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Ms Anthea Harris
CEO
Energy Security Board

Via email: info@esb.org.au

Dear Ms Harris,

Re: CCG's Response to Capacity Mechanism Project High-Level Design Paper

The dilemmas faced by the Australian electricity sector have been highlighted yet again by AEMO's Final 2022 Integrated System Plan (ISP)[1]. In simple terms the total generation portfolio will need to rise in power capacity terms from 85 GW in 2023-24 to 142 GW in 2032-33 , and to 287 GW by 2049-50[2]. This is an over build of 1.7 times the existing generation fleet capacