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Australian Energy Market Operator
Submitted via email to: ISP@aemo.com.au

To whom it may concern,

Climateworks Centre submission to the 2026 Integrated System Plan (ISP) Methodology consultation

Climateworks Centre welcomes the opportunity to provide a submission to the Australian Energy Market Operator (AEMO) in response to the *ISP Methodology Issues Paper.*

Climateworks bridges the gap between research and climate action, operating as an independent not-for-profit within Monash University. We develop specialist knowledge to accelerate emissions reduction, in line with the global 1.5 degrees Celsius temperature goal, across Australia, Southeast Asia and the Pacific.

In 2023, and in preparation for the forthcoming 2026 ISP, AEMO has engaged CSIRO, supported by Climateworks, to conduct multi-sector modelling to quantify the dynamic influences that would shape electricity demand under different emissions reduction scenarios. The recommendations in this submission draw on insights from that process, and previous modelling for AEMO, and will contribute to a robust and optimised Integrated System Plan (ISP).

Rapid decarbonisation of the electricity and energy system is essential for Australia to meet its obligations under the Paris Agreement. Electricity generation is the nation's largest source of greenhouse gas emissions. The adoption of renewables will directly reduce national emissions by approximately one-third (CSIRO 2023) and will have powerful flow-on effects for other sectors of the economy.

However, the transformation is complex. It requires forecasting and planning that considers evolving energy generation, transmission and storage technologies, changing market and regulatory conditions, increasing industrial, transport and building demand and emerging opportunities in renewable energy and resource exports. AEMO must also ensure the electricity supply contributes to increasingly ambitious jurisdictional emissions reduction targets and remains reliable, secure, safe and affordable.

In March 2024, the Energy and Climate Change Ministerial Council (ECMC) recognised AEMO's evolving role and directed it to play a more active part in guiding the energy transformation (Commonwealth of Australia 2024). Climateworks supports this approach, and the recommendations in this submission will help facilitate that shift.

The energy system in Climateworks' 1.5°C-aligned decarbonisation scenario

In 2023, Climateworks published least-cost emissions reduction pathways for Australia. Our report shows a Paris-aligned least-cost pathway for limiting warming to 1.5°C reaches emissions reductions of 68 per cent below 2005 levels by 2030 and net zero before 2040.

In our 1.5ºC-aligned scenario, renewables make up 90 per cent of total electricity generation in the NEM by 2030 and close to 100 per cent by 2034. Clean electricity generation capacity would expand from around 62 GW in 2024 to around 116 GW by 2030 and 298 GW by 2050. All coal-fired power generation would cease by 2035, and gas-powered generation would be reduced by 69 per cent by 2030 and 96 per cent by 2050 (Climateworks Centre 2023). To achieve net zero, renewables, electrification and energy-efficiency measures underpin buildings, industry and transportation decarbonisation.

Submission summary

Climateworks suggests AEMO consider the following recommendations as they develop the methodology for the 2026 ISP. The submission body includes specific details on each point. Climateworks recommends AEMO:

- integrate key findings from the *Multi-sector energy modelling 2022: Methodology and results Final report* on making modelling more robust into the current ISP methodology.
- revise its role in system forecasting and planning from responding to trends and transformations to providing evidence that enables governments and energy market operators to shape them
- expand its multi-sector modelling to include an additional 1.5°C-aligned scenario or additional sensitivity analysis on its 'Green Energy Exports' scenario
- expand multi-sector modelling to analyse a broader range of sensitivities across all scenarios
- outline contingency pathways that offer alternate responses where there is low confidence in the pace and characteristics of change within scenarios
- broaden the scope of the ISP methodology, particularly for gas and consumer energy resources (CER), to fully align with the ECMC's directive and intention
- design an energy system that will enable Australia to become a 'renewable energy superpower', including analysis to enable forecasting and planning supply, storage and transmission solutions for 'regional ISPs'.

Recommendations for the 2026 ISP Methodology

Recommendation 1: Integrate key findings from the *Multi-sector energy modelling 2022: Methodology and results Final report* into the ISP methodology

In order to inform the 2022 ISP, AEMO commissioned CSIRO and Climateworks to undertake multi-sector modelling to quantify the changing influences that would affect energy demand under different emissions reduction targets. Following that process, CSIRO and Climateworks produced the *Multi-sector energy modelling 2022: Methodology and results Final report* (CSIRO and Climateworks Centre 2022). The report included a series of findings that Climateworks now recommends AEMO consider as it develops the methodology for the 2026 ISP. The following are key insights and suggestions on how they can be incorporated into the ISP methodology.

The modelling reaffirmed that changes occur across all four pillars of decarbonisation – energy efficiency, electricity system decarbonisation, electrification, and non-energy emissions reductions and sequestration – on least-cost pathways to meet the Paris Agreement goals. The ISP methodology would benefit from continuing to include those pillars, including economy-wide analysis of how they unfold in each scenario and how they affect different aspects of the energy system.

Our modelling has repeatedly shown that high levels of energy efficiency across sectors underpins least-cost decarbonisation pathways for a wide range of scenarios (including those we produced for AEMO and our own released in 2020, *Decarbonisation Futures,* and *Climateworks Centre decarbonisation scenarios 202*3). Energy efficiency is an area where current policy and markets are not creating the level of change seen in our modelling and is an area in which we see sensitivity analysis as particularly useful. This would allow AEMO to explore the benefits of higher levels of energy efficiency to reduce energy system costs.

Modelling also shows electrification is cost-effective for a number of sectors to reduce economy-wide emissions. Across all scenarios, there are 'no-regrets' strategies to decarbonise buildings, industry and transport. For example, in both Paris-aligned scenarios that Climateworks modelled, gas use in buildings falls between 49 to 53 per cent by 2030 and reaches near zero by the 2040's. The ISP methodology would benefit by exploring how different levels of electrification affect the scale of electricity infrastructure investment needed. This will enable a better understanding of how additional investment in the electricity sector unlocks least-cost emissions reductions in other sectors.

The *Multi-sector energy modelling 2022: Methodology and results Final report* also discusses findings that alternative fuels, such as hydrogen and biomethane, only have a limited role under all scenarios – even where this was explored further through sensitivity analysis. Modelling shows some alternate fuel adoption occurs in the industrial sector in circumstances where electrification would not be viable (Liebreich 2020). Climateworks expects that high uptake of alternative fuels would require overcoming significant technical barriers, such as infrastructure upgrades, and would still be unlikely to displace electrification as the least-cost option for most

applications.

Recommendation 2: Revise AEMO's role in system forecasting and planning from responding to trends and transformations to providing evidence that enables governments and energy market operators to shape them. This will support them to meet their decarbonisation and economic development ambitions.

An AEMO that actively steers the energy transition will result in greater confidence for investors, stronger economic outcomes, reduced emissions and a more robust grid. If AEMO rethinks its approach to its forecasting and planning function by creating an ISP that outlines what 'could and should' happen in the energy system given government priorities, it will assist governments and energy market agencies in meeting their objectives.

The Australian electricity and energy landscape is undergoing unprecedented change. All levels of government have implemented policies aimed at reducing emissions while ensuring a prosperous economic future. These policies – including the six net zero sector plans, Future Made in Australia, National Consumer Energy Resources Roadmap, National Energy Performance Strategy, National Hydrogen Strategy and increasingly ambitious jurisdictional emissions reduction targets – will significantly impact the nature and requirements of the National Electricity Market (NEM).

The *National Electricity (South Australia) Act 1996* (Government of South Australia 1996) and *National Electricity Rules* (Australian Energy Market Commission 2024) confer a range of statutory obligations and discretionary powers to AEMO. It is required to consider the National Electricity Objective (NEO), which now includes a greenhouse gas emissions reduction ambition, and to 'plan, authorise, contract for, and direct, augmentation of the declared shared network' (Government of South Australia 1996). In determining how the ISP will contribute to the NEO, AEMO must consider jurisdictional emissions reduction targets and may take into account the array of environmental and energy policies across jurisdictions (Australian Energy Market Commission 2024).

AEMO has the complex task of planning an energy system that is reliable, secure, safe, affordable and quality while also helping jurisdictions achieve emissions reduction targets. It also has scope – within the bounds of electricity laws and rules – to modify the balance it strikes between responding to energy system trends and transformations and providing the information that shapes them.

In its *Response to the Review of the Integrated System Plan* in March 2024, the ECMC noted 'AEMO's role is changing as the energy market rapidly evolves' and 'governments and energy sector participants now look to the ISP for guidance on issues across the energy value chain' (Commonwealth of Australia 2024). The ECMC direction means that AEMO, alongside its statutory power, now has the prerogative to support governments in shaping Australia's energy transformation.

Australia's energy system transformation will benefit from an ISP that accounts for the full scope of government decarbonisation policies, including those pertaining to renewable energy

and product exports and the electrification of industry and transport. For example, the Future Made in Australia policy has allocated $22.7 billion to positioning Australia as a 'renewable energy superpower'. As it stands, these ambitions are not comprehensively reflected in the Emissions Target Statement that AEMO must consider as it determines the ISP optimal development path. Climateworks recognises their inclusion would require the government to define these ambitions more precisely and the ECMC to direct the Australian Energy Market Commission (AEMC) to broaden its scope to include them in the Emissions Target Statement. Nevertheless, AEMO has the opportunity to emphasise this as both an opportunity and a need to the government and other market governance bodies as it develops the ISP methodology.

Recommendation 3: Expand the multi-sector modelling to include an additional 1.5°C-aligned scenario or additional sensitivity analysis on the 'Green Energy Exports' scenario

As a signatory to the Paris Agreement, Australia has committed to pursuing a decarbonisation pathway consistent with holding warming to well below 2°C, and to pursuing efforts to limit the temperature increase to 1.5°C (United Nations 2015). Under the National Electricity Rules, AEMO is empowered to consider international environmental policies, such as the Paris Agreement, where they have been sufficiently developed to identify the impacts on the power system (AEMC 2024). Given the inclusion of a 1.5°C target in that agreement, AEMO is warranted, consistent with the National Electricity Rules, to plan for and pursue a 1.5°C aligned ISP optimal development path.

Climateworks therefore recommends AEMO commission modelling of an additional 1.5°C-aligned scenario or additional sensitivity analysis for the 'Green Energy Exports' scenario. A key variable to tune would be the scale of renewable energy and resource exports, which have extensive implications for the magnitude and composition of grid infrastructure.

In its 'Net Zero Emissions by 2050' scenario, the International Energy Agency (IEA) (2024) projects that the international market value of minerals critical to the energy transition will more than double by 2040, reaching US$770 billion. The ambition of the Future Made in Australia agenda is to capitalise on that opportunity by building an Australian economy powered by clean energy and the nation's abundant mineral resources (The Treasury 2024). The ISP's 'Green Energy Exports' scenario could enable that vision, delivering an NEM with 583 GW of dispatchable capacity and 26,000 km of transmission by 2050, capable of powering the mining and industrial processes needed to position Australia as a 'renewable energy superpower' (AEMO 2024).

Climateworks supports using 'Green Energy Exports' as the scenario to guide Australia's energy system transformation. It promises significant economic benefit and is consistent with a least-cost pathway to limiting warming to 1.5°C. However, we acknowledge that shocks in international demand for renewable energy and resources may diminish the confidence of governments and energy system stakeholders in planning for and investing in the substantial additional infrastructure required.

To address uncertainty and ensure flexibility, Climateworks proposes modelling multiple

1.5°C-aligned scenarios or sensitivities. This will offer more comprehensive insights and recommendations on the scale of transformation and investment required to realise government ambitions around green exports. By giving greater consideration to the uncertainties inherent in projecting such significant changes, AEMO can create credible evidence for 1.5°C-aligned investments and a broader range of options for the sector.

Recommendation 4: Expand multi-sector modelling to analyse a broader range of sensitivities across all scenarios

A range of factors will influence grid size and composition during the energy transition. Sectors across the economy, including industry, buildings and transport, will depend on having sufficient capacity to electrify. In turn, AEMO must ensure the grid expands quickly enough to instill confidence in these sectors but not so fast as to overspend on infrastructure. It is a complex 'chicken and egg' situation, compounded by various national and international economic, political, technological and social uncertainties.

Climateworks and CSIRO's whole-of-economy modelling provided scenarios for the 2023 IASR and 2024 ISP. Assumptions in that modelling included projections across a range of energy generation, storage and distribution factors, such as the economic and technical feasibility of widespread hydrogen uptake and investment in electrification, energy efficiency and biomethane. However, sensitivities were predominantly applied to the below-2°C-aligned 'Step Change' scenario rather than the 1.5°C-aligned scenario (AEMO 2023). Consequently, the ISP optimal development path does not fully account for the range of variables, such as CER coordination or non-transport electrification, that could influence future grid capacity and energy mix in the event of a massive transformation towards a 1.5°C-aligned economy. Climateworks recommends expanding the multi-sector modelling to include analysis of a broader range of sensitivities for all Paris-aligned – below-2°C and 1.5°C – scenarios rather than only for the scenario selected as 'most likely'.

Additional sensitivity analysis would extend to testing variables and research questions that are presently unable to be incorporated into the IASR candidate pathways. That may be the case either because there is a lack of available data or because an issue is considered contentious. For example, there is currently insufficient data and uncertainty for assumptions pertaining to the technical and commercial feasibility of replacing 100 per cent of gas in distribution networks with green hydrogen. By investing in sensitivity analysis in these areas now, it will be possible to explore variables that could inform future ISPs.

We note that the 'Progressive Change' scenario from the 2022 IASR is inconsistent with Australia's increasingly ambitious jurisdictional net zero targets and policies.

Recommendation 5: Outline contingency pathways that offer alternate responses where there is low confidence in the pace and characteristics of change within scenarios

AEMO has to plan an energy system in an environment of acute uncertainty. However, by employing sensitivity analyses and a range of assumptions, it is possible to pinpoint areas of low confidence and outline how scenarios might unfold under different conditions. This presents

an opportunity for AEMO to better navigate unknowns and adopt a more active role in energy system planning.

Climateworks recommends that AEMO identify areas of low confidence in its scenarios and conduct sensitivity analyses to understand how different assumptions affect energy system requirements. The anticipated pathway, and alternate responses where change is not consistent with expectations, would be transparently detailed in forecasting and planning materials. Having both would enable governments and energy system stakeholders to plan and allocate resources in alignment with the expected pathway as well as understand the implications of changing conditions.

For example, Climateworks' modelling indicates that CER, industrial and building electrification, demand management and energy efficiency all play crucial roles in achieving a 1.5°C-aligned energy system. However, uncertainties remain regarding the pace and scale of their adoption and the behaviour of actors within the system. AEMO's forecasting and planning materials could trigger alternative approaches if changes are not in line with expectations, such as increased investment in grid-scale generation and storage.

This approach has two significant benefits. First, it will enable AEMO to pursue a 1.5°C-aligned scenario with confidence that contingency plans will guide governments and energy system stakeholders if assumptions do not unfold as expected. Second, it will help achieve the first recommendation: providing the information that enables governments and energy system stakeholders to shape trends and transformations.

Recommendation 6: Broaden the scope of the ISP methodology, particularly for gas and CER, to fully align with the ECMC's directive and intention

Climateworks supports the ECMC directive for AEMO to better integrate CER and gas into the ISP (Commonwealth of Australia 2024). Climateworks' multi-sector modelling and analysis consistently demonstrate that electrification, energy efficiency and demand flexibility are among the most cost-effective emissions reduction strategies. While these strategies will certainly impact the pace CER are deployed and gas is phased out, details of that interplay are unclear.

CER and larger distributed energy resources, such as community batteries, offer a significant opportunity to transform how electricity is generated, traded, delivered and consumed. By integrating analysis on CER more effectively into AEMO's planning and forecasting tools, governments and energy system stakeholders will be better equipped to implement policies that support CER deployment and encourage consumer participation in orchestration programs. Climateworks recommends that AEMO's scenario planning account for the expected levels of CER adoption and the complexities of incorporating CER into the grid, along with implications for operational demand for all scenarios. Moreover, we recommend AEMO also detail how CER could be enabled by electrification, energy efficiency and mechanisms to promote demand flexibility to reach optimal adoption levels.

Similarly, the scale and pace of decarbonisation mechanisms – renewable energy deployment, fuel switching in buildings and industry, and energy efficiency and demand flexibility – will

influence the proportion of gas in the energy system. Climateworks modelling indicates that a significant switch from gas to electricity is essential for least-cost decarbonisation, and it would help jurisdictions meet their emissions reduction targets. AEMO can support an ISP optimal development path aligned with the NEO and build confidence in the orderly and rapid phase-out of gas by providing detailed analysis of these decarbonisation mechanisms. This analysis can give governments and energy system stakeholders a more comprehensive understanding of the future of the reticulated gas network and gas usage for electricity generation. Additionally, Climateworks recommends undertaking modelling alongside the ISP to outline the likely sequence, location and causal factors of gas asset and distribution network closures.

Both Climateworks' decarbonisation scenarios show CER deployment and gas phase-out (Climateworks Centre 2023). Under the 1.5°C scenario, generation from distributed solar PV increases from around 30 TWh today to 69 TWh by 2030 and 111 TWh by 2050. Gas provides 15 per cent of end-use energy demand by 2030 and 5 per cent by 2050, reduced from 24 per cent in 2022. Concurrently, the share of energy demand met by electricity grows from 23 per cent in 2022 to more than 30 per cent by 2030 and almost 60 per cent by 2050. Industry gas demand falls 46 per cent by 2030 and 86 per cent by 2050, relative to 2022 levels, and building gas demand falls 53 per cent by 2030 compared to 2022 levels.

Recommendation 7: Design an energy system that will enable Australia to become a 'renewable energy superpower', including analysis to enable forecasting and planning supply, storage and transmission solutions for 'regional ISPs'

Climateworks supports the establishment of 'net zero industrial precincts' across Australia (Climateworks Centre 2024). Precinct-scale planning for industrial regions can provide long-term guidance for industry and assurance to communities transitioning to net zero emissions. The effectiveness of this strategy will be enhanced if each major industrial region has a 'regional ISP' or equivalent, improving understanding of the amount of renewable energy that would support ambitious decarbonisation. This would help major industrial precincts integrate and share resources, workforces and clean energy alternatives. Through a place-based approach, policy-makers can leverage an industrial region's comparative advantages and unique characteristics and establish Australia as a 'renewable energy superpower'.

Regional energy system planning, overseen by AEMO, must be carried out alongside coordinated development planning across multiple levels of government. This approach is essential to build confidence among companies and investors as they evaluate capital allocation for zero-emissions industrial energy demand. The Net Zero Economy Authority has been established to facilitate this process, while the Future Made in Australia funding is available to support the demand-side transition within industry.

Heavy industry, such as iron and steel, aluminium, copper, nickel, zinc, lithium, chemicals and liquified natural gas, accounts for around 44 per cent of Australia's total emissions. Mining and

manufacturing processes consume 44 per cent of total energy and 40 per cent of electricity. Most industry emissions come from burning fossil fuels to power boilers, turbines and haulage and electricity usage (Climateworks Centre and Climate-KIC 2023).

The transition away from fossil fuels will significantly increase industry reliance on electricity as well as green hydrogen, bioenergy and, to a much lesser extent, gas with carbon capture and storage in some subsectors. For this shift to be successful, industry and investors need confidence that there will be sufficient renewable energy supply that is affordable and reliable.

That confidence does not currently exist. The ISP 'Step Change' scenario plans for moderate levels of industrial electrification and new renewable energy and resource exports, with generation capacity (excluding rooftop solar PV) reaching 85 GW by 2030 and 150 GW by 2050 (AEMO 2024). To fully capitalise on the economic opportunities presented by low-emissions exports and to electrify industry in line with a 1.5°C pathway, the Australian Industry Energy Transitions Initiative report indicates a NEM generation capacity of 141 GW by 2030 and 341 GW by 2050 (Climateworks Centre and Climate-KIC 2023). Similarly, the ISP 'Green Energy Exports' scenario projects grid generation capacities of 124 GW by 2030 and 396 GW by 2050 (AEMO 2024).

Climateworks recently conducted an analysis in the Gladstone region, showing that even the 'Green Energy Exports' scenario may fall short of the electricity capacity needed to rapidly decarbonise existing industries and establish new low-emissions export sectors. Our Gladstone analysis projects demand could reach 74 TWh/year by 2040, whereas the industrial forecast under the 'Step Change' scenario is only 44 TWh/year (AEMO 2024). If future analyses of industrial precincts across Australia tell a similar story, it may be that even the 'Green Energy Exports' scenario would not provide enough generation capacity to support the industrial energy transformation. It is for this reason that detailed regional energy system planning is critical.

Climateworks recommends that AEMO develop forecasting materials in tandem with precinct-scale energy system planning to better guide the deployment of energy generation, storage and transmission technologies. Localised planning, which provides detailed insights into the specific electricity and energy needs of different regions and sectors, is essential for directing investment, allocating resources and securing social license. Integrating regional planning into the ISP and subsequent forecasting and planning materials, such as regional ISPs, or utilising government-conducted analyses, such as the regional modelling commissioned by the Department of Climate Change, Energy, the Environment and Water under the National Energy Transformation Partnership, will help ensure that regional industry actors, investors and communities have the confidence to transition away from fossil fuels.

Thank you for taking the time to consider our submission. We welcome an opportunity to brief your team to provide further insights from our work.

Yours Sincerely,

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REFERENCES

Australian Energy Market Commission (2024) *National Electricity Rules*, Australian Energy Market Commission, accessed 21 November 2024.

AEMO (Australian Energy Market Operator) (2024) *2024 Integrated System Plan*, AEMO, accessed 21 November 2024.

AEMO (Australian Energy Market Operator) (2023) *2023 Inputs, Assumptions and Scenarios Report*, AEMO, accessed 21 November 2024.

Climateworks Centre (2024) *Net Zero Industrial Precincts*, Climateworks Centre, accessed 21 November 2024.

Climateworks Centre (2023) *Climateworks Centre decarbonisation scenarios 2023: Australia can still meet the Paris Agreement*, Climateworks Centre, accessed 21 November 2024.

Climateworks Centre and Climate-KIC Australia (2023) *Pathways to industrial decarbonisation: Positioning Australian industry to prosper in a net zero global economy*, Australian Industry Energy Transitions Initiative, Phase 3, Climateworks Centre, accessed 21 November 2024.

Climateworks Centre and CSIRO (2022) *Multi sector energy modelling 2022: Methodology and results final report*, Climateworks Centre and CSIRO, accessed 21 November 2024

Commonwealth of Australia (2024) *Response to the Review of the Integrated System Plan*, Commonwealth of Australia, accessed 21 November 2024.

CSIRO (Commonwealth Scientific and Industrial Research Organisation) (2023) *What are the sources of carbon dioxide in the atmosphere?*, CSIRO, accessed 21 November 2024.

Government of South Australia (2016) *National Electricity (South Australia) Act 1996*, Government of South Australia, accessed 21 November 2024.

International Energy Agency (2024) *Global Critical Minerals Outlook 2024*, International Energy Agency, accessed 21 November 2024.

Liebreich, Michael (2020) *Leibreich: Separating Hype from Hydrogen - Part Two, The Demand Side* Bloomberg NEF, accessed 21 November 2024.

The Treasury (2024) *Future Made in Australia National Interest Framework*, Commonwealth of Australia, accessed 21 November 2024.

United Nations (2015) *Paris Agreement*, United Nations, accessed 21 November 2024.