Institute for Energy Economics and Financial Analysis
ieefa.org

91 Percy Street
Warwick, QLD 4370

aus_staff@ieefa.org

15 September 2023

To: Climate Change Authority

RE: Economic modelling of potential Australian emissions reduction pathways

Thank you for the opportunity for the Institute for Energy Economics and Financial Analysis (IEEFA) to present its submission to this consultation.

Regards

Amandine Denis-Ryan – Chief Executive, IEEFA Australia

Jay Gordon – Research Analyst, Australian Electricity

Anne-Louise Knight – Lead Analyst, Australian Coal

Institute for Energy Economics and Financial Analysis
ieefa.org

91 Percy Street
Warwick, QLD 4370

aus_staff@ieefa.org

Key points

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

The authors of IEEFA's submission have extensive experience with climate, energy and economic modelling and the proposed models.

Prior to her role at IEEFA, Amandine Denis-Ryan was Head of Research and then Head of National Programs at Climateworks Centre, where she oversaw many climate and energy modelling projects. In particular, Amandine led the modelling for the Deep Decarbonisation Pathways project, which developed the first economy-wide pathway to net zero emissions for Australia, aligned with a 2°C carbon budget. The modelling was done in partnership with the CSIRO, the Australian National University (ANU) and Victoria University, and utilised the LUTO model, the ESM model (the precursor to AusTIMES) and the MMRF, a CGE model.

Amandine subsequently led the modelling for the Decarbonisation Futures project, which developed the first 1.5°C-aligned pathway for Australia, as well as two 2°C-aligned pathways, utilising the newly developed AusTIMES model. The results from both these projects were widely used by government, financiers and business, and were considered a benchmark for Paris-aligned pathways for Australia. AusTIMES was co-developed by CSIRO and Climateworks Centre, and Amandine developed the initial version of the buildings and industry sectors parts of the model. Amandine is also a recognised expert in climate and energy scenario development, and delivered an executive education course on climate risk management, which included advice on how to use climate and energy scenarios.

Prior to his role at IEEFA, Jay Gordon was Modelling Manager at Climateworks Centre. As part of this role, Jay led the development of the end-use sectors in the AusTIMES model. He also led or contributed to the development of many scenarios utilising the AusTIMES model. These included scenarios informing the Australian Energy Market Operator (AEMO)'s Integrated System Plan (ISP) in 2021 and 2022, as well as a range of advisory projects for government and the private sector between 2019 and 2022.

Jay has a deep understanding of the structure and capabilities of AusTIMES as it pertains to the end-use sectors. He contributed to improving the AusTIMES model's capabilities by developing emissions constraints, expanding the technological and sectoral detail within industry, updating the model's emissions sequestration capabilities, and improving visibility over domestic-versus-exported energy commodities.

Anne-Louise Knight has extensive experience constructing econometric models to analyse Australia's trade and investment landscape and has produced original research on climate change and investment behaviour and international trade for the Australian government. Before joining IEEFA, Anne-Louise worked with the Australian Trade and Investment Commission as a senior economist producing commodity forecasts and constructing economic models on Australia's trade and investment outlook. In this role she provided input to Treasury on their climate change econometric modelling techniques and supported the Department of Foreign Affairs and Trade on designing economic models using the Business Longitudinal Analysis Data Environment (BLADE) to analyse Australian exporters.

Prior to this she worked with the New South Wales Government on water policy and legislation under the Murray-Darling Basin Plan. She was responsible for drafting and amending water sharing plans, analysing New South Wales water markets and licence categories, and drafting groundwater policies and effluent water re-use and management strategies for mining and

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

agricultural users. Anne-Louise holds a Bachelor of International Studies degree from the University of New South Wales, an MSc in Economics, and an MA in Environmental Management and Development from ANU.

What questions is the modelling aiming to answer?

Consultation questions: What are your views on the two modelling questions? Are there other questions the authority should explore through economic modelling to inform its advice?

Modelling Question 1 cannot be properly answered within the scope of the economic modelling analysis

As the economic modelling is currently set up, its results could be used to contribute to answering Modelling Question 1, but they would not be sufficient to answer it completely. Unless the scope of the modelling exercise is extended, Modelling Question 1 should be abandoned as part of the economic modelling exercise. The question could be one that the broader review tries to answer, rather than one that the modelling exercise tries to answer.

The modelling currently excludes from its scope two of the largest (if not the two largest) economic effects of different emissions pathways: the costs or avoided costs of climate change impacts; and the costs or avoided costs of the health impacts of air pollution. As such, it would not be appropriate to present the results of the economic modelling as an assessment of the economic effects of different emissions pathways. Presenting those results without incorporating those other effects would be misleading.

Several studies show the materiality of those factors on the economy. The recently published *Intergenerational Report 2023* looked at a range of economic implications from climate change impacts, all highly significant for Australia. For example, it estimated that just the impact of increased temperatures on productivity could cost the economy between A$135 and A$423 billion in today's dollars to 2063.[1] A global study also showed that the economic benefits of reducing air pollution could outweigh the cost of mitigation actions.[2]

Modelling Question 2 should be adjusted to include the impacts of decarbonisation in our key export markets

Modelling Question 2 ignores the impact of changes in demand for our energy export commodities driven by our partner markets' net zero transition pathways. In addition to negating the long-term market outlooks in some of our key energy export destinations, the two modelling questions do not account for the greenhouse gas (GHG) emissions embedded in our second and third highest value exports – coal and liquified natural gas.

[1] Australia Government. Intergenerational Report 2023. August 2023. Page 99.
[2] The Lancet. *A Markandya et al*. Health co-benefits from air pollution and mitigation costs of the Paris Agreement: a modelling study. March 2018.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

Examining the long-term demand outlook and embedded GHG emissions of our major energy exports should not remain outside the scope of this model if the authority intends to understand how to achieve a 'whole-of-economy emissions reduction pathway'. Australia's 2022-23 budget surplus[3], the first in 15 years, was driven by a short-term surge in these commodity prices, with the export value of Australian goods and services contributing 25.8% to Australia's nominal GDP in 2022[4].

It is proposed that, when addressing Modelling Question 2 to break down the whole-of-economy results, the authority considers how Australia's high-emissions commodity exports will be impacted by our partner markets' net zero transition pathways. Additionally, the authority should consider how Australia's domestic net zero transition pathways address the embedded GHG emissions in our energy commodity exports.

Australia is traditionally reactionary to changes in international export market demand, but there is also precedent for Australia to re-evaluate our approach to exporting GHG emissions through our export controls. Australia already has export controls in place regarding the intended use in imported countries for uranium, weapons, livestock, and ozone-depleting substances and synthetic GHGs[5,6,7]. This sets a precedent for examining the export of commodities such as thermal coal, metallurgical coal and liquified natural gas based on their intended uses and estimated greenhouse gas emissions in destination export markets.

The authority should identify a small set of key sub-questions it hopes to answer with the economic modelling

Modelling Questions 1 and 2 do not provide any guidance for what different scenarios the authority should model. There are many different possible national pathways aligned with limiting warming to 1.5°C or 2°C above pre-industrial levels, so it will be important for the authority to narrow down on a small number of sub-questions it is interested in testing. For example, it could be interesting to test:

- What balance of demand-side vs supply-side action provides the best economic outcomes for Australia?
- What balance of large-scale vs small-scale solutions provides the best economic outcomes for Australia?
- If key implementation risks exist in a given pathway, are there alternative pathways that offer similar emissions reduction levels and similar economic outcomes?
- What are the key technology uncertainties, and what are the economic outcomes of alternative pathways?

Identifying the key sub-questions that the model should answer will help design scenarios that can appropriately answer those questions.

[3] Australian Department of Finance. Australian Government General Government Sector Monthly Finance Statements January 2023. February 2023.
[4] World Bank. World Bank national accounts data, Exports of goods and services (% of GDP) Australia.
[5] Australian Government – Federal Register of Legislation. Customs (Prohibited Exports) Regulations 1958.
[6] Department of Foreign Affairs and Trade. Australia's Uranium Export Policy.
[7] The Conversation. How to answer the argument that Australia's emissions are too small to make a difference. 18 June 2019.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

What models does the authority plan to use?

Consultation questions: What are the strengths or limitations of these models the authority should keep in mind when interpreting their outputs? Are there other models that would provide valuable insights into the questions the authority is trying to answer?

The representation of the gas supply side needs to be significantly upgraded in the model

While the AusTIMES model includes a high level of granularity on the supply side for electricity, it does not have any granular representation of the gas supply side. A fixed gas price forecast is used to inform future gas costs.[8] This means that the model cannot properly assess the relative economic costs or benefits of changes in gas demand.

Indeed, increased gas production requires large, lumpy investments in long-life assets to develop new gas fields or infrastructure. Significant infrastructure upgrades are also required to enable hydrogen or biomethane to be blended into domestic gas supply.[9] IEEFA understands that AusTIMES largely makes these decisions based on relative fuel costs, and does not include adequate evaluation of gas infrastructure requirements and their associated costs.

To properly assess the economic costs and benefits of various gas demand pathways, it will be critical to upgrade the AusTIMES model to better represent the gas supply side and associated infrastructure, in a similar way to how electricity or hydrogen production are represented. TIMES models are highly modular in nature and offer the flexibility to represent energy conversion processes with costs. These upgrades could be completed within AusTIMES given a reasonable timeframe and cost, building upon data used by AEMO for its own gas analyses.

Without such an upgrade, the model will have an inherent bias – underestimating the economic benefits of additional gas demand reduction, and the costs of delivering additional gas supply.

The models should be complemented to properly capture the technical opportunity and economic benefits of demand-side and DER solutions

The AusTIMES model is unlikely to be able to capture the significant network benefits of flexible demand, load-shifting or distributed energy resources (DER) solutions. One key limitation is the low time resolution of electricity production and demand. This is a necessary compromise for the high level of sectoral coverage in the model. However, in the past, CSIRO has iterated AusTIMES scenarios with other models such as STABLE to provide greater time resolution.[10] This enables greater opportunities for understanding demand-side opportunities from storage and load-

[8] Australian Industry Energy Transitions Initiative. Pathways to industrial decarbonisation. Phase 3 Technical report. February 2023. Page 14.
[9] IEEFA. 'Renewable gas' campaigns leave Victorian gas distribution networks and consumers at risk. August 2023.
[10] Australian Industry Energy Transitions Initiative. Pathways to industrial decarbonisation. Phase 3 Technical report. February 2023. Page 13.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

shifting. However, additional modelling or upgrades to AusTIMES may be needed to ensure these solutions are adequately represented.

Key DER assumptions such as rooftop solar uptake, electric vehicle uptake and charging patterns are currently exogenous inputs to AusTIMES. This means that the model is unable to determine the cost-optimal mix of these technologies when compared with supply-side electricity technologies. Including these technologies directly into the model would significantly improve its ability to optimise the demand and supply side of the energy system.

IEEFA's research suggests that DER could materially shift the electricity demand profile and even potentially eradicate the evening peak. This would significantly reduce network capital expenditure requirements and deliver extensive economic benefits for Australia.[11] If these benefits cannot be captured by the models used, it would misrepresent the relative benefits of high DER scenarios.

Assumptions on the costs and performance of CCS should reflect real life experience rather than unrealistic projections

The AusTIMES model currently seems to assume that carbon capture and storage (CCS) can capture up to 90% of emissions (post combustion or process emissions). It also assumes that CCS costs can be as low as $75 per tonne of carbon dioxide (CO_2) for reservoir CCS in gas extraction.[12] These assumptions are overly optimistic compared with CCS's track record to date and need to be updated. Using unrealistic cost and performance assumptions for CCS could overestimate the benefits of the technology in contributing to Australia's energy transition.

In Australia, the Gorgon project has cost A$3.2 billion to date, and has injected just 6.5 million tonnes of CO_2 ($MtCO_2$) in its first six years of operation. This represents a 32% capture rate.

Last year, IEEFA conducted a review of 13 flagship CCS projects globally comprising about 55% of the total nominal capture capacity operating worldwide.[13] It found that failed or underperforming projects considerably outnumbered successful examples (***Figure 1***). This underperformance was compared to the companies' own targets, not a theoretical best practice benchmark.

[11] IEEFA. Saturation DER modelling shows distributed energy and storage could lower costs for all consumers if we get the regulation right. April 2023.
[12] Australian Industry Energy Transitions Initiative. Pathways to industrial decarbonisation. Phase 3 Technical report. February 2023. Pages 50, 65, 70, 71.
[13] IEEFA. The carbon capture crux: Lessons learned. 1 September 2022.

Figure 1. Performance of flagship CCS projects globally

Carbon Capture and Storage (CCS) projects' poor report card

Project	Capacity (MtCO2 p.a.)	Performance
Natural Gas processing		
1986 Shute Creek	7	Lifetime under-performance of 36%
1996 Sleipner	0.9	Performing close to the capture capacity
2004 In Salah	1.1	Failed after 7 years of operation
2007 Snøhvit	0.7	Performing close to the capture capacity
2019 Gorgon	4	Lifetime under-performance of ~50%
Industrial sector		
2000 Great Plains	3	Lifetime under-performance of 20-30%
2013 Coffeyville	0.9	No public data was found on the lifetime performance.
2015 Quest	1.1	Performing close to the capture capacity
2016 Abu Dhabi	0.8	No public data was found on the lifetime performance.
2017 Illinois Industrial (IL-CCS)	1	Lifetime under-performance of 45-50%
Power sector		
2014 Kemper	3	Failed to be started
2014 Boundary Dam	1	Lifetime under-performance of ~50%
2017 Petra Nova	1.4	Failed after 4 years of operation

Source: IEEFA. The Carbon Capture Crux: Lessons learned. September 2022.

A more recent IEEFA analysis of Norway's Sleipner and Snohvit projects, two of the three successful CCS examples in the earlier review, demonstrated that CCS is not an exact science and that each project will present unique challenges.[14] This suggests that economies of scale for this technology will be very limited.

IEEFA's report stated that: "The subsurface areas of Sleipner and Snøhvit are among the most studied geological fields in both oil and gas and CO_2 storage globally. […] Despite the studies, experience and passage of time, the security and stability of the two fields have proven difficult to predict. In 1999, three years into Sleipner's storage operations, CO_2 had already risen from its lower-level injection point to the top extent of the storage formation and into a previously unidentified shallow layer. Injected CO_2 began to accumulate in this top layer in unexpectedly large quantities. Had this unknown layer not been fortunate enough to be geologically bounded, stored CO_2 might have escaped.

"At Snøhvit, problems surfaced merely 18 months into injection operations despite detailed pre-operational field assessment and engineering. The targeted storage site demonstrated acute signs of rejecting the CO_2. A geological structure thought to have 18 years' worth of CO_2 storage capacity was indicating less than six months of further usage potential. This unexpected turn of events baffled scientists and engineers while at the same time jeopardizing the viability of more than US$7 billion of investment in field development and natural gas liquefaction infrastructure.

[14] IEEFA. Norway's Sleipner and Snøhvit CCS: Industry models or cautionary tales? 14 June 2023. Page 4.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

Emergency remedial actions and permanent long-term alternatives needed to be, and were, identified on short notice and at great cost."[15]

Direct Air Capture is not a proven technology, and should be constrained in the modelling

AusTIMES modelling for AEMO's 2024 ISP incorporated Direct Air Capture (DAC) as a technology option for the first time.

This had significant impacts on emission sequestration outcomes in the model, with DAC accounting for around 37% of the total emission sequestration effort needed by 2050 in the central *Step Change* scenario.[16]

However, DAC is not mature or proven at large scale. The International Energy Agency (IEA) classifies DAC development as 'More efforts needed', and notes that: "To date, 27 DAC plants have been commissioned in Europe, North America, Japan and the Middle East. All of these plants are small-scale."[17] No DAC developments exist in Australia.

