



Climate Council of Australia

Submission to: Australian Energy Market Operator's
Draft Inputs, Assumptions and
Scenarios Workbook Consultation
2021

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About the Climate Council

The Climate Council is an independent non-profit organisation funded by donations by the public. Our mission is to provide authoritative, expert advice to the Australian public on climate change and solutions based on the most up-to-date science available.

To find out more about the Climate Council's work, visit www.climatecouncil.org.au.

1. Overview

The Climate Council thanks the Australian Energy Market Operator for this opportunity to contribute to the development of the 2021 Inputs, Assumptions and Scenarios Report (IASR), and the development of the 2022 Integrated System Plan (ISP). We would like to congratulate the forecasting team on bringing together the insights gained in the early workshops so thoroughly and look forward to engaging further in future.

Our feedback on the draft report cuts across several disparate areas: some narrow and some broad. Our most pressing concerns relate to the 'Diversified Technology' scenario. The Climate Council does see merit in developing a scenario that assumes greater diversity of generation and storage technologies. That said, we feel that this particular scenario and its assumptions are quite implausible and struggle to see how this scenario could be useful for any stakeholder at present.

We believe that its output would likely be quite likely to be misleading as to the possible future of Australia's largest grid. As a result, we feel that this scenario, as currently written, would have a detrimental effect on sensible efforts to plan electricity network infrastructure and suggest that it needs considerable on those grounds detailed below.

Diversified Technology scenario recommendations

Each of these recommendations go to the following matters for consultation in the draft IASR:

- *What, if any, elements of the Diversified Technology scenario as proposed are not plausible or internally consistent, and how would you suggest they be altered?*
- *If the scenario as specified is not considered to be useful in assessing the costs, benefits and/or need for investment in the NEM or eastern and south-eastern gas systems, are there adjustments that could be applied which would increase the utility of the scenario, while exploring similar risks and opportunities? and*
- *Do you have any feedback on the assumed coal and gas price trajectories?*

1. The Diversified Technology scenario featured in the draft IASR does not align with the Diversified Technology scenario in CSIRO's GenCost. This mislabelling is likely to mislead stakeholders relying on the IASR and the publications that build on it. The Operator should not attempt to obfuscate what this scenario is.
2. There is no realistic prospect of stable, consistently low gas prices across the next 20 years on the Australian east coast. While averages may be lower or higher depending on various assumptions, the next 20 years will be defined by price volatility. Any work building on the IASR needs to factor in this inherent volatility, including extreme short term spikes and crashes which will affect the economics of gas in the NEM. The Operator should consider alternative means to model gas prices that factor in the effects of this volatility.
3. It is not sufficient to simply assume two decades of consistently low gas prices without specifying the means by which this will be accomplished. The various mechanisms that might be implemented to distort the price of gas in this way will have different consequences for Australia's energy networks, including the NEM. For this scenario to have any utility at all, a specific and realistic mechanism to reduce the price of gas must be assumed and transparently disclosed.
4. The Diversified Technology scenario assumptions currently state that the internationally agreed goal of limiting global temperature increases to well below 2°C above preindustrial levels can be met while Australia free-rides on the decarbonisation efforts of other countries. This is quite simply not possible and there is no realistic prospect of meeting an RCP 2.6 pathway without Australia acting in a way that is commensurate with that goal. All references to meeting the global goal should be removed from this scenario, and the consequences of this failure to act on the grid, and on the

Australians relying on it, should be appropriately considered.

Along with these larger concerns, we have several relatively simple, though important, recommendations that apply more broadly.

General recommendations

The following recommendations are linked to a range of matters for consideration, as described in the body of the text.

5. The Operator should be clearer about the role of the Central scenario.
6. The Operator should confirm that the implementation of SSPs in the IASR has been conducted correctly by incorporating external advice from recognised experts in the field.
7. We suggest that the Operator revisit assumed emissions intensities in the NEM to implement recent changes to reporting and the most up-to-date science.
8. It is implausible that sustained low coal and gas prices would occur under pressure to decarbonise. The Operator should revisit the assumed fuel prices in those scenarios with high levels of decarbonisation.
9. We encourage the Operator to give the unique features and prospects of offshore wind more detailed consideration in the IASR and ISP than has occurred so far.

2. The Diversified Technology scenario

Each of the four recommendations in this section relate to the following matters for consultation in the draft IASR:

- *What, if any, elements of the Diversified Technology scenario as proposed are not plausible or internally consistent, and how would you suggest they be altered?*
- *If the scenario as specified is not considered to be useful in assessing the costs, benefits and/or need for investment in the NEM or eastern and south-eastern gas systems, are there adjustments that could be applied which would increase the utility of the scenario, while exploring similar risks and opportunities? and*
- *Do you have any feedback on the assumed coal and gas price trajectories?*

The Diversified Technology scenario contained in the draft IASR appear to be an effort to model the implications of the Federal Government's gas-led recovery, while including certain aspects of the Technology Investment Roadmap. We note as well that the scenario was named 'Gas-led Recovery' in the webinars that occurred before the second round of scenario development workshops. We have canvassed the issues with this approach elsewhere.¹

While the IASR and ISP should sit above the political fray, we think it is vitally important to note the political context that AEMO's work operates alongside. We are very concerned that AEMO's work may be used to mislead the general public about the relative merits of fossil fuel infrastructure in managing the 21st Century grid.

As a preliminary matter, we would like to suggest revising the name of the scenario to either restore the earlier, more accurate name ('Gas-led Recovery') used in the November webinar, or to something else entirely. The current title of the scenario (Diversified Technology) is misleading and does not reflect the true nature of the scenario and its origins. We note that the intention of the current name is to create a link with CSIRO's GenCost report, which has its own Diversified Technology Scenario. However, we contend that the use of this name is liable to confound or mislead stakeholders.

These two scenarios are quite distinct in their assumptions, and are not assessing the same thing. Quite apart from the fact that the draft IASR's scenario isn't in fact a 'diversified technology' pathway – in fact, we would expect that the output will show quite the opposite given the assumptions used – this misalignment means that drawing a link to the GenCost report is inappropriate. Among other things, we note that:

- (1) The CSIRO GenCost Diversified Technology scenario assumes a carbon price. No carbon price is assumed by the draft IASR.
- (2) CSIRO's GenCost assumes Australia acts commensurately with an RCP2.6 (low emissions) pathway and so plays its part in meeting a global goal of limiting global temperature increase to well below 2°C above pre-industrial levels. The draft IASR assumes Australia is and remains a global laggard and follows an RCP 4.5 (medium effort)-compliant pathway.

Setting aside the lesser difference between the two scenarios, this differences alone are sufficient to ensure that the two scenarios produce wildly different outcomes.

We do see merit in modelling a scenario that prioritises diversity of supply and increased redundancy, particularly given that the grid will be forced to handle increasing extreme events over the coming decades as a result of past and future greenhouse gas emissions.² But while recognising that this would be something other than a least-cost modelling scenario, the

Diversified Technology scenario proposed here is something quite different.

Recommendation 1. The Diversified Technology scenario featured in the draft IASR does not align with the Diversified Technology scenario in CSIRO's GenCost. This mislabelling is likely to mislead stakeholders relying on the IASR and the publications that build on it. The Operator should name the scenario accurately to order to avoid misleading stakeholders and the general public about its nature.

Alongside this, we question the gas price assumptions that are being relied on in the draft IASR on two grounds. While we are thankful that the AEMO forecasting team has rightly avoided some of the more extraordinary and fanciful prices have been discussed in recent media commentary, we nonetheless feel the price estimates relied on lack credibility by virtue of being stable.

Figure 1, below shows average gas prices across mainland NEM states over the past nine financial years. During this time, the price of gas has fluctuated wildly and – as AEMO has pointed through its Quarterly Energy Dynamics reports – this fluctuation has had a significant impact on the economics of energy in Australia. This is not an unsurprising outcome, given that the annual average wholesale price of gas tripled in each of these markets, but it is nonetheless remarkable.

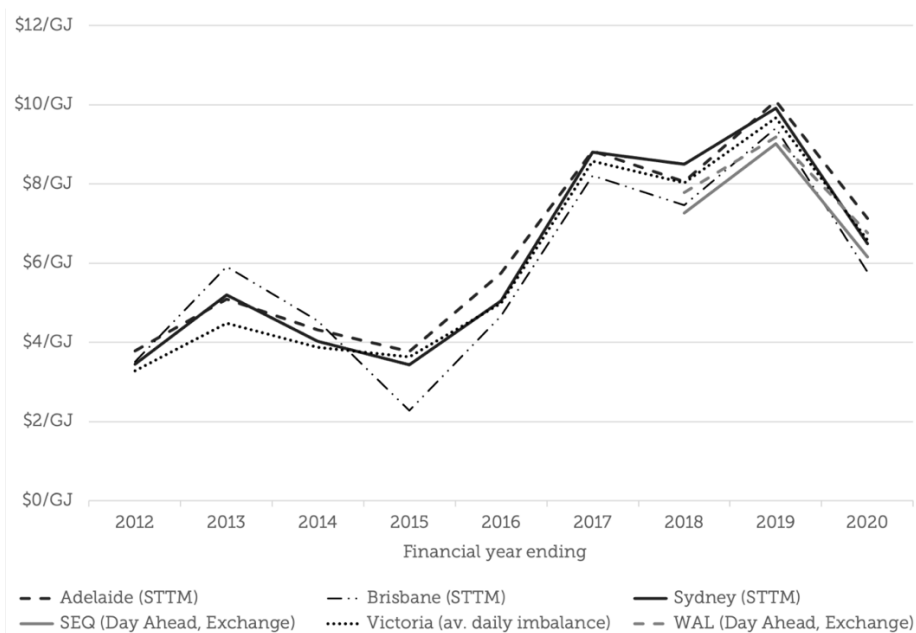


Figure 1: Wholesale gas prices in mainland NEM states (2012 - 2020). Data Source: AER.

Put simply – as the Climate Council has discussed more completely elsewhere,³ as has been confirmed in analysis conducted by the market Operator itself,⁴ and as covered by the work of bodies such as the Australian Competition and Consumer Commission⁵ – the over-inflation of the Australian east coast gas export industry has led to record volatility in the price of gas in that region.

Our opinion is that the most likely outcome for the gas price over the next two decades is that the price of gas will cycle repeatedly between being very expensive at times, and relatively cheap at others. We contend that the now the eastern Australian market for gas is linked to volatile international dynamics, this market is most likely to follow those boom-and-bust cycles seen elsewhere. In many ways, this is the worst possible outcome for the gas industry in NEM states. It will create bad outcomes for the producers of gas and for the users of the fossil fuel, including gas-powered electricity infrastructure.⁶ While COVID-19 has exaggerated these trends, many other global trends also contributed significantly, including international tensions around the price of oil,⁷ and a global over-supply of the fossil fuel.⁸ The pandemic will pass. However, the other volatile dynamics in the global oil and gas market will remain, ensuring that the global price of oil and gas will continue to fluctuate, as it has done for many decades.

Australia has previously been insulated from these fluctuations, but the commissioning and operation of Queensland's three gas export facilities ensures that energy prices in Australia is now acutely exposed, in part because the gas being exported from the three Gladstone terminals is expensive by world standards (see Figure 2). As noted by others, there is a significant risk of curtailment of these facilities in a globally over-supplied market.⁹ Meanwhile, recent spikes in the price of gas demonstrate the other aspect of this volatility, as high demand in China and southeast Asia has pushed the price of gas back up from the recent low prices.¹⁰

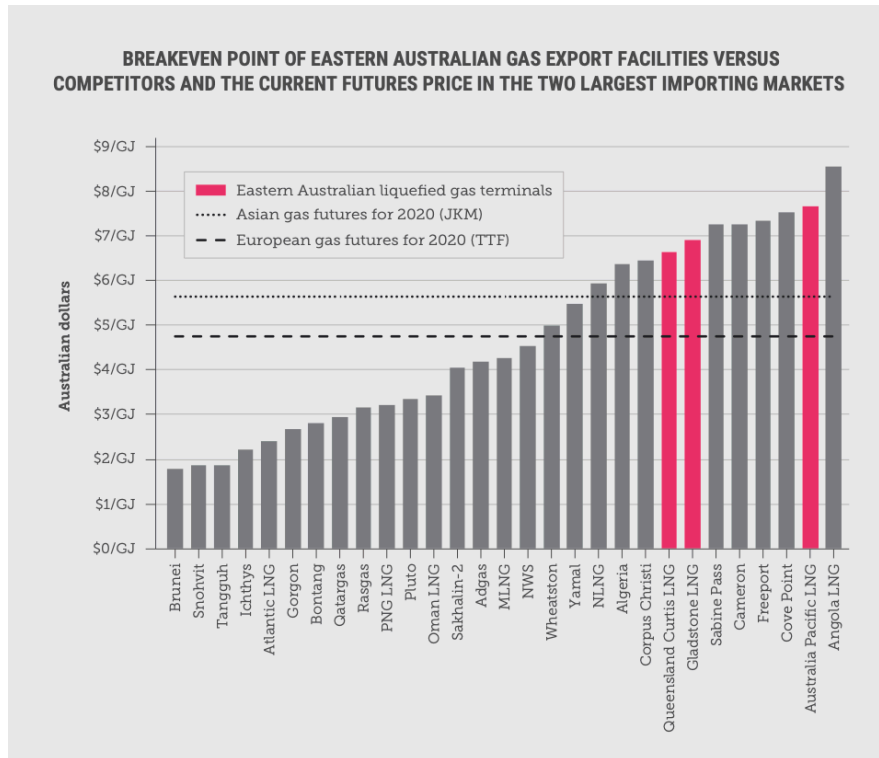


Figure 2: Eastern Australian gas facilities are expensive by world standards. Image source: Climate Council.¹¹

Of many possible futures for the price of gas in NEM states, we contend that the least likely of all possible outcomes is that there will be sustained, consistently-low gas price for two straight decades. The recently signed Heads of Agreement signed by the Federal Government and Queensland's three gas exporters includes no substantial new commitments to lower the price of gas.¹² Even if considerable, unnecessary and undesirable underwriting of gas infrastructure by Australian governments proceeds – as was reportedly proposed by the National COVID-19 Coordination Commission's Manufacturing Taskforce report last year¹³ – price shocks will continue to affect the market for gas on the east coast. This will of course flow into the economics of gas-powered generation.

It is vital that IASR be built on a more realistic future gas price than an assumption that gas will be either relatively expensive or relatively cheap for twenty straight years. As noted in the AEMO commissioned report from Lewis Grey Advisory, predicting anything about future gas prices ahead of time is difficult,¹⁴ and predicting volatility in the gas price is even more complicated. That said, we note that the ISP does already manage this kind of aleatory uncertainty elsewhere and note that inter-annual changes in the availability of hydro-electricity are already accounted for. There may be similar ways to replicate this to account for volatility in the price of gas.

Related to the above, we feel that it is insufficient for the Diverse Technology scenario to just assume a low gas price. The method used to bring about this outcome will have significant flow on effects for Australia's energy networks and these must be accounted for if the forecasting efforts are to have utility.

Many different mechanisms have been proposed over the past year in order to artificially lower the price of gas. These include potential gas reservations or price controls, the underwriting of new gas infrastructure, the NCCC Manufacturing Taskforce's proposed 'book build' mechanism to de-risk investment, the indication that government-owned corporations might be compelled to build new gas-fired infrastructure, and many others. Each of these different mechanisms to artificially lower the price of gas, or gas-fired generation, will distort the market for gas in different ways, with flow on effects for the entire Australian energy network.

There is little utility to the Diverse Technology scenario if it does not transparently disclose how the low gas price is reached and maintained for 20 straight years years.

Recommendation 2. There is no realistic prospect of stable, consistently low gas prices across the next 20 years on the Australian east coast. While averages may be lower or higher depending on various assumptions, the next 20 years will be defined by price volatility. Any work building on the IASR needs to factor in this inherent volatility, including extreme short term spikes and crashes which will affect the economics of gas in the NEM. The Operator should explore options for modelling the price of gas that account for continued volatility in the price of gas.

Recommendation 3. It is not sufficient to simply assume two decades of consistently low gas prices without specifying the means by which this will be accomplished. The various mechanisms that might be implemented to distort the price of gas in this way will have different consequences for Australia's energy networks, including the NEM. For this scenario to have any utility at all, a specific and realistic mechanism to reduce the price of gas must be assumed and transparently disclosed. The Operator should make a principled decision about which distortions of the gas price it is modelling.

Finally, we note that there is a material inconsistency in the stated global emissions pathway contained in the draft IASR and the integrated assessment models that these pathways claim to be based on. The unprecedented level of decarbonisation required to meet even the globally agreed upper goal of limiting global temperature increases to well below 2°C above pre-industrial levels – an RCP2.6 emissions pathway – cannot

be met without decisive and concerted effort from Australia, currently one of the world's largest emitters.

To assume, as the draft IASR does, that the goals of the Paris Agreement can be met without sustained effort from every one of the world's largest emitters is to misunderstand the scale of the global emissions reduction challenge. The assumption that Australia can act in accordance with an RCP4.5 emissions reduction scenario while the global community meets the level of emissions reduction necessary for an RCP2.6 world is inappropriate and should be removed.

Australia is the world's fourteenth largest emitter.¹⁵ Given that more than 180 countries emit less than it, that makes its contribution to climate change significant on these terms alone. On a per person basis, Australia is one of the biggest emitters in the world. The lives and livelihoods of Australians are the highest emitting of any developed nation, and the only countries emitting more than Australia on a per person basis, such as Qatar, have substantially lower populations. The three brown coal fired power stations in Victoria, Yallourn, and Loy Yang A and B emit as much per year as the entire nation of Sri Lanka: a country with a population of 22 million people.¹⁶ Even if one only considers the greenhouse gases emitted from Australia, Australian is an extraordinary greenhouse gas emitter.

However, considering Australia's impact on climate change only in terms of what is burned here misses important aspects of the story. Australia is also an extraordinary exporter of fossil fuels. On a production basis, the fossil fuel emissions of Australia's coal and gas is sufficient to make it the third largest exporter of fossil fuels in the world, and the fifth largest producer.¹⁷ This is hardly surprising given that Australia is the world's largest exporter of both metallurgical coal and liquefied gas, and the world's second largest exporter of thermal coal.¹⁸

Australia is no special case, and there is no prospect of Australia being permitted to fail, while every other countries act. Indeed, given the scale of Australia's fossil fuel exports, international action without Australian action is not possible. Countries worth 70% of Australia's exports have set net zero emissions targets, signalling their intent to transition away from fossil fuels. It is not believable that they will not expect Australia to take steps to do the same.¹⁹

There is no realistic prospect of meeting the goal of limiting global temperatures to well below 2°C above pre-industrial temperatures without Australia playing a meaningful part in meeting that goal. There is no clear rationale why the modelling of the Diversified Technology scenario should assume that the global goal is met. In the interest of transparency, the Operator should ensure that the Diversified Technology scenario – and the entire Gas-led Recovery initiative – be represented accurately.

We are already paying the price for failing to deeply and rapidly reduce our emissions. Any further failure to act on climate change will have catastrophic consequences for Australian lives, livelihoods and the places we cherish. If Australia fails to act with ambition, then this will have global consequences, it is incumbent on the Operator to deal with this fact transparently, rather than minimising it within the assumptions.

Recommendation 4. The Diversified Technology scenario assumptions currently state that the internationally agreed goal of limiting global temperature increases to well below 2°C above preindustrial levels can be met while Australia free-rides on the decarbonisation efforts of other countries. This is quite simply not possible and there is no realistic prospect of meeting an RCP 2.6 pathway without Australia acting in a way that is commensurate with that goal. All references to meeting the global goal should be removed from this scenario, and the consequences of this failure to act on the grid, and on the Australians relying on it, should be appropriately considered.

3. General Feedback

This recommendation relates to the matter for consideration:

- Acknowledging that AEMO will consider current committed policy settings within this scenario which meet the criteria outlined in Section 4.1 and clause 5.22.3 of the NER, and considering AEMO's best estimates of all key drivers, do you have any feedback on the Central scenario as proposed?
- Do you support the approach outlined for the inclusion of government policy across the scenarios?
- Are there any energy or environmental policies missing that you consider important to include in some or all of the proposed scenarios? Please provide details.

In the 2020 Integrated System Plan, it is at times unclear whether the Central scenario is intended to represent a stated policies scenario or a scenario that assumes neutral settings. These are not interchangeable concepts, especially in terms of assessing likely future policies, such as the need for the Australian government to submit new Nationally Determined Contributions (NDCs) the Paris Agreement as part of our international commitments. We note that it is similarly difficult to determine which role the Central scenario is intended to fill in the draft IASR. We contend that the use of the term 'Central' implies neutral settings, but that the NER requires that it be more of a stated policies scenario.

This may seem excessively particular, but we note that the Central scenario is widely – often wrongly – used as a forecast of the most likely future for the NEM. It is in the interests of the operator to limit the degree to which the scenarios might be misused. The Central scenario cannot be both at once given Australia’s climate mitigation commitments to the international community.

Under the Paris Agreement (article 4.2), Australia has committed to submit a revised NDC every five years. While much of the Paris Agreement is non-binding, the commitment to submit a revised commitment every five years is enforceable. Alongside this, each of these commitments must represent a progression beyond the previous contribution (article 4.3). Australia’s international emissions reduction commitments must progress beyond the current 2030 goal, and so the best estimate of the future is that they will.

Given that the Central scenario is intended to fulfil the requirements of section 4.1 and clause 5.22.3 of the NER, and so limited to those government policies announced and sufficiently supported by concrete action, it cannot represent the best estimate of the future.

We recommend that the Operator split the current Central scenario up, creating a truly Central scenario and a separate Current Policies Scenario.

Recommendation 5. The Operator should be clearer about the role of the Central scenario. This may require creating one scenario that is a ‘stated policies scenario’ and another the represents a best estimate of the future of Australia’s largest grid.

The following recommendation is related to the matters for consideration:

- *Do you consider the proposed scenario alignment to the SSPs appropriate?*
- *Do you consider the global temperature pathways proposed to be assigned to each scenario appropriate?*
- *Would you support the use of the AR6 updated climate assessments, if available ahead of the final 2021 IASR?*
- *Do you consider the proposed Australian pathway and proposed NEM budgets appropriate for each scenario?*
- *Do you have an alternative proposed method to decompose global emission pathways to a NEM target? What is it? How would you account for emission reductions in other sectors, and the contribution of the LULUCF sector?*

We praise the forecasting team for endeavouring to link the IASR to the Shared Socio-economic Pathways (SSPs) contained in the forthcoming Sixth Assessment Report of the Intergovernmental Panel on Climate Change. That said, while there is insufficient detail in the draft report to

understand the full methodology used, we suspect that there may be some issues of implementation.

This is a highly technical and specialised exercise and we suggest reaching out to external experts to ensure that the implementation is performed correctly. These same experts would be best placed to assist with the best methods for downscaling the global emissions budget to Australia and then, in turn, to the NEM.

Recommendation 6. The Operator should confirm that the implementation of SSPs in the IASR has been conducted correctly by incorporating external advice from recognised experts in the field. We would gladly facilitate the necessary connections and encourage the Operator to reach out to the Climate Council team for these referrals.

We were unable to find a specific matter for consideration the following recommendation within the draft report, though note that it is relevant to several other background for several other matters for consideration. Including the emissions budgeting matters addressed above.

Using the same method as was relied on in the original ACIL Allen report,²⁰ and applying it to the four most recent years of Clean Energy Regulator data, we have noted certain issues in the power station emissions intensities contained in the draft workbook. While we did not check every power station contained and its listed emissions factor, we note that the Scope 1 emissions factors listed for Barcaldine and Hunter Valley GT (999.96 kgCO₂e/MWh 887.18 kgCO₂e/MWh respectively) are very far from the efficiencies that had been obtained at these stations over the course of the past four years (2,430.14 kgCO₂e/MWh and 1,228.30 kgCO₂e/MWh).

We suggest that it is time for the assumed emissions intensity of NEM power stations to be revisited. We note that the Federal Government has recently amended the *National Greenhouse and Energy Reporting Regulations 2008* in an attempt to bring Australia emissions reporting into line with the Fifth Assessment Report of the IPCC.²¹ However, as noted in a recent Climate Council report, we note that these changes were implemented incorrectly.²²

The above issues mean that there is good reason to revisit the assumed emissions intensity of NEM power stations. Given extensive changes expected in the IPCC's Sixth Assessment Report²³ – to be released in 2021 – and the failure to correctly implement the previous assessment report, we suggest that this analysis should go beyond the Clean Energy Regulator data.

Recommendation 7. We suggest that the Operator revisit assumed emissions intensities in the NEM to implement recent changes to reporting and the most up-to-date science.

The following recommendation concerns the matter for consideration:

- *What, if any, elements of the Sustainable Growth scenario as proposed are not plausible or internally consistent, and how would you suggest they should be altered?*
- *What, if any, elements of the Sustainable Growth scenario as proposed are not plausible or internally consistent, and how would you suggest they should be altered?*
- *Do you have any feedback on the assumed coal and gas price trajectories?*

We would like to query the assumed coal and gas fuel prices for the Sustainable Growth and Export Superpower scenarios. In these scenarios, the cost of both oil and gas is assumed to be low as a result of decreased demand for the fuels, we would suggest that the most like outcome under these scenarios is indeed a drop in domestic price of oil and gas over the short term. However, the decarbonisation imperatives that will drive down demand for fossil fuels must also impact the supply of oil and gas. While the impact on supply may be slower, it is not plausible that these two scenarios would have sustained low prices for coal and gas over a 20-year period.

The impact, and will likely do so in a relatively short period of time, is it certainly not likely that aggressive and necessary decarbonisation will lead to 20 years of sustained low gas prices. As with the Diversified Technology scenario, is it necessary for the Operator to develop assumed fuel prices that are far more nuanced than what is currently being used.

Recommendation 8. It is implausible that sustained low coal and gas prices would occur under pressure to decarbonise. The Operator should revisit the assumed fuel prices in those scenarios with high levels of decarbonisation.

The following brief recommendation is relevant to the following matter for consideration:

- *Is AEMO's proposed list of candidate technologies reasonable? If not, what should be included/excluded?*

Offshore wind is a unique resource, and the features and benefits deserve deeper consideration in the IASR and ISP that has been seen to date.

Sustained policy support for the industry would likely deliver long-term benefit to the security of the grid. There has been considerable progress on efforts to establish an Australian offshore wind industry, both through the Star of the South project and elsewhere in the country.

We are concerned that under the current process the benefits that offshore wind would bring to the grid are likely to be downplayed, with the resource being given less consideration than it deserves. This deeper consideration could take a number of forms, but we suggest that the operator might consider developing a sensitivity that factors in the possibility of consistent and stable policy support for this new industry with clear potential.

Recommendation 9. We encourage the Operator to give the unique features and prospects of offshore wind more detailed consideration in the IASR and ISP than has occurred so far.

Endnotes

- ¹ Climate Council, *Passing Gas: Why Renewables Are the Future* (December 2020) <<https://www.climatecouncil.org.au/resources/passing-gas-renewables-are-future/>>; Climate Council, *Primed for Action: A Resilient Recovery for Australia* (21 May 2020) <<https://www.climatecouncil.org.au/resources/primed-for-action-a-resilient-recovery/>>; Climate Council, *Submission to the Technology Investment Roadmap Discussion Paper* (2020) <<https://www.climatecouncil.org.au/resources/submission-to-technology-investment-roadmap-discussion-paper/>>; Climate Council, *Unpacking the 'Tech Roadmap'* (2020) <<https://www.climatecouncil.org.au/resources/unpacking-tech-roadmap/>>.
- ² CSIRO and Bureau of Meteorology, *State of the Climate 2020* (12 November 2020) <<http://www.bom.gov.au/state-of-the-climate/>>.
- ³ Climate Council, 'Passing Gas: Why Renewables Are the Future' (n 1).
- ⁴ Australian Energy Market Operator, *Quarterly Energy Dynamics Q3 2020* (22 October 2020) <<https://aemo.com.au/energy-systems/major-publications/quarterly-energy-dynamics-qed>>.
- ⁵ Australian Competition and Consumer Commission, *Gas Inquiry 2017-2025* (Interim Report, January 2020) <<https://www.accc.gov.au/publications/serial-publications/gas-inquiry-2017-2025/gas-inquiry-january-2020-interim-report>>.
- ⁶ Climate Council, 'Passing Gas: Why Renewables Are the Future' (n 1).
- ⁷ Nick Toscano, 'Woodside Shelves Plans, Wipes Billions from Budget as Oil Crash Bites', *Sydney Morning Herald* (online, 27 March 2020) <<https://www.smh.com.au/business/companies/woodside-shelves-plans-wipes-billions-from-budget-as-oil-crash-bites-20200327-p54ehj.html>>; Nick Toscano, 'Santos Braces for Heavy Hit as Oil Price Tumbles "into the Teens"', *Sydney Morning Herald* (online, 23 April 2020) <<https://www.smh.com.au/business/companies/santos-braces-for-heavy-hit-as-oil-price-tumbles-into-the-teens-20200423-p54mge.html>>.
- ⁸ International Energy Agency, *Gas 2020* (Market Report Series, June 2020) <<https://www.iea.org/reports/gas-2020>>.
- ⁹ HSBC Global Research, *Global Gas: A Deflated Market* (5 July 2020) <<https://www.research.hsbc.com/R/51/nfZ7pKw>>.

- ¹⁰ Angela MacDonald-Smith, "'Super-Spike' to Fire up LNG Producers', *Australian Financial Review* (online, 17 January 2021) <<https://www.afr.com/companies/energy/super-spike-to-fire-up-lng-producers-20210114-p56u0f>>.
- ¹¹ Climate Council, 'Passing Gas: Why Renewables Are the Future' (n 1).
- ¹² Department of Industry, Science, Energy and Resources, *Securing Australian Domestic Gas Supply* (21 January 2021) <<https://www.industry.gov.au/regulations-and-standards/securing-australian-domestic-gas-supply>>.
- ¹³ Nick O'Malley and Mike Foley, 'Government's Gas-Led Economic Recovery Plans Questioned', *The Sydney Morning Herald* (27 April 2020) <<https://www.smh.com.au/business/the-economy/government-s-gas-led-economic-recovery-plans-questioned-20200427-p54no4.html>>.
- ¹⁴ Lewis Grey Advisory, *Gas Price Projections for the 2021 GSOO* (Public Version, 13 December 2020) <https://www.aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2021/gas-price-projections-for-the-2021-gsoo-public-final-13-12-20.pdf?la=en>.
- ¹⁵ J Gütschow et al, *The PRIMAP-hist national historical emissions time series (1850-2017) v2.1* (2019) <<https://doi.org/10.5880/pik.2019.018>>.
- ¹⁶ Clean Energy Regulator, *Electricity Sector Emissions and Generation Data* (28 February 2020) <<http://www.cleanenergyregulator.gov.au/NGER/National%20greenhouse%20and%20energy%20reporting%20data/electricity-sector-emissions-and-generation-data>>; Gütschow et al (n 15).
- ¹⁷ Tom Swann, *High Carbon from a Land Down Under Quantifying CO₂ from Australia's Fossil Fuel Mining and Exports* (Australia Institute, July 2019) <<https://www.tai.org.au/content/new-analysis-australia-ranks-third-fossil-fuel-export>>.
- ¹⁸ Office of the Chief Economist, *Resources and Energy Quarterly* (December 2020) <<https://www.industry.gov.au/publications/resources-and-energy-quarterly>>.
- ¹⁹ Climate Council, *Climate Ambition Summit* (Factsheet, 10 December 2020) <<https://www.climatecouncil.org.au/resources/factsheet-climate-ambition-summit/>>.
- ²⁰ ACIL Allen Consulting, *Emissions Factors Assumptions Update (Final Report)* (No Report to Australian Energy Market Operator, 10 May 2016) <https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/ntndp/2016/data_sources/acil-allen---aemo-emissions-factors-20160511.pdf>.
- ²¹ G Myhre et al, 'Anthropogenic and Natural Radiative Forcing' in TF Stocker et al (eds), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, 2013) 659 <<http://www.climatechange2013.org>>.
- ²² Climate Council, 'Passing Gas: Why Renewables Are the Future' (n 1).
- ²³ In particular, to implement the findings of more recent research that showed the need to very significantly revise the global warming potential for methane: M Etminan et al, 'Radiative Forcing of Carbon Dioxide, Methane, and Nitrous Oxide: A Significant Revision of the Methane Radiative Forcing' (2016) 43(24) *Geophysical Research Letters* 12,614-12,623 ('Radiative Forcing of Carbon Dioxide, Methane, and Nitrous Oxide').