position, Head of Equities. Responsible for oversight of Shaw's Research, Institutional Research Sales and Corporate Finance arms, leveraging an excellent retail equities advisor business.
- The role was designed to provide Shaw a leadership transition to allow the CEO to retire on a 3 year timeframe. The GFC's onset meant this transition did not eventuate.

Citigroup – Managing Director, Head of Equity Research (1998-2007)

- 2006-2007: Managing Director, Equity Research - Equity Capital Markets – Investment Banking co-ordination and transaction vetting. A member of the five person Australasian Commitments Committee (CC). Evaluation and approval of all initial public offering and equity market issuance roles of Citigroup. A key project in this time was the $15bn bid for Alinta (jointly with Macquarie).
- 2002-2006: MD, Head of Research with a equity research staff of 100; Citigroup Australasia Executive (a management board of 8 covering Citibank, Diners Club, GCIB, Private Clients, Research & Insurance); Australasian CC; Equities Executive.
- 1998-2001: Deputy Head of Research, Appointed Managing Director in 2000.
- 1998-2003: Equity Market Research in Diversified Industrials and Beverages.

Deutsche Morgan Grenfell Asia – Director, Head of Equity Research (1996-98)

- Singapore based, Tim was co-head of DMG Singapore Equities, and worked closely with our retail equity partner, DMG & Partners (Singapore), a top 10 institutional and retail broker covering Singapore and Malaysia.
- Equity Market Research in the Asia Region Pulp & Paper (P&P) Sector.
- Singapore Equity Strategist / Head of Research with a team of 20.

County Natwest Securities – Director, Senior Equity Analyst (1992-1996)

- Equity Market Research in the Diversified Industrials, Beverages and P&P sectors. Key stocks under coverage included Foster's, BTR Nylex, Pacific Dunlop, Southcorp, Lion Nathan, Amcor, Fletcher Challenge, Carter Holt Harvey, Spicers Paper, Howard Smith, Wesfarmers and FIF.
- Career highlights: consistently ranked Top 3 in the Diversified Industrials, Beverages and P&P categories; and being ranked by BRW as Australia's top analyst in 1994/5.

Macquarie Equities – Senior Industrial Analyst (1988-1991)

- Equity Market Research in the Diversified Industrials sector. Key stocks covered included: Elders IXL, BTR Nylex, Pacific Dunlop, Southcorp, AFP and Wormald.
- Career highlights included being black-banned by Elders IXL's CEO John Elliott, and achieving Top 3 rankings in the Diversified Industrials category of the BRW and ABM analyst polls.

Education

HSC achieved at Barker College Hornsby (graduating in 1984, Top 1% in NSW)

Bachelor of Business, University of Technology, Sydney (1985-87)
- Graduated with Distinction
- Double Major in Accounting and Finance, Minors in Marketing and Computing

Lecturer in Finance and Accounting, University of Technology, Sydney – 1988

Lecturer in SIA – Advanced Equity Market Analysis 1990-1991

American Securities Exams   Series 7 Financial Analysts – 1998
Series 24 General Securities Representative Exam- 2003

ASIC required PS146 Registered Representative – 2003-2010

ASX Responsible Executive exam – 2008

A Selection of Tim Buckley's Major Reports Published

- "*Remote Prospects: A Financial Analysis of Adani's coal gamble in Australia's Galilee Basin*" in November 2013.
- "Shenhua Watermark Coal: A Stranded Asset", November 2014.
- "*A Better Way Forward for Electrification in Bangladesh*", November 2016
- "*Japan: Greater Energy Security Through Renewables*", March 2017
- "*State-Owned Utility NTPC Takes a Lead Role in India's Electricity Transition*", May 2017
- "*Winners and Losers Among Big Utilities as Renewables Disrupt Markets Across Asia, Europe, the U.S., and Africa*", October 2017
- "*India's Electricity Sector Transformation*", November 2017.
- "*China in 2017 Continued to Position Itself for Global Clean Energy Dominance*", Jan 2018
- "*Tamil Nadu's Electricity Sector Transformation*", February 2018
- "*Adani Godda Power Project: Too Expensive, Too Late, and Too Risky for Bangladesh*", April 2018
- "*Advances in Solar Energy Accelerate Global Shift in Electricity Generation*", May 2018
- "*Marubeni's Coal Problem: A Japanese Power Business Is at Risk*", July 2018
- "*Karnataka's Electricity Sector Transformation*", July 2018
- "*Tata Power exemplifying the Indian energy transition*", April 2019
- "*GE made a massive bet on the future of natural gas and thermal coal, and lost*", June 2019
- *"Conflating Queensland's Coking and Thermal Coal Industries",* June 2019

Expert Report

Rix's Creek South Continuation of Mining Project

Independent Planning Commission (IPC)

Written Submission

10 October 2018

Professor Will Steffen

Emeritus Professor, The Australian National University

Senior Fellow, Stockholm Resilience Centre

Executive Summary

1. Anthropogenic climate change is real and poses serious risks for the wellbeing of humans and our societies. These risks rise rapidly and nonlinearly with the rise in global average surface temperature.

2. Recognising that the risks to human wellbeing of unchecked climate change are too high to accept, governments around the world have agreed to limit warming to 1.5-2.0°C (the 2015 Paris accord).

3. The carbon budget approach is the most robust way to determine the rate of emissions reductions required to meet the goals of the Paris accord. This approach limits the cumulative amount of additional CO_2 emissions that can be allowed consistent with the Paris accord.

4. To meet a 2°C carbon budget, a very rapid phase-out of all fossil fuel usage by 2050 at the latest, or preferably earlier, is required. The 1.5°C carbon budget is smaller, requiring an even more rapid phase-out of fossil fuel usage.

5. This means that the majority of the world's existing fossil fuel reserves must be left in the ground, unburned. Furthermore, no new fossil fuel developments, or extensions to existing fossil fuel mines or wells, can be allowed.

Introduction

6. I have prepared this report in response to an expert brief provided to me by EDO NSW acting on behalf of Hunter Environment Lobby Inc, dated 8 October 2019.

7. I have reviewed Division 2 of Part 31 and the Expert Witness Code of Conduct under the *Uniform Civil Procedure Rules 2005*. In providing this report, I agree to be bound by their terms.

8. I declare that I have made all inquiries which I believe are desirable and appropriate (save for any matters identified explicitly in the report), and that no matters of significance which I regard as relevant have, to my knowledge, been withheld.

9. A copy of my curriculum vitae, including my relevant qualifications, is attached (**Appendix A**).

Anthropogenic climate change and its impacts

10. Anthropogenic (human-driven) climate change refers to the changes in the climate system caused by human activities, primarily the emission of greenhouse gases into the atmosphere. The most important of these gases is carbon dioxide (CO_2), with about 90% of CO_2 emissions arising from fossil fuel (coal, oil, gas) combustion and the remainder from land-use change (Le Quéré et al. 2017).

11. Greenhouse gases change the climate by trapping outgoing heat (long-wave radiation) from the Earth's surface and retaining it in the lower atmosphere and at the surface, thus increasing the energy of the climate system and raising its average temperature (Intergovernmental Panel on Climate Change (IPCC) 2013).

12. Currently global average surface temperature is about 1°C higher than pre-industrial levels and 2015, 2016, 2017 and 2018 were the four hottest years on record (National Oceanic and Atmospheric Administration, USA (NOAA) 2019).

13. The rate of climate change is alarming. The rise in atmospheric CO_2 concentration is up to 10 times faster than the most rapid changes in the geological record (Lüthi et al. 2008). Since 1970 global average surface temperature has been rising at a rate of 1.7°C per century, compared to a 7,000-year background rate of change of about 0.01°C per century (NOAA 2016; Marcott et al. 2013).

14. Many other features of the climate system, in addition to global average surface temperature, are changing as a result of anthropogenic greenhouse gas emissions (IPCC 2013). These include changes in the basic circulation patterns of the atmosphere and the ocean, increasing intensity and frequency of many extreme weather events, increasing acidity of the oceans, rising sea levels and consequent increases in coastal flooding, and intensification of the hydrological cycle.

15. The impacts of climate change are already being felt around the world. As reported by the IPCC (2013), the most authoritative assessment body on the science of climate change, some of the most important impacts are:
    a) Warmer and/or fewer cold days and nights over most land areas.
    b) Warmer and/or more frequent hot days and nights over most land areas.
    c) Increases in the frequency and/or duration of heat waves in many regions.
    d) Increase in the frequency, intensity and/or amount of heavy precipitation (more land areas with increases than with decreases).
    e) Increases in intensity and/or duration of drought in many regions since 1970.
    f) Increases in intense tropical cyclone activity in the North Atlantic since 1970.
    g) Increased incidence and/or magnitude of extreme high sea levels.

16. The most recent report of the IPCC, on oceans and the cryosphere (ice), show that these critical systems are changing rapidly, leading to increasing impacts, primarily on coastal areas (IPCC 2019):
    a) The global ocean has warmed unabated since 1970 and has taken up more than 90% of the excess heat in the climate system.
    b) Marine heatwaves have very likely doubled in frequency since 1982 and are increasing in intensity.
    c) By absorbing more CO_2, the ocean has undergone increasing surface acidification.

d) Global mean sea level is rising, with acceleration in recent decades due to increasing rates of ice loss from the Greenland and Antarctic ice sheets.
e) Increases in tropical cyclone winds and rainfall, and increases in extreme waves, combined with sea-level rise, exacerbate extreme sea level events and coastal hazards.

17. These changes in oceans and ice due to climate change have led to many observable impacts (IPCC 2019):
a) Ecosystems in high mountain and polar regions have been impacted by decreasing ice cover, with changes in abundance of species, ecological disturbances and ecosystem functioning.
b) Since 1950 many marine species have undergone shifts in range and seasonal activities due to ocean warming, sea ice change and biogeochemical changes. Impacts include shifts in species composition abundance, and changes in the biomass production of ecosystems.
c) Coastal ecosystems are being impacted by ocean warming more intense marine heatwaves, acidification, loss of oxygen, salinity intrusion and sea-level rise, in addition to direct impacts from human activities.

18. The impacts of climate change are also being felt in many ways across Australia, especially in the form of changes in extreme weather events (CSIRO and BoM 2015).

19. The evidence for the influence of climate change on worsening extreme weather includes:
a) All extreme weather events are now occurring in an atmosphere that is warmer and wetter than it was 70 years ago (Trenberth 2012).
b) Long-term data records show observed changes in the nature of extreme weather.
c) Climate models run with and without the additional greenhouse gases in the atmosphere from human emissions show the increase in likelihood that a specific extreme weather event would have occurred because of climate change.

20. The most important of these climate-related impacts are (CSIRO and BoM 2015):
a) Australia’s average surface temperature has increased by 0.9°C from 1910 to 2014 (and now to over 1.0°C (CSIRO and BoM 2018)).

b) Many heat-related records were broken in the summer of 2012-2013, and again in the two most recent summers. 2013 was Australia's hottest year on record.
c) Heat waves have increased in duration, frequency and intensity in many parts of the country.
d) Cool-season rainfall has declined in southeast and southwest Australia and wet-season rainfall has increased in northern Australia.
e) Heavy daily rainfall has accounted for an increased proportion of total annual rainfall over an increasing fraction of the Australian continent since the 1970s.
f) Extreme fire weather days have increased at 24 out of 38 monitoring sites from 1973-2010 due to warmer and drier conditions.
g) For 1966-2009 the average rate of relative sea-level rise along the Australian coast was approximately 1.4 millimetres per year.

21. Southeast Australia has experienced many of the impacts that have been observed around Australia as a whole (CSIRO and BoM 2015). In particular, these include:
a) Changes in heatwaves, such as more frequent occurrence, increasing number of heatwave days and the hottest day of a heatwave becoming even hotter.
b) Increases in the Forest Fire Danger Index have occurred mostly in the southeast region of the continent.
c) Strong drying trends in cool-season rainfall since 1990.
d) Three-fold increase in coastal flooding in the Sydney region through the 20th century.

22. The NSW mid-north coast region and adjacent inland areas have also experienced many impacts of climate change. These include:
a) The incidence of coastal flooding events has likely increased by approximately three-fold through the 20th century, as observed in Sydney Harbour (the nearest observation station with long-term records) (Church et al. 2006).
b) Heatwaves have worsened in the following ways: (i) the number of heatwave days is increasing; (ii) the first heatwave of the season is occurring earlier; and (iii) the hottest day of a heatwave is becoming hotter (Perkins and Alexander 2013).
c) In terms of bushfire weather, there are no long-term monitoring stations in the NSW mid-north coast region, but further inland in central-west NSW there has been a significant increase in the McArthur Forest Fire Danger Index (FFDI) from 1973 to 2013 (CSIRO and BoM 2015). At Nowra on the NSW South Coast, there has also

been an increase in the FFDI from 1973 to 2013, although of a smaller magnitude than for the central-west NSW station (Clarke et al. 2013).

d) Observations show mixed changes in rainfall patterns for the region. For the October to April period, rainfall has been above average for the 1997-2013 period. For the April to September period, rainfall has been above average along the coast but below average in some inland areas (CSIRO and BoM 2015).

Projections of future climate change

23. Future climate change will be driven in the near-term (several decades into the future) by the further amount of greenhouse gas emissions emitted by human activities, and in the longer term by both human emissions and feedbacks in the climate system (e.g., melting of permafrost, collapse of the Amazon rainforest) that could emit significant additional amounts of greenhouse gases to the atmosphere.

24. The projections for future changes in Australia's climate include (CSIRO and BoM 2016):

a) Temperatures will continue to increase, with more hot days and fewer cool days.
b) Oceans around Australia will warm further and acidification will continue.
c) Tropical cyclones are projected to decrease in number but increase in intensity.
d) Extreme rainfall events are likely to be more intense.
e) Harsher fire weather is projected for southern and eastern Australia.
f) Further decreases in winter rainfall for southern continental Australia, with an increase in droughts.

25. Projected changes in the climate of mid-NSW North Coast region and adjacent inland region (as part of the East Coast region) include (https://www.climatechangeinaustralia.gov.au/en/, based on CSIRO and BoM 2015):

a) Average temperatures will continue to increase in all seasons (*very high confidence*).
b) More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence*.
c) Decreases in winter rainfall are projected for East Coast South with *medium confidence*. Other changes are possible but unclear.

d) Increased intensity of extreme rainfall events is projected, with *high confidence*.
e) Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
f) A harsher fire-weather climate in the future (*high confidence*).

26. Globally, climate change projections for the rest of the 21st century range from:
a) A low emissions scenario (phasing out fossil fuels by the 2040-2050 period), which leads to a rise in global average surface temperature of 1.5-2.0°C above pre-industrial levels; to
b) A high emissions scenario, which is based on an increasing level of fossil fuel emissions through this century, leads to a temperature rise of 4°C or greater by 2100 (Collins et al. 2013).

27. Current global emissions are over 10 billion tonnes of carbon (emitted as CO_2) per annum, and have risen steadily since the mid-20th century, when emissions were about 3 Gt C (billion tonnes of carbon, emitted as CO_2) per year (Le Quéré et al. (2018; Figure 3). If the trend of rising emissions is continued, it would put the world on an emissions pathway between the IPCC RCP6.0 and RCP8.5 scenarios[1] (Collins et al. 2013, based on extrapolation of observed emissions trend in Le Quéré C et al. (2018); consistent with analysis in Climate Action Tracker (CAT) (2018).[2] Based on scenarios of changes in radiative forcing (i.e., the effect of (i) the atmospheric concentration of greenhouse gases and aerosols and (ii) the reflectivity of the Earth's surface on the Earth's surface energy balance – the difference between incoming solar energy and outgoing heat energy), climate models can simulate the resulting changes to the climate system).

28. Model-based projections of the level of climate change consistent with this emissions trajectory would lead to a global average surface temperature rise of 3-4°C by 2100. Thus, the world is currently on a pathway much closer to 26b) than to 26a) above.

[1] "RCP" is Representative Concentration Pathway, which is a scenario for the concentration of greenhouses in the atmosphere. The numbers refer to the 'radiative forcing' for each scenario, in watts per square metre.
[2] The Climate Action Tracker is an independent scientific analysis produced by three research organisations tracking climate action since 2009: www.climateactiontracker.org

29. The IPCC has summarised the risks to humanity of various levels of climate change through the so-called ‘burning embers’ diagram (IPCC 2014), Figure 1 below:

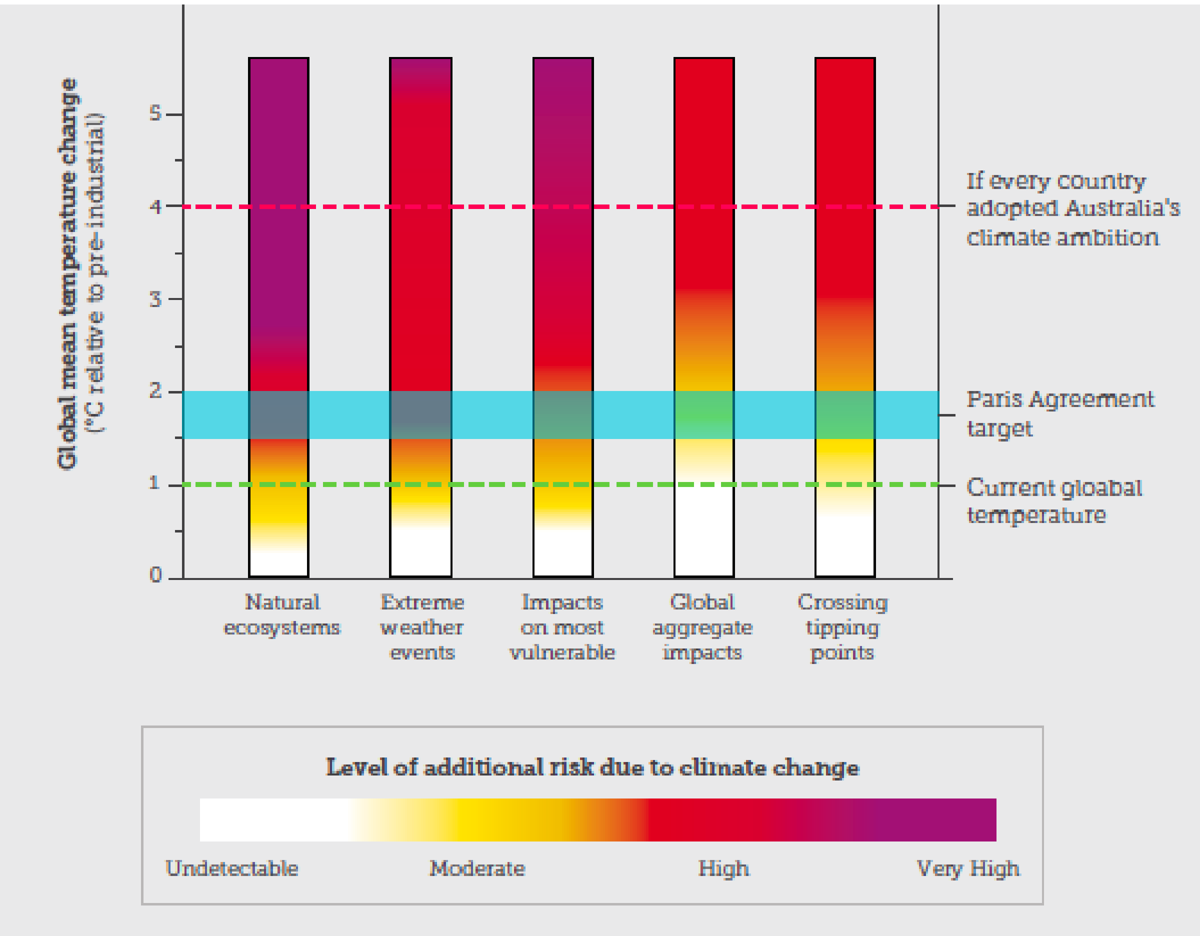


Figure 1: The IPCC ‘burning embers’ diagram – the reasons for concern about the impacts of climate change with increasing temperature. Adapted from IPCC (2014).

30. Figure 1 shows clearly that the impacts and risks of climate change increase nonlinearly with the increase in global average surface temperature, and connects these risks to levels of climate change using global average temperature as the indicator.

31. Figure 1 shows several levels of temperature:

a) The current observed level, ca. 1°C above pre-industrial levels.

b) The 1.5-2°C target range for the Paris accord.

c) The level of temperature increase by 2100 (ca. 3-4°C above pre-industrial) that would be reached if every country adopted Australia’s level of ambition in terms of targets and policies (CAT 2018). In its country analysis dated 30 April 2018, CAT identifies that Australia’s emissions are set to far exceed its Paris accord Nationally Determined

Contributions (NDC) target for 2030 (itself a target which, if followed by all other countries would lead to global warming of over 2°C and up to 3°C). Further, CAT assesses that, if all other countries were to follow Australia's current policy settings, warming could reach over 3°C and up to 4°C.

32. The synthesis of information represented by Figure 1 shows that:

a) Australia is not doing nearly enough to meet its obligations under the Paris accord, which it signed.
b) If every country followed Australia's level of action, the world would be on a trajectory to reach a 3-4°C temperature rise by 2100 and would thus face extremely damaging levels of climate change impacts (point 29c) above and Figure 1).

33. At today's level of climate change – about 1°C above pre-industrial – many impacts are already occurring. For example, many natural ecosystems are already being severely damaged (cf. points 15-22 above).

34. In Australia alone, the Great Barrier Reef suffered consecutive mass bleaching events in 2016 and 2017 driven by unusually high surface water temperatures as a result of climate change (Hughes et al. 2017); a large area of Tasmania's World Heritage forests was decimated by bushfires driven by unusually dry conditions with high temperatures (Prof D. Bowman, personal comm.); and a mass die-off of mangroves in the Gulf of Carpentaria which was driven by exceptionally high sea temperatures (Duke et al. 2016). Also at a 1°C temperature rise, extreme weather events are worsening in most parts of the world and severe impacts are already hitting the most vulnerable groups of people and countries (IPCC 2013; IPCC 2014).

35. The Paris accord range of 1.5-2.0°C is by no means 'safe'. As shown in Figure 1, at this level of climate change, the following risks/impacts would be expected:

a) Risks to natural ecosystems would be high; this refers to a rapidly rising risk of extinction for vulnerable species as well as increasing damage to ecosystems, such as bleaching of coral reefs and damage to forests by fires and insect attacks.

b) Extreme weather events would be far worse than today; for Australia this means far more severe heatwaves, more frequent and intense bushfires, an increase in extreme rainfall, and more frequent and damaging coastal flooding.
c) The risk of widespread impacts on the most vulnerable would rise from moderate towards high; this includes the population of less developed countries who have low resilience and adaptive capacity as well as the most vulnerable people in wealthy countries – children, older people and disadvantaged people.
d) The aggregated impacts of climate change around the world would increase political tensions and instabilities and take its toll on the global economy; as the most vulnerable countries and groups of people suffer increasing impacts, the risk of conflict and migration increases significantly, creating security threats in other parts of the world (UK MoD (Ministry of Defence) 2010; The White House 2015).
e) Some important tipping points, such as the Greenland ice sheet, would be at risk of being crossed, driving an unstoppable rise in sea level of up to 7 metres (Kintisch 2017). The summertime Arctic sea ice would almost surely disappear, accelerating warming in the northern high latitudes and disrupting atmospheric circulation patterns (e.g., the jet stream) (Figure 1; Schellnhuber et al. 2016).

36. A 4°C temperature rise would likely lead to a world that would hardly be recognisable today (IPCC 2014; Figure 1). There is a high to very high risk that:

a) Most of the world's ecosystems would be heavily damaged or destroyed.
b) Extreme weather events would be far more severe and frequent than today.
c) The most vulnerable people would increase greatly in number and, as large areas of the world become uninhabitable, migration and conflict would escalate.
d) The aggregated impacts around the world would significantly damage the entire global economy.
e) A cascade of intrinsic tipping points in the climate system could drive ongoing strong warming even as humanity finally took action to reduce its emissions (Figure 1).

Global and Australian targets for stabilising the climate system

38. In 2015, countries around the world carefully assessed the risks of allowing climate change to continue on a high emissions scenario (cf. Figure 1 and "Projections of future climate change" above) and agreed in the Paris accord on a new international framework for tackling climate change. The accord aims to "*…limit global average temperature rise to well below 2℃ and to pursue efforts to limit warming to 1.5℃*". The Paris accord is near-universal, with 197 countries signing the agreement.

39. Australia is a signatory to the Paris accord and so has committed to do its part in keeping the global average temperature rise to the 1.5-2.0°C range. Yet Australia's national greenhouse gas emission reduction target of a 26-28% reduction by 2030 compared to a 2005 baseline (United Nations Framework Convention on Climate Change (UNFCCC) 2015) is, based on an expert analysis by Australia's Climate Change Authority (CCA 2015), inadequate to meet Australia's Paris accord obligations.

40. The Climate Change Authority calculated that the appropriate target for Australia, consistent with its Paris accord obligations, would be a 45-65% reduction in emissions by 2030 from 2005 levels (CCA 2015).

41. Australia is not on track to meet its 2030 target, based on a linear emission reduction pathway between 2018 and 2030. Australia's emissions have actually risen over the past three years so Australia is trending in the wrong direction (Australian Government 2018), much less reducing emissions in order to meet the rate required. In fact, if the rest of the world adopted Australia's targets and policy settings, global average temperature would be headed for up to 4°C by the end of the century (CAT 2018), with all of the high-risk consequences outlined above.

42. This leads to the question of how does one scientifically determine what is an adequate rate of emission reductions to meet the Paris accord targets. A commonly used approach based on the well-proven relationship between the cumulative anthropogenic emissions of greenhouse gases and the increase in global average surface temperature (Collins et al. 2013) – the one adopted by the Climate Change Authority in 2015 (CCA 2015) – is the carbon budget approach.

The global carbon budget approach to climate stabilisation

43. The ‘carbon budget’ approach is a conceptually simple, yet scientifically robust, approach to estimating the level of greenhouse gas emission reductions required to meet a desired temperature target, for example, the Paris accord 1.5°C or 2°C targets (Collins et al. 2013).

44. The approach is based on the approximately linear relationship between:

a) The cumulative amount of CO_2 emitted from all human sources since the beginning of industrialisation (often taken as 1870); and
b) The increase in global average surface temperature (Figure 2; IPCC 2013).

45. Once the carbon budget has been ‘spent’ (emitted), then emissions need to be net zero[3] to avoid exceeding the temperature target.

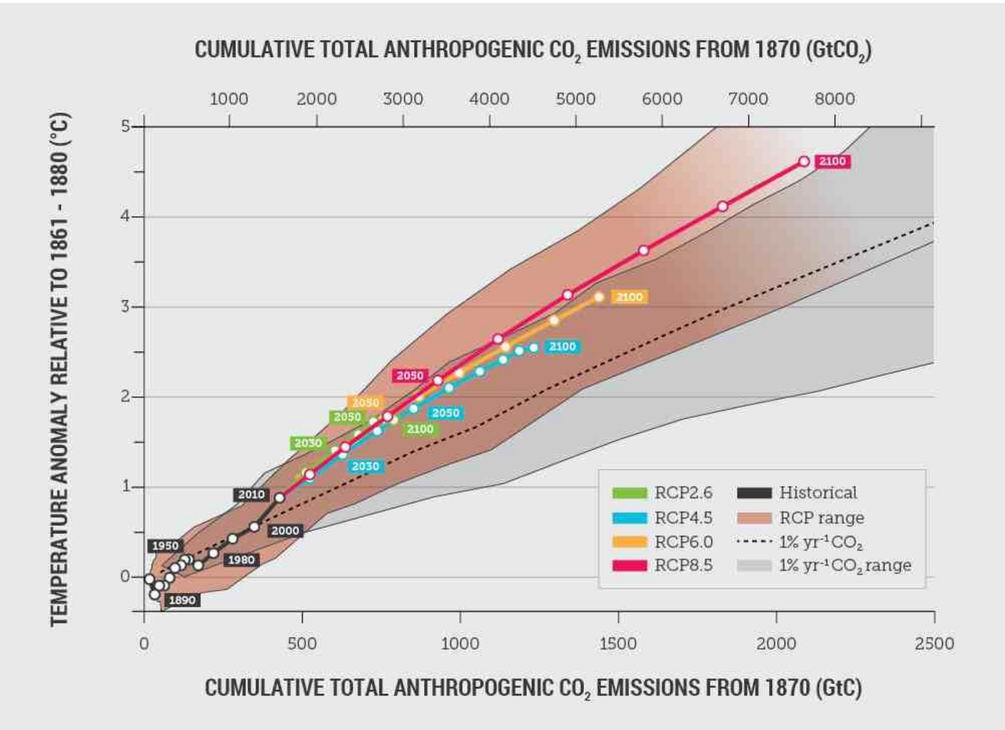


Figure 2: Global mean surface temperature increase as a function of cumulative global CO_2 emissions. The black line is global historical emissions and the coloured lines are climate model projections for various levels of human emissions. The coloured plume represents the spread of results across the models. From IPCC (2013).

[3] “Net zero emissions” means the magnitude of carbon dioxide emissions to the atmosphere is matched by the magnitude of carbon dioxide removal from the atmosphere by, for example, “carbon capture and storage – CCS” technologies, sometimes called “Negative Emission Technologies”. At present these technologies are in the early development stage, and none are technologically or commercially viable yet.

46. There are several key areas of uncertainty that influence the carbon budget required to meet a temperature target:

a) **<u>Probability of meeting the target</u>**. Higher probabilities of meeting a given temperature target (e.g. 2°C) require a more stringent carbon budget. Thus, there is a critical trade-off: relaxing the carbon budget to make it more feasible to meet means that there is a lower probability of achieving the desired temperature target.

b) **<u>Accounting for other greenhouse gases</u>**. Non-CO_2 gases (e.g., methane (CH_4) and nitrous oxide (N_2O)), which are important contributors to warming, are assumed to be reduced to zero at the same rate as CO_2 is reduced to zero. If non-CO_2 gases are not reduced, or reduced more slowly than CO_2, then the CO_2 budget is reduced accordingly. Most of the CH_4 and N_2O emissions arise from the agricultural sector, where emission reductions are generally considered to be more difficult and expensive to achieve than for the electricity generation sector. Thus, carbon budgets are often configured on the basis that reduction of CO_2 emissions from the electricity and transport sectors is more technologically feasible and less expensive than for the non-CO_2 gases, and therefore CO_2 emissions should be reduced even further to compensate for the continued emission of non-CO_2 gases.

c) **<u>Accounting for feedbacks in the climate system</u>**. Carbon cycle feedbacks, such as permafrost melting or abrupt shift of the Amazon rainforest to a savanna, are not accounted for in the carbon budget approach. Including estimates for these would reduce the budget further (Ciais et al. 2013). These are likely to be very significant. Quantitative estimates suggest that at a 2°C temperature rise (the upper Paris accord target), about 100-200 Gt C (billion tonnes of carbon, emitted as CO_2) of additional emissions to the atmosphere (about 10-20 years worth of human emissions at current rates) would be emitted (Ciais et al. 2013; Steffen et al. 2018). The upper estimate would virtually eliminate the remaining carbon budget (see Table 1 below).

47. Applying the carbon budget for a 2°C target demonstrates how it can be used. The IPCC estimates that for a greater than 66% probability of limiting global average temperature rise to no more than 2°C, cumulative human emissions since 1870 must be less than 1,000 Gt C (emitted as CO_2) (IPCC 2013). If non-CO_2 greenhouse gases are not reduced at the same rate, the carbon budget must be reduced by up to a further 210 Gt C to 790 Gt C (see 41b) above).

From 1870 through 2018 cumulative human emissions have been about 585 Gt C (Collins et al. 2013; Le Quéré C et al.2017). The remaining budget then becomes 205 Gt C.

48. The current rate of human emissions of CO_2 is about 10 Gt C per year (Le Quéré et al. 2017), so at these present rates of emissions, the carbon budget would be consumed in little more than two decades (at about 2040). Carbon cycle feedbacks are estimated to be 110 Gt C by 2100 for a 2°C temperature rise (the upper Paris target) (Steffen et al. 2018). This would reduce the budget to 95 Gt C, or about one decade of emissions at current rates.

49. I summarise this analysis in tabular form below:

Table 1: Carbon budget for a 66% probability of restricting temperature rise to no more than 2°C, based on the IPCC AR5 approach

Budget Item/Process	**Gt C**
Base budget based on IPCC (2013)	1,000
Accounting for non-CO_2 greenhouse gases	-210
Historical emissions through 2018	-585
Carbon cycle feedbacks (Steffen et al. 2018)	-110
Remaining budget to net zero emissions	**95**

50. The conclusion is that the world has 9.5 years of emissions (at current rates) remaining before the world's economy must reach net zero emissions (95 Gt C divided by 10 Gt C per year = 21.5 years). If carbon cycle feedbacks are ignored, the remaining budget is 205 Gt C, and so the world would have 20.5 years of emissions remaining (at current rates).

51. The IPCC SR1.5 (IPCC 2018) updated the carbon budget analysis and applied it to both the 1.5 and 2°C Paris targets. There are some differences between these budgets and the earlier IPCC AR5 budget (Table 1 above), primarily due to updated estimates of climate sensitivity, methodological changes in how pre-industrial temperature levels are estimated, and treatment of aerosol emissions, which lead to a net cooling effect. These updated methodologies, however, do not significantly alter the outcome of the carbon budget analysis, as shown in the two tables below, based on the IPCC SR1.5 budget estimates for the Paris

targets. Note that these budgets begin from 1 January 2018, and not from the beginning of the industrial revolution, as for the AR5 budget shown in Table 1.

Table 2: Carbon budget for a 66% probability of restricting temperature rise to no more than 2°C, based on the IPCC SR1.5 approach (IPCC 2018)

Budget Item/Process	**Gt C**
Base budget from 1 Jan 2018	360
Accounting for non-CO_2 greenhouse gases (Estimated from Table 2.2 of IPCC SR1.5 (2018))	-25
Historical emissions for 2018	-10
Carbon cycle feedbacks (Steffen et al. 2018)	-110
Remaining budget to net zero emissions	**215**

Table 3: Carbon budget for a 66% probability of restricting temperature rise to no more than 1.5°C, based on the IPCC SR1.5 approach (IPCC 2018)

Budget Item/Process	**Gt C**
Base budget from 1 Jan 2018	155
Accounting for non-CO_2 greenhouse gases (Estimated from Table 2.2 of IPCC SR1.5 (2018))	-25
Historical emissions for 2018	-10
Carbon cycle feedbacks (Steffen et al. 2018)	-70
Remaining budget to net zero emissions	**50**

52. A synthesis of all three carbon budget estimates shows that the world has, at most, about two decades remaining of emissions at current rates for a reasonable (66%) probability of meeting even the upper Paris target (a range of budgets from 50 to 215 Gt C, or from 5 to 21.5 years at current rates of emissions).

53. Applying these budgets to emission reduction trajectories emphasises the need to peak emissions by 2020 at the latest, followed by a steep reduction curve thereafter (the area under

the curves created by emission reduction trajectories is equal to the cumulative emissions of CO_2, which can then be directly compared to a remaining carbon budget – see Figure 3 below).

Implication of carbon budget approach for the rate of emission reductions

54. The carbon budget approach has strong implications for the trajectory of emission reductions towards their eventual phasing out. Figure 3 shows the importance for the rate of emissions reductions of the peaking year (the year in which global emissions peak before starting their downward trajectory). The areas under all of the curves on the graph are the same; they are equivalent to the cumulative carbon budget estimated by Figueres et al. 2017 (cf. Figure 3), either 600 Gt CO_2 or 800 Gt CO_2[4]. To allow comparison to the carbon budget above, expressed as Gt C, these CO_2 budgets become 144 and 198 Gt C, the more generous budget comparing well with the budget estimated above (215 Gt C, Table 1), and the smaller budget comparable to the 1.5°C carbon budget.

55. Figure 3 demonstrates the absolute importance of peaking global emissions as soon as possible, and then reducing emissions strongly thereafter. Although global CO_2 emissions flat-lined for the 2014-2016 period, they rose again in 2017 and yet again in 2018 (Le Quere et al. 2018). This implies that 2020 is probably the earliest that emissions can peak, and it is important that they do. Delaying the peak just five further years would create a subsequent emission reduction trajectory that would be impossible to follow economically or technologically (Figueres et al. 2017).

56. The clear message from any carbon budget analysis, under any reasonable set of assumptions regarding probabilities of actually meeting the budget and the sensitivity of the climate system to the level of greenhouse gases in the atmosphere, is that fossil fuel combustion must be phased out quickly, at the rate of the curves shown in Figure 3.

[4] The 600 Gt CO_2 budget is the midpoint of a wider range of budgets that represents different ways of calculating the budget for the Paris target range (1.5-2.0°C). The 800 Gt CO_2 budget is based on a lower probability of meeting the Paris target temperature range (Figueres et al. 2017).

57. Most of the world's existing fossil fuel reserves[5] – coal, oil and gas – must be left in the ground, unburned, if the Paris accord climate targets are to be met. I say that because the exploitation, and burning, of fossil fuel reserves leads to an **increase in** CO_2 emissions when meeting the Paris accord climate targets requires a rapid and deep **decrease** in CO_2 emissions.

58. An obvious conclusion that follows from this fact is that: No **new** fossil fuel development is consistent with meeting the Paris accord climate targets. That is, paragraphs 54-57 above demonstrate clearly that to meet the Paris accord, emissions must be reduced rapidly and deeply (cf. Figure 3 below), and to do this requires the rapid phase-out of **existing** fossil fuel mines/wells. **It is an obvious conclusion that no new fossil fuel developments can therefore be allowed.**

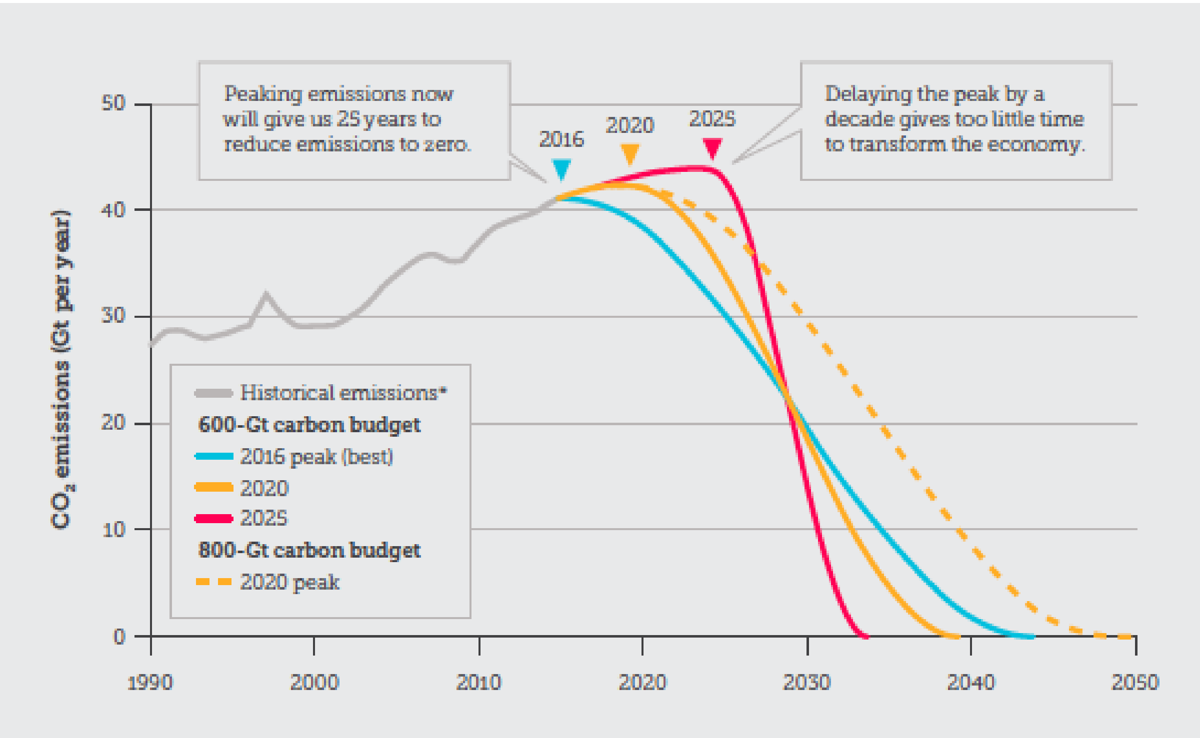


Figure 3. Emission reduction trajectories for meeting the Paris accord target(s). Delaying peak emissions to 2025 is too late for any achievable emission reduction trajectory. Note that the budgets in Gt CO_2; converting them to Gt C would give budgets of 164 Gt C and 218 Gt C, respectively. Budgets are from 2016; converting them to budgets from the end of 2017 would yield 144 Gt C and 198 Gt C, respectively. Source: Figueres et al. 2017

[5] "Reserves" are defined by McGlade & Ekins (see below) as a subset of "resources" that are recoverable under current economic conditions and have specific probability of being produced. "Resources" are the remaining ultimately recoverable deposits of fossil fuels that are recoverable over all time with both current and future technologies, irrespective of economic conditions. Thus, "resources are all of the fossil fuels that are known to exist, and "reserves" are the subset of resources that are economically and technologically viable to exploit now.

Applying the carbon budget approach to Australia and the Rix's Creek South Continuation of Mining Project

59. An economic analysis of a generous global carbon budget highlights the implications of meeting the Paris accord climate targets for the Australian fossil fuel sector (McGlade and Ekins 2015). Based on a 50% probability of meeting the 2°C temperature target, the global budget for the 2011-2050 period was estimated by the authors at 300 Gt C, somewhat higher than the budget in Table 1. The study showed that if all of the world's existing fossil fuel reserves were burned, about 780 Gt C would be emitted as CO_2, about 2.5 times greater than the allowable budget. Globally, 62% of the world's existing fossil fuel reserves need to be left in the ground, unburned, to remain within the carbon budget.

60. Meeting the carbon budget consistent with the Paris accord climate targets therefore means that not only must currently operating mines and gas wells be closed before their economic lifetime is completed (obvious from point 59 above – 780 is much larger than the assumed budget of 300), but also that no approved (but not yet operating) and no proposed fossil fuel projects, based on existing reserves, can be implemented. This analysis applies to the Rix's Creek South Continuation of Mining Project.

61. McGlade and Ekins (2015) then applied an economic analysis to the three types of fossil fuels – coal, oil and gas – and to the various regions of the world that are major producers of fossil fuels. Based on their analysis, 88% of global coal reserves are unburnable for any purpose (it is the CO_2 emissions that matter for the carbon budget approach, not the purpose for which the fossil fuel is burnt). The regional analysis yielded even more stringent conditions for Australia's fossil fuel industry (Australia is the only major fossil fuel producer in the OECD Pacific region; other countries in the region are only minor producers of fossil fuels). Over 90% of Australia's existing coal reserves cannot be burned to be consistent with the Paris accord 2°C target, and certainly not with the more stringent Paris accord 1.5°C target (McGlade and Ekins 2015).

62. The conclusions from this – or any other analysis based on a carbon budget – are:

- **Australia's existing fossil fuel industries must be phased out as quickly as possible, with most of the Australian fossil fuel reserves (and nearly all of**

Australia's coal reserves) left in the ground. Whether the fossil fuels are burnt within Australia or elsewhere is irrelevant from a scientific perspective; it is a single global atmosphere and a single planetary climate system that are affected by anthropogenic fossil fuel emissions.

- **Development of new fossil fuel reserves, no matter how small, is incompatible with any carbon budget assuming a 50% orbetter chance of the budget meeting the temperature target (see paragraph 46a): that is, a very generous budget) and with Australia's commitments to the Paris accord.**

- **Based on this analysis, approval of Rix's Creek South Continuation of Mining Project is inconsistent with the carbon budget approach to climate stabilisation.**

The fallacy of the "my emissions are too small to matter" or "some other coal resource will be developed if this one isn't" arguments

63. A common argument made for proceeding with new fossil fuel developments is that the resulting emissions are so small compared to the total global emissions (currently about 9 billion tonnes of carbon per annum) that they do not matter. The argument is also made at the national level in terms of Australia's national emissions being such a small fraction (ca. 1.2%) of the global total that they don't matter (i.e., "even if we reduce our emissions, it won't have a major effect on the climate").

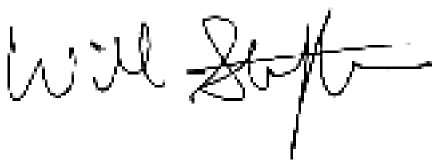
64. A second common argument is that if a proposed new coal development is not allowed to proceed, another new coal resource, either in Australia or overseas, will be developed to take its place. A supporting argument is that the development of new coal resources is required to meet society's basic energy needs (i.e., electricity).

65. These arguments are, in my opinion, fundamentally flawed. The first argument (paragraph 63) is flawed because it ignores the fact that global greenhouse gas emissions are made up of millions, and probably hundreds of millions, of individual emissions around the globe. All emissions are important because cumulatively they constitute the global total of

greenhouse gas emissions, which are destabilising the global climate system at a rapid rate. Just as many emitters are contributing to the problem, so many emission reduction activities are required to solve the problem.

66. A useful analogy for this first argument is the total tax revenue that a government agency collects each year to support the activities of the government. While there are certainly some large taxpayers (just as there are some large carbon emitters), there are also millions of Australians who pay a small amount of tax each year, compared to the total revenue. Each of these taxpayers could make the argument to the government agency that their amount of tax compared to the total revenue collected is so small that it does not matter. The government agency would very likely not accept that argument, and nor should decision makers, in my view, accept the argument that some activity's greenhouse gas emissions are so small that they do not matter.

64. The second argument (paragraph 64) is flawed because it assumes that there is now, and will continue to be, a demand for new coal resources beyond those that already exist. Observations of global coal production show that this assumption is not valid. Global coal production peaked in 2013/2014 and has been in a steady decline since then (Our World in Data 2018). In fact, coal production is dropping in all regions of the world – North America, Europe & Eurasia, Africa, South & Central America, the Middle East and Asia-Pacific (which includes Australia) (Our World in Data 2018). The trend towards decreasing coal production is very likely to continue, or even accelerate, as the world experiences more severe impacts of climate change over the coming decades and the economic and social advantages of renewable energy technologies become even more apparent than they are today.



Professor Will Steffen

10 October 2019

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APPENDIX A
CURRICULUM VITAE
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PERSONAL DATA

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CITIZENSHIP: Australian (Naturalised, February 1985)
MARITAL STATUS: Married, with one daughter (born 20/09/86)

EDUCATION AND DEGREES:

PhD (Honoris causa)	University of Canberra, Australia (April 2015)
PhD (Honoris causa):	Stockholm University, Sweden (September 2010)
PhD (Chemistry):	University of Florida, USA (August 1975)
MS (Chemistry):	University of Florida, USA (August 1972)
BS (Chemical Engineering):	University of Missouri, USA (May 1970)

ACADEMIC AFFILIATIONS

Senior Fellow, Stockholm Resilience Centre, Stockholm University, Sweden
Emeritus Professor, The Australian National University, Canberra
Adjunct Professor, The University of Canberra, Australia
Fellow, Beijer Institute of Ecological Economics, Stockholm
Senior Associate, University of Cambridge Institute for Sustainability Leadership, UK
Honorary Professor, Copenhagen University, Denmark

POSITIONS HELD

Sept 2013-present	Climate Councillor (with the independent, publicly funded Climate Council of Australia)

Nov 2011-present	Member, ACT Climate Change Council
Feb 2011-Sept 2013	Climate Commissioner (with Australian Government Climate Commission)
Jul 2008-June 2012	Executive Director, ANU Climate Change Institute, The Australian National University (ANU), Canberra
Aug 2004-Jan 2011	Science Adviser (part-time), Department of Climate Change and Energy Efficiency (earlier Australian Greenhouse Office), Australian Government, Canberra
Mar 2007-Jul 2008	Director, Fenner School of Environment and Society, and Director, ANU Institute of Environment, The Australian National University (ANU), Canberra
Oct 2006-Feb 2007	Pro Vice-Chancellor (Research), The Australian National University, Canberra
Oct 2005-Oct 2006	Director, Centre for Resource and Environmental Studies, and Director, ANU Institute of Environment, The Australian National University (ANU), Canberra
Jul 2004 –Jun 2006	Chief Scientist, International Geosphere-Biosphere Programme (IGBP), Stockholm
Aug 2004-Sept 2005	Visiting Fellow, Bureau of Rural Sciences, Department of Agriculture, Fisheries and Forestry, Australian Government, Canberra
Mar 1998 - Jun 2004	Executive Director, International Geosphere-Biosphere Programme (IGBP), Stockholm, Sweden
Dec 1990 - Feb 1998:	Executive Officer, Global Change and Terrestrial Ecosystems (GCTE) Core Project, International Geosphere-Biosphere Programme (IGBP), based at CSIRO, Canberra
April 1981 - Nov 1990:	Editor and Information Officer, CSIRO Centre for Environmental Mechanics, Canberra
Aug 1977 - July 1980:	Research Fellow, Research School of Chemistry, The Australian National University, Canberra
Sept 1975 - June 1977:	Postdoctoral Fellow, Department of Chemistry, Cornell University, New York, USA

PROFESSIONAL EXPERIENCE

Research Interests and Experience: -

- Earth System science, with a focus on integration and synthesis towards understanding planetary dynamics involving coupling of biogeochemical cycles and physical climate; dynamics of abrupt and irreversible changes; integration of natural and human dimensions of Earth System and climate science, particularly around the concept of the Anthropocene; global carbon cycle.

- Sustainability science, with an emphasis on ecosystem services as a unifying concept; global aspects of sustainability; integration of humanities scholarship into sustainability research; participatory research approaches.

- Global change and terrestrial ecosystems, with a focus on regional and global scales; terrestrial carbon cycle; incorporation of ecosystem dynamics in global vegetation models; functional type approach to modelling vegetation dynamics under global change; transect-based analysis of regional vegetation change.

- Structural inorganic chemistry, using x-ray crystallography as the primary tool to study transition metal chemistry; systems studied included tetrahedral zinc(II) complexes, isomerism in the palladium(II) thiocyanate system, stereochemistry of monothiocarbamate-metal complexes, the iron(II) porphyrin system and olefinic diphosphine complexes of tungsten and manganese tricarbonyls.

Science Leadership and Management:

- Creation of the ANU Climate Change Institute (Australian National University) in 2008, and its first Executive Director. Development of transdisciplinary climate change research projects involving natural science, social science, economics and humanities scholars at the ANU.

- Creation of the Fenner School of Environment and Society at the ANU in 2007, and its inaugural Director. Development of the School (60 academic staff and 120 PhD students) as Australia's leading transdisciplinary research and teaching unit on environment and society.

- Leadership as Executive Director of the International-Geosphere Biosphere Programme (IGBP), a multi-disciplinary international research programme on global change involving about 10,000 scientists in 80 countries around the world. Duties included: coordination of research effort involving 10 projects, support to the IGBP Chairman and to the Scientific Committee of the IGBP, management of the IGBP Secretariat (Stockholm) with a staff of 10 and an annual budget of USD 2.5M, publication of overview and synthesis papers on global change and Earth System science, promotion of global change science at international meetings and conferences around the world; numerous presentations at a wide range of fora in ca.

35 countries, liaison with policy communities on the application of IGBP science, and raising funds for IGBP activities.

- Management of the day-to-day operation of the Global Change and Terrestrial Ecosystems (GCTE) Core Project, an international research effort under the auspices of the IGBP, from 1990 to 1998. Duties included overall coordination of GCTE's international Core Research Programme (41 countries, 700 scientists and technicians, USD 33M per annum; establishment and overall direction of GCTE Impacts Centre, Bogor, Indonesia; and raising funds for GCTE activities.

- Leadership role in planning and carrying out a large number of international conferences and policy events, including three in the prestigious Dahlem Conference Series in Germany, Royal Colloquia in Sweden, two IGBP Congresses and the Challenges of a Changing Earth global change conference in Amsterdam in 2001.

Science-Policy Interface:

- Independent expert adviser to the Multi-Party Climate Change Committee. Australian Government. The role of the MPCCC, chaired by the Prime Minister Hon Julia Gillard, was to develop a long-term policy to reduce Australia's greenhouse gas emissions. The MPCCC built the Clean Energy Futures package, the centrepiece of which is an emissions trading scheme but with complementary programs for land carbon sequestration and biodiversity conservation.

- Advice to the Department of Climate Change and Energy Efficiency (previously Australian Greenhouse Office), Australian Government, on the link between science and climate change policy, with an emphasis on the scientific research needed to support policy development. Specific projects include carbon cycle research in support of carbon accounting and reporting; generic climate adaptation strategies across a broad range of sectors; definition of "dangerous climate change" with respect to Article 2 of the UN Framework Convention on Climate Change; and a review of the Australian Climate Change Science Program, towards developing a national framework for climate change research.

- General briefings and inputs at the international level to the development of policy on climate change and other aspects of global environmental change. The work included interaction with the European Union Commission for the Environment; advice to the Swedish Government Departments of Environment and Education and the Stockholm City Government, primarily on application of carbon cycle research; and contributions to the work of the Intergovernmental Panel for Climate Change (IPCC), primarily on implications of carbon cycle dynamics for carbon sinks policy.

- Contributions to development of climate risk management strategy for Australian agricultural sector, Bureau of Rural Sciences (BRS), Australian Government. The project involved consultation with industry/producers through workshop series, and production of decision support tools for climate risk management.

Teaching:

- Contribution to course development at the ANU, focusing on climate change courses at the post-graduate level and professional courses for public servants.

- Lectures on global change and the Earth System at the ANU and at Stockholm University, Sweden.

- Lectures, tutorials, and demonstrations in chemistry at the tertiary level at the ANU and the University of Florida, USA.

Communication and Outreach:

- Member of the independent Climate Commission, formed by the Australian Government in February 2011. Role of the Commission is to engage the Australian public, private sector and community groups on climate science, the economics of climate change mitigation, and international action on climate change. Activities in public forums around the country, business roundtables, site visits, community group engagement, production of reports and communication via the media. With the closure of the Commission in September 2014, became a Councillor with the publicly funded Climate Council of Australia, formed to replace the Commission.

- Numerous presentations on climate change, the Earth System and the Anthropocene to a very wide range of audiences, including governments at high levels, business and industry, non-governmental organisations (NGOs), professional organisations and the general public.

- Participation in a large number of conferences, summits, future think tanks and other events involving participants from all walks of life. Participation in the 2020 Summit in Canberra in April 2008.

- Much experience with the media, both print and electronic, on complex and contentious issues like climate change and sustainability.

- Provision of background support to and appearances in the Swedish documentary film “The Planet”, and contributions to several films on the Anthropocene.

- Operation of the editorial, communication, and information services at the CSIRO Centre for Environmental Mechanics 1981-1990.

ADVISORY/HONORARY POSITIONS AND REVIEW PANELS

Apr 2016 – present	Member, International Advisory Board, Centre for Collective Action Research, Gothenburg University, Sweden

Jan 2011 – present	Member, Volvo Environment Prize jury, Sweden (Chair of Jury from May 2013)
Jul 2004 – Dec 2015	Member, National Committee for Earth System Science (NCESS), Australian Academy of Science
Oct 2010 – July 2011	Member, Multi-Party Climate Change Committee, Australian Government
Oct 2009- Dec 2014	Chair, Antarctic Science Advisory Committee, Australian Government
Aug 2009 – May 2011	Member, Science Advisory Committee, APEC Climate Center, Busan, Korea
Jan 2005 – May 2010	Chair, International Advisory Board, QUEST (Quantifying and Understanding the Earth System) programme, UK
Oct 2005 – Nov 2008	Chair, Advisory Panel, Earth and Sun System Laboratory, National Center for Atmospheric Research, Boulder, CO, USA
Jan 2006-Dec 2008	Member, Advisory Board, Australian Bureau of Meteorology
May 2007	Review of the Australian Climate Change Science Program. Australian Government. Carried out with Dr Susan Solomon, NOAA, USA and Convening Lead Author, Working Group 1, IPCC Fourth Assessment Report
Apr 2007	Member of review panel, Potsdam Institute for Climate Impact Research, Germany
Aug 2006 – Dec 2006	Member, PMSEIC (Prime Minister's Science, Engineering and Innovation Council) working group on Australia's S&T Priorities for Global Engagement
Feb 2005	Member of review panel for du Laboratoire des Sciences du Climat et de l'Environnement (LSCE), Paris, France
Apr 2004	Member of review panel for the Tyndall Centre, UK (Climate Adaptation Research)

PUBLICATIONS LIST

WILL STEFFEN

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