AusTIMES assumes a 57% reduction in the capital costs of DAC will occur between 2020 and 2030.[18] These assumptions draw on research by the IEA; however, they are largely theoretical, not based on an Australian context, and depend on factors such as an underlying demand for CO_2.[19]

The cost and availability assumptions underpinning DAC will have material impacts on the cost of sequestration in the model, and subsequently the balance of sequestration versus reduction in underlying emissions.

If DAC does not emerge as a cost-effective and reliable technology in the timeframe assumed by the model, this could materially compromise Australia's ability to meet its emissions reduction targets based on the assumed effort by other sectors.

The costs and/or uptake rates of DAC should be significantly constrained in AusTIMES modelling to reflect substantial uncertainty surrounding its actual cost, effectiveness and scalability.

Changes in water take by the energy sector should be included in the economic cost/benefit analysis

The energy sector consumes significant amounts of water – in particular coal mining processes as well as water take by coal- and gas-fired power stations. This is an important economic consideration given that Australia's water markets had an estimated turnover of A$6 billion in 2020-21.[20]

The economic value of water consumed by coal mines and coal-fired power stations in New South Wales and Queensland was estimated at between A$770 million and A$2.49 billion per

[15] Ibid. Pages 5-6.
[16] CSIRO and Climateworks Centre. Multi-sector energy modelling 2022. December 2022. Page 52.
[17] IEA. Tracking Direct Air Capture.
[18] CSIRO and Climateworks Centre. Multi-sector energy modelling 2022. December 2022. Page 30.
[19] IEA. Direct Air Capture: A key technology for net zero. April 2022. Page 41.
[20] Australian Government Bureau of Meteorology. Australian Water Markets Report 2020-21. 2022.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

annum.[21] This does not include water consumption from gas-fired power stations or coal mines and power plants located in Western Australia or Victoria, and is only based on publicly available data on coal mining and power stations' water take. Almost all water used in coal mines is consumed and cannot be reused. Additionally, of those that do currently have effluent water treatment management strategies in place for water reuse, some mines have previously violated these regulations[22,23,24].

Actual take is estimated to be much higher than this due to lack of mandatory reporting regulations and difficulty monitoring actual water take.[25] For example, some research found that the actual water take from coal mining is 40% higher than the amount of water take reported by mining companies and the Australian Bureau of Statistics.[26]

Existing research has found that wind and solar photovoltaic energy production consume significantly less water than gas- and coal-fired power stations[27,28,29]. Analysis from Australia has found that coal mining and power generation uses approximately 120 times the water to generate the same amount of electricity as solar or wind.[30]

The required water take by various energy production and generation options should be incorporated into the modelling exercise to calculate these opportunity costs to the Australian economy. The LUTO model may be able to support the calculation of the opportunity cost for the water consumed, as well as the economic value of the avoided water consumption. If the authority utilises a baseline for current water take, it should ensure it utilises accurate data and does not rely on public water accounting released by individual companies.

The authority should be aware of the limitations of CGE modelling when interpreting the modelling results

CGE models are not well set up for representing non-linear transformations of the scale of the upcoming energy transition, and as such modelling should be used for "insights not numbers".[31] Any numbers coming out of the modelling should be considered with circumspection and tested with other sources of insights. The focus should be on the broad trends and relative changes.

In the authors' experience, aligning energy and CGE models is not an easy task. In the development of the Deep Decarbonisation Pathways project, it took months of iterations to ensure that the two models were providing internally consistent results, sense-checking results continuously, and identifying and then resolving the root causes of inconsistencies. This was the

[21] University of Adelaide. *I Overton*. Aren't we in a drought? The Australian black coal industry uses enough water for over 5 million people. 5 May 2020.
[22] ABC News. Idemitsu's Boggabri Coal mine escapes prosecution despite breaching water licence. 6 July 2023.
[23] ABC News. 'Slap on wrist' for Rio Tinto and Fortescue after breaching environmental regulations in WA. 18 May 2023.
[24] NSW Environmental Protection Authority. Fines for coal mine for dirty water discharge. 9 November 2021.
[25] Australian Government – National Water Commision. *A Smart & A Aspinall*. Water and the electricity generation industry: Implications of use. Waterlines Report Series No. 18. August 2009.
[26] University of Adelaide. *I Overton*. Aren't we in a drought? The Australian black coal industry uses enough water for over 5 million people. 5 May 2020.
[27] Renewable and Sustainable Energy Reviews. *Y Jin, P Behrens, A Tukker & L Scherer*. Water use of electricity technologies: A global meta-analysis. November 2019.
[28] International Renewable Energy Agency. Renewable Energy in the water, energy & food nexus. January 2015.
[29] Australian Government – National Water Commision. *A Smart & A Aspinall*. Water and the electricity generation industry: Implications of use. Waterlines Report Series No. 18. August 2009.
[30] Australian Conservation Foundation. *I Overton*. Water for coal: Coal mining and coal-fired power generation impacts on water availability and quality in New South Wales and Queensland. April 2020.
[31] Atmósfera. *T Schinko et al*. Modeling for insights not numbers: The long-term low-carbon transformation. April 2017.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

case despite multiple scenarios previously being developed using the two models. It will be critical for the authority to properly resource this project in both time and staffing to ensure a good quality of results.

What scenarios does the authority plan to run?

Consultation questions: Do you think the proposed global action pathways provide an appropriate context for assessing potential Australian emissions pathways? Are there alternatives you think are higher priority pathways to consider? Are the IPCC, IEA and GLOBIOM assumptions appropriate for the proposed scenarios?

The 2°C global scenario should be changed to a well below 2°C global scenario

The authority mentions that it proposes to model pathways aligned with the Paris Agreement but includes in those a '2°C pathway'. This is proposed to draw on assumptions from the IEA's 2.1°C-aligned scenario, and a GLOBIOM 2°C-aligned scenario. However, the Paris Agreement is clear that its objective is to "[hold] the increase in the global average temperature to well below 2°C above pre-industrial levels and [pursue] efforts to limit the temperature increase to 1.5°C above pre-industrial levels".[32] While there is no clear definition of what 'well below 2°C' means, it has been intentionally upgraded from the previous language of 'below 2°C' in international agreements.

The authority should therefore replace its '2°C pathway' by a 'well below 2°C pathway' – and update its key assumptions accordingly. This could mean, for example, using scenarios that result in a carbon budget equivalent to a 67% likelihood of staying below 1.7°C or 1.8°C, which corresponds to a likelihood greater than 83% of staying below 2°C.[33]

The Climate Change Authority has past experience in developing carbon budgets for Australia aligned with particular temperature outcomes.[34] The authority should work with experts to update these budgets, hence ensuring that the emissions constraints for these scenarios are up to date and based on robust scientific arguments.

Consultation question: What potential Australian emissions pathways or scenarios do you think would provide the most valuable modelling insights and inputs to support the authority's advice?

[32] United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement.
[33] IPCC. Climate Change 2021. The Physical Science Basis. Page 98.
[34] CCA. Targets and Progress Review: Final report. February 2014.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

The authority should include scenarios with no new fossil fuel developments that focus on demand-side action

The typical approach for scenarios is to set demand-side assumptions, and then look at how supply can meet that resulting demand, rather than looking at what would be an optimum approach to manage both the supply and demand sides of the equation. In its economic modelling, we believe that the authority should explore both scenarios that take fixed demand-side assumptions, and scenarios that take fixed supply-side assumptions. This would provide a more comprehensive understanding of the range of possible pathways and their relative economic costs and benefits.

In particular, the authority should explore scenarios that limit new fossil fuel developments. The Intergovernmental Panel on Climate Change (IPCC) stated that: "Projected cumulative future CO_2 emissions over the lifetime of existing fossil fuel infrastructure without additional abatement exceed the total cumulative net CO_2 emissions in pathways that limit warming to 1.5°C (>50%) with no or limited overshoot. They are approximately equal to total cumulative net CO_2 emissions in pathways that limit warming to 2°C with a likelihood of 83%."[35]

Limiting new gas developments as much as possible by prioritising demand-side action is therefore crucial to achieving the goals of the Paris Agreement. Modelling scenarios that limit new fossil fuel developments would enable a greater understanding of the demand-side actions that could be deployed to meet those constraints and their relative economic costs/benefits. The authority should at least model a scenario with no additional fossil fuel developments (new or expansion). It could also model a scenario with no new basin/field developments.

IEEFA's May 2023 submission to AEMO on updates to the ISP methodology emphasised the need for better optimisation of demand-side and supply-side solutions in its electricity scenarios.[36] In addition, IEEFA's recent gas supply gap analysis showed that faster and stronger demand-side action could fill the gas supply gap and avert the need to develop new costly and emissions-intensive gas fields. It showed that making small adjustments to the demand-side actions included in AEMO's 2023 GSOO *Green Energy Exports (1.5°C)* scenario could eradicate the gas supply gap for the next two decades. The analysis stated that: "Accelerating action to improve energy efficiency and electrification in buildings could eradicate the gas supply gaps for the next decade while also alleviating the cost of living crisis for households. […] The rest of the gas supply gap could be filled by a small increase in industrial gas demand reduction, well within the identified technological and economic potential."[37]

Demand-side action usually presents high economic benefits. Investments in energy efficiency in particular deliver multiple benefits. For consumers, these include cost reductions[38] as well as improved health outcomes[39]. Demand-side activities also typically create more jobs than supply-side activities.[40] Australia has a lot of untapped energy efficiency potential. In its recent review of

[35] IPCC. AR6 Synthesis Report – Longer Report. 2023. Page 24.
[36] IEEFA. Response to AEMO consultation on updates to the ISP Methodology. May 2023.
[37] IEEFA. Australia can and should eradicate its gas supply gap – but not with more gas. April 2023.
[38] IEA. Energy Efficiency 2022. Page 76.
[39] IEA. Capturing the multiple benefits of energy efficiency. 2014. Pages 21-22.
[40] Economic Modelling. *H Garrett-Peltier*. Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. February 2017.

Institute for Energy Economics and Financial Analysis
ieefa.org

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

Australia's energy policy, the IEA highlighted that recent improvements in energy efficiency had slowed to about 1.9% per year, and that they should be increased to 4.2% a year until 2030 to align with the global IEA Net Zero roadmap.[41]

The use of land carbon sequestration to meet targets should be constrained

AusTIMES optimises land carbon sequestration against emissions reduction opportunities given a function of cost and available supply. However, this does not recognise that the emissions reductions delivered by land carbon sequestration are not equivalent to emissions reductions delivered by avoided fossil fuel use or avoided methane fugitive emissions. Therefore, there should be some constraints to the use of land carbon sequestration to meet Australia's emissions targets.

Beyond the integrity and permanency concerns surrounding carbon offsets, recent analysis shows that using the land sector to offset fossil fuel emissions is risky. A report from Climate Analytics noted that: "Fossil fuel emissions have a very long lifetime in the atmosphere. Each tonne of carbon released into the atmosphere is long-lived, with around 40 percent remaining after 100 years, 20-25% remaining after 1,000 years, and up to 20% after 10,000 years. Land-based offsets do not and cannot guarantee such long-term sequestration."[42]

The report also stated: "There is therefore a fundamental difference between directly reducing a source of CO_2 emissions by one tonne, and offsetting that same tonne of CO_2 emissions through sequestration in trees or soil. The direct reduction of emissions does so permanently, whereas the CO_2 that is captured and stored in trees or newly sequestered soil carbon will at some point be released back into the atmosphere."[43] This is particularly concerning given that forest and soil carbon impermanence will be exacerbated by climate change.[44]

The Climate Analytics report found that: "Pathways that limit warming to 1.5°C […] substantially increas[e] carbon sequestration in the terrestrial biosphere while also reducing CO_2 emissions from fossil fuels very rapidly towards zero. In the IPCC 6th Assessment Report, CO_2 emissions excluding negative emissions from CO_2 removal still fall 45% from 2020 to 2030 in 1.5°C compatible pathways that meet sustainability constraints. Carbon removal in these pathways is therefore in addition to ambitious CO_2 emissions reductions. Most of the mitigation in these pathways is emissions reduction rather than emissions removal."[45]

With limited potential for land-based carbon sequestration, we should make sure it is not used to offset emissions that should have been reduced in the first place.[46] In particular, land carbon sequestration should not be used to offset fugitive methane emissions.

Methane represents about 18% of global emissions[47], and is estimated to have contributed to around 30% of the rise in global temperatures since the Industrial Revolution[48]. While it represents a much smaller proportion of emissions in terms of mass, it has had a disproportionate impact on climate change. Methane has a short lifespan – around 12 years – but

[41] IEA. Australia 2023 - Energy policy review. April 2023. Page 12.
[42] Climate analytics. Why offsets are not a viable alternative to cutting emissions. February 2023. Page 3.
[43] Ibid. Page 14.
[44] Ibid. Pages 14-15.
[45] Ibid. Page 19.
[46] Ibid. Page 3.
[47] IPCC. Climate Change 2022. Mitigation of Climate Change. 2022. Page 7.
[48] International Energy Agency (IEA). Understanding methane emissions. 2023.

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

it absorbs much more energy than CO_2 while it exists in the atmosphere. Over a 100-year period, methane warms as much as 30 times more than CO2. However, over a 20-year period, methane warms as much as 82 times more than CO_2.[49] CO_2 removal will not have the same impact on global warming as avoiding methane emissions.

Consultation questions: How do you think the authority should capture the potential benefits of stronger action to reduce national and global emissions in its modelling? Are some approaches better than others?

The authority should ensure it captures all material benefits of stronger action

While it is not reasonable to expect that all benefits can be assessed, the authority should ensure it includes all elements that are material. In particular, it will be critical that the authority captures (within the economic modelling or through side analyses):

- Cost savings from reduced energy bills and subsequent economic benefits.
- Jobs created in green industries, in particular in renewables and energy efficiency sectors that have a high job-intensity.
- Avoided cost of fossil fuel infrastructure investments.
- Avoided cost of mitigating the emissions from new or existing fossil fuel production.
- Higher competitiveness of domestic industries in a low-carbon world.
- Health and productivity benefits from reduced use of fossil fuels and improved thermal insulation.
- Economic benefits from reduced impacts of climate change.

On the last point, it will be important for the authority to explore the economic costs of higher temperature outcomes for Australia, to properly quantify the benefits of stronger action. The authority should at least consider the economic costs associated with a 3°C temperature outcome.

It will also be important for the authority to test the impact of different action timelines on the economic cost and benefits of stronger action. Indeed, significant economic benefits may be achieved from timely action, which can limit stranded investments in assets incompatible with a net zero future and avoid abrupt transitions. Timely action can also help to progressively develop capabilities and supply chains for the technologies that will be needed at scale in the future.

The review and economic modelling should also test the impact of different timelines of action on Australia's competitiveness in decarbonised exports. IEEFA's recent report on international green iron investment found that Australia faces growing competition from Brazil, Africa and the Middle

[49] IPCC. Climate Change 2021. The Physical Science Basis. Page 1017.

Institute for Energy Economics and Financial Analysis
ieefa.org

91 Percy Street
Warwick, QLD 4370
aus_staff@ieefa.org

East. Australia could lose market share in iron ore exports and future green iron production if it does not accelerate action.[50]

What questions is the modelling not intended to assess?

Consultation question: Are there any other issues the authority should consider as part of its modelling exercise?

Please see IEEFA's response to the other consultation questions.

[50] IEEFA. Australia faces growing green iron competition from overseas. September 2023.