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Clean Energy Council submission in response to the Draft 2023 Inputs, Assumptions and Scenarios Report

The Clean Energy Council (CEC) welcomes the opportunity to comment on the Draft 2023 Inputs, Assumptions and Scenarios Review ('the draft IASR').

The CEC is the peak body for the clean energy industry in Australia. We represent and work with more than 1,000 businesses operating in Australia across solar, wind and hydro power, energy storage and renewable hydrogen. Our mission is to accelerate Australia's clean energy transition.

We welcome and broadly support the range of updated scenarios, and note that for the first time these scenarios are explicitly linked to global temperature outcomes. This is a vital improvement to the IASR, as it will ensure that policy makers and industry can clearly connect different investment pathways with climate outcomes.

We note that the purpose of the scenarios is to allow AEMO to consider a range of possible futures to inform the necessary investment in the electricity system over time, taking a range of uncertainties into account. At the same time, we note that these scenarios must be internally consistent, plausible, distinctive, broad and useful[1].

These scenarios must also be consistent with the urgent and inexorable requirement to decarbonise our economy. As such, scenarios that reflect 'worst case' outcomes, such as the poorly named *Progressive Change*, must be carefully assessed to ensure they capture the full suite of economic and social costs associated with the catastrophic climate collapse with which they will be associated. More generally, these scenarios should also be carefully tested to ensure they are consistent with the Australian Government's international emissions reduction commitments.

AEMO must carefully assess what costs are currently internalised and externalised in its modelling and assumptions. As we have recently seen with the reform to the National Electricity Objective (NEO), the cost of carbon emissions must now be formally accounted for by regulatory decision makers, and can no longer be a false externality. AEMO must therefore carefully assess all of its scenarios, inputs and assumptions, to ensure that they accuratey account for the full suite of carbon costs.

[1] 2022, AEMO, *Draft 2023 Inputs, Assumptions and Scenarios Report,* p. 18

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This submission provides feedback on the following:

1. Uncertainties – Intensifying global competition relating to clean energy (a 'clean energy arms race')
2. Sensitivites – Support for incorporating a social licence sensitivity; offshore wind sensitivity
3. Scenarios – 1.5°C Green Energy Exports; 2.6°C Progressive Change
4. Eligible technologies
5. Other issues

1. Uncertainties

The Draft IASR outlines a number of 'critical dimensions and uncertainties' affecting the energy sector, including the health and evolution of the Australian economy, the pace, scale and orchestration of consumer energy resources ('CER'), progress and cost outlooks for enabling technologies across electricity generation, storage and CER, and the role of emerging energy technologies affecting Australia's decarbonisation pathway and export economy.

We note that another uncertainty which could have profound impacts on Australia's clean energy transition is the intensifying global competition for green capital, clean energy equipment and skilled workers, precipitated by the passing of the US Inflation Reduction Act in August 2022.

This mammoth package of policies and incentives targets US$369 billion (AUD $520 billion) for clean energy and climate change initiatives across renewable electricity generation, storage, transmission investment, electric vehicles, critical minerals, household electrification, hydrogen, and industrial decarbonisation, and is rapidly repositioning the United States as a new clean energy superpower. In recent months, private enterprise has begun to rapidly pivot their forward investment strategies to place a much larger focus on the North American market, and Europe is now also responding in kind with its own Net Zero Act, funding and regulatory measures to prevent a flight of capital to the US.

The uncertainties associated with these events relate to the nature of Australia's response. If the Australian Government decides to respond (as many other economies are doing) with its own clean energy package which will enable Australia to compete with the US in some areas of comparative advantage, we could see the costs or commercialization gaps for certain technologies (eg. renewable hydrogen) close earlier than otherwise anticipated. By contrast, a lack of intervention could see new renewable energy investment and green energy export opportunities contract. The next six months will be critical.

2. Sensitivities

Offshore wind sensitivity

The CEC supports inclusion of the targets set by the Victorian Governments Offshore Wind Policy Directions paper of 2GW of offshore wind capacity by 2032, 4GW by 2035, and 9GW by 2040. With the Gippsland offshore wind zone having now been declared and the potential for first power to be provided by offshore wind in Victoria from as early as 2028, the CEC believes it is sensible for AEMO to plan accordingly as part of its forthcoming Integrated System Plan.

Should offshore wind remain only a sensitivity, and not be included in the ISP as it is not yet legislated, we would encourage AEMO to ensure they are sufficiently prepared to include it should this status change.

Given the scale of offshore wind projects and required supporting transmission, clear guidance to the Victorian Government as to what would need to occur for declared zones to be clearly planned for would also be welcome.

Social licence sensitivity

We note that AEMO is also proposing to apply social licnece considerations in its sensitivity analysis. The CEC agrees that social acceptance of clean energy infrastructure will be critical to the smooth and efficient deployment of new generating capacity and transmission generally, and this may become an increasingly important factor as the share of renewable energy in the NEM climbs.

Asymmetric risk

A fundamental principle that we encourage AEMO to consider in its assumptions in the IASR (and in subsequent methodology documents) is the nature of risk asymeetry. That is, the risks of going too late in regards to transmission build far exceed the risks associated with going too early. Bringing forward transmission build provides an inherent buffer in the power system that helps manage the price and reliability risks associated with unplanned events, such as the unanticipated failure of an ageing coal unit, or another price shock event as we saw in June 2022.

While planning tools such as the ISP can hope to deliver the ideal 'just in time' delivery of required transmission, the multitude of complexities that impact delivery of large-scale projects, especially in a constrained post-COVID market, mean that targeting earlier rather than later should be prioritised as a matter of necessity.

Missing the window of opportunity to deliver transmission on time sees reduced investor confidence, spilled energy, and ultimately increased costs for consumers. Insurance value of delayed transmission should therefore be considered as a sensitivity to generate a clearer understanding of the impacts of delays on transmission delivery.

Smoothed infrastructure sensitivity

The CEC is highly supportive of a smoothed infrastructure sensitivity to explore the employment impacts of a structured delivery of large-scale renewable projects. This sensitivity should be modelled at an appropriate level of localisation (i.e., by REZ), and account for projected local employment supply. Recent research from projects including Net Zero Australia[2], Race for 2030 and Construction Skills Queensland[3] all project significant regional labour demands in excess of local supply.

[2] https://www.netzeroaustralia.net.au/employment-impacts-aug-2022
[3] https://www.csq.org.au/renewables

This sensitivity would mitigate the current modelling gap in which localised cost factors ignore premiums resulting from competition for limited labour resources.

3. Scenarios

The CEC considers that at the highest level, AEMO must actively consider whether the scenarios it is considering are consistent with Australia's international commitments to achieve a temperature rise of no more than 1.5 degrees.

For example, AEMO should consider whether it is appropriate or consistent with Austalian government policy for any of the scenarios to target an outcome which is only consistent with a 50% probability of staying below 1.8 degrees. AEMO should err towards much higher confidence values across its scenarios of outcomes that are consistent with beating 1.8 degrees.

1.5ºC Green Energy Exports

The CEC welcomes the new Green Energy Exports scenario which more holistically reflects Australia's renewable energy superpower opportunity, including opportunities for metals processing and domestic green manufacturing.

However, on the whole it's likely that this scenario remains a relatively conservative picture of what a renewable energy superpower future could involve, should Australia vigorously pursue the true scope of its clean energy export opportunities.

The 2022 Hydrogen Superpower scenario envisaged a more than eight-fold increase in generating capacity (almost 1,000 TWh) by 2050. The underlying assumptions for the Superpower scenario did not, however, consider the full range of green manufacturing and processing opportunities available to Australia (eg. such as replacing our immense iron ore exports with iron metal exports, utilising our domestically produced green hydrogen).

Ross Garnaut's recently released book, *The Superpower Transformation*[4], estimated that meeting the *full* Superpower opportunity (including the replacement of iron ore exports with 'green' iron, and many other opportunities) '*would require in the order of 10,000 TWh of annual power generation'* – representing more than 50-times the current capacity of the NEM. On Garnaut's estimates (based on current technologies and costs), the cost of this investment in the electricity sector alone would be in the order of $6 trillion.

Similarly, the Net Zero Australia study[5], currently being undertaken by researchers at the University of Queensland, University of Melbourne, Princeton University and Nous Group), which is *'analysing net zero pathways that reflect the boundaries of the Australian debate, for both our domestic and export emissions'* finds in its 'Electrification+ scenario' that electricity generation capacity would expand to 40-times the capacity of the NEM in 2050.

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[4] Garnaut, R., *The Superpower Transformation: Making Australia's Zero-Carbon Future* (2022), Latrobe University Press
[5] https://www.netzeroaustralia.net.au/

While acknowledging that many opportunities will exist off-grid, and outside the NEM, compared with these above visions of a net zero, green economy by 2050, the 1.5 Green Energy Exports scenario does appear to represent a somewhat subdued vision for the country's green exporting future.

For example, achieving 1.5 degrees of warming is predicated on the rapid phase out of fossil fuels. However, the assumed volume of hydrogen produced for export in this scenario would only decarbonise 10 per cent of Australia's current energy exports.

Electrification and hydrogen

The CEC is pleased to see the 1.5 Green Energy Exports, 1.8 Orchestrated Step Change and 1.8 Diverse Step Change scenarios assume strong electrification across all three of these scenarios. The CEC expects electrification will be the main decarbonisation solution for fossil fuels used today by homes, business and light transport, noting its efficiency dividends.

We do however consider there to be an internal inconsistency with the assumption of very high levels of green hydrogen for the decarbonisation of gas networks in the 1.5 Green Energy Exports scenario. This is internally inconsistent because:

1. This scenario represents the most ambitious climate action and rapid deployment of decarbonisation solutions. As such, the CEC finds it implausible that in a scenario of rapid action, households and businesses will be prepared to wait for hydrogen to become available (with the associated appliance, infrastructure and cost implications), when a more easily accessible and cheaper solution is available via direct electrification.
2. It is particularly implausible in light of the current energy crisis (which saw very high gas prices in 2022, with elevated prices expected to continue in 2023 and beyond) that consumers would both a) be prepared to fuel switch to a more expensive fuel than gas, and/or b) wait for many years for the opportunity to do so, noting that a 91 per cent hydrogen share in existing gas networks would not be feasible for most distributed gas networks within the next decade.

Over the past year, there has been a steady stream of announcements by state and territory governments, indicating that they understand that electrification is the most efficient and flexible decarbonisation option for gas consumption. Accordingly, hydrogen blending in gas distribution networks (even small amounts, like the 8-10 per cent envisaged by AEMO in all scenarios of the Draft IASR) appears to becoming less likely to eventuate, and the CEC would urge AEMO to review its current assumption that hydrogen blending should be included in all scenarios.

2.6ºC Progressive Change

The CEC acknowledges AEMO's draft *Progressive Change* scenario, which reflects the IEA's 20201 World Energy Outlook State Emissions Policy Scenario (STEPS), that sees the current but insufficient emissions reductions pledges leading us to dangerous climate outcomes.

The CEC understands why AEMO would include a scenario within the IASR outlining what slow progress might look like in terms of investment, however, it must then be clearly labelled as such.
Given that a 2.6ºC temperature increase would represent a climate catastrophe, this should clearly be labelled as such, ensuring that policy decision makers understand the implications of a slow clean energy transition. Other names that AEMO could consider could be 'Inadequate Change' or 'Climate failure'.

This scenario sees a very low level of battery electric vehicle uptake by 2050 (63 per cent). Even though this scenario is intended to represent slow change, the CEC finds this 63 per cent penetration to be excessively low, noting that other auto-making markets which Australia relies on are quickly ramping up EV production, that car manufacturers are increasingly making announcements about phasing out the production of internal combustion engines, and that such low penetration would be inconsistent with Australia's legislated Net Zero Target by 2050.

Eligible technologies

Before excluding or not specifically considering technological mixes, including hybrid and co-located technologies, a solid understanding of the future physical requirements of a renewable energy system needs to be determined. This will allow AEMO to select the optimal mix of technologies to meet the reliability and stability needs of the system.

The data that feeds the IASR, and subsequently the ISP, must actively look at diverse technologies to meet the sustained energy demand at all times, at the lowest possible cost.

We consider that the list of eligible technologies included on page 92 is lacking in several respects.

Firstly excluding hybrid technologies is not consistent with current practice in the NEM, where an increasing number of developers are opting for this approach (as seen in the recent VRET tender). Given this technoloigy type will likely be incentivised by multiple policies including the Commonwealth Capacity Investment Scheme and the various state based REZ schemes, as well as through new regulatory processes such as the Integrating Energy Storage Systems framworks, it seems impractical to exclude it from explicit consideration as an eligible technology.

Similarly, the list should give consideration to other forms of storage technology, particularly technologies that may help to meet the increasing need for mid to long duration energy supply. We have already seen announced projects utilising this technology in the NEM - such as the Silver City project in Broken Hill – and it is likely that other technology types will become viable over the time horizon of the ISP, such as flow battery technology and thermal storage.

AEMO should also carefully consider the likelihood of additional revenue streams that will become available to renewable generation and storage assets, such as the likelihood of system strength and network support agreements being entered into with standalone storage and hybrid assets. The likely availability of these additional revenue streams will change the economics of utility scale storage and should be explicitly accounted for in the assumptions around generator and storage costs.

Moreover, as the power system transitions to an increasingly high penetration of variable resources, AEMO should consider the extent to which demand for medium to long duration storage is likely to change. In particular, AEMO should note indicative policy direction from the AEMC and Reliability Panel, which points to significant changes to the reliability standard and settigs, which will likely support further investment in utility scale medium to long duration storage

We note this feedback may be more aligned to the upcoming Draft ISP Methodology, and will reinforce this thinking following engagement with the March publication of the Methodology.

Hydrogen technologies

The IASR assumes that all hydrogen not produced by electrolysis will be made by steam methane reforming (SMR). However, research suggests that autothermal reforming (ATR) will increasingly become cost-competitive with SMR at scale and has stronger carbon capture potential. ATR also operates at higher process efficiency than SMR.

The electricity consumption rate for Polymer Electrolyte Membrane (PEM) electrolysers is potentially elevated for the coming decade. Recent research from Hodges et al. (2022) demonstrate that alkaline capillary-fed electrolysis cell can achieve energy efficiency of up to 98%, with an energy consumption of 40.4 kWh/kg hydrogen. The researchers believe that this technology will be available commercially by 2025.

Workforce modelling

Workforce modelling should be expanded to address the hydrogen supply chain to include production, storage, transport and carrier conversion. The Race for 2030 ISP modelling argues that most green hydrogen employment is likely to be associated with electricity generation, and that robust employment indicators are not currently available[6]. However, several recent research projects have modelled projected that the number of jobs across the hydrogen supply chain is non-trivial, including Net Zero Australia[7], Net Zero America[8], and Construction Skills Queensland[9]. As most of these projects will be regionally located, they will place additional pressure on limited local workforces.

Workforce modelling should also be expanded to include operations and maintenance jobs for electricity transmission and distribution. These jobs account for about half of all electricity jobs at present but are currently excluded from workforce modelling. Failure to model all jobs across the supply chain risks providing an incomplete understanding of the labour demands of the energy transition.

The CEC also endorses the inclusion of a workforce modelling sensitivity that increases onshoring manufacturing of up to 50-60%. This increase reflects government priorities around onshoring manufacturing capability and supply chain diversification.

Other issues

Generally we consider that AEMO must carefully assess all of the assumptions made in the IASR, to ensure that the rest of the ISP process remains robust to the full range of potential future outcomes that may arise over the modelled time horizon.

For example, AEMO should carefully asses assumptions around forced outage rates and long-duration outages. As observed outages become more frequent, particularly for fossil fuel generators, combined

[6] https://www.racefor2030.com.au/fast-track-reports
[7] https://www.netzeroaustralia.net.au/employment-impacts-aug-2022
[8] https://netzeroamerica.princeton.edu/img/NZA%20Annex%20R%20-%20Labor%20modeling%20methodology.pdf
[9] https://www.csq.org.au/renewables

with the effects of increased VRE penetratrion, AEMO must carefully test its assumptions around outage rates and how these may change over the modelling period. In particular, given that recent values demonstrate forced outage rates to be worsening as thermal units age, AEMO must factor in a continued degradation of the forced outage rates into its analysis. We particularly note the figures on page 83 of the report, which seem to assume an improved forced outage rate from 2024 onwards – this seems inconsistent with the forced outage rate trajectories observed in the years up to 2023, which clearly demonstrate a worsening outcome.

AEMO must also carefully consider the disproportionate impacts that large outages will have given the complex interactions that exist in the power system, where the loss of a large thermal unit providing system strength or other system stability services may cause cascading effects across the broader power system.

Assumptions around the capacity of the distribution network to host additional volumes of rooftop PV must also be carefully assessed. While the CEC considers that consumer energy resources and distributed energy solutions are central to the transition, there is a complex interplay between uptake of these resources and volumes of utility scale generation and storage.

AEMO must carefully assess assumptions such as the extent to which distribution networks can be optimised to increase hosting capacity and uptake rates of distributed storage. Equally, AEMO should reassess its assumptions around VPP type arrangements, which we understand underpin the practicality of consumers installing large behind the meter battery storage systems.

Testing these assumptions is critical as investments behind the meter tend to be traded off against investment in utility scale generation, storage and transmission. It is essential that all underpinning assumptions are tested, to ensure the correct balance between small and large scale is accounted for in the ISP modelling.

Testing for this robustness to uncertainty must also be made explicit and become a central element of AEMO's assumptions and approach. This will help to reduce risk that later iterations of the ISP will need to be substantially revised, which brings with it increased costs for investors.

In particular, AEMO must expliciutly take into account black (or at least grey) swan events, or 'high-impact, low probability' events in its planning processes. These events tend to have a disproportionate impact on consumers in terms of price and reliability outcomes. Understanding the impact of unexpected events such as major asset failures, global energy crises, pandemics, bushfires and other such outcomes should be considered in the planning, testing the system design against potential challenges. Testing how well the designed system would cope with various disturbances could be done in a relatively simple post-processing step without additional optimisation.

AEMO should also consider the assumptions it makes around minimum stable configurations of synchronous generation online. As noted on page 80, AEMO bases its assumptions on "internal analysis of historical generation and operational experience." This should be reconciled with the fact that through the Engineerig Framework, AEMO has committed to an approach of moving the power system through a series of 'hold points', which we understand to be consistent with the approach taken in South Australia where the reliance on minimum synchronous thermal unit combinations is consistently reduced over time.

AEMO should therefore purposefully factor in a reduction in the number of synchronous units that are required to be online, especially over the out years of the forecast, where it is expected technologies such as grid forming batteries and other non-thermal system stability assets will form the backbone of these minimum synchronous requirements.

Conclusion

The CEC welcomes further engagement from the AEMO on this reform.

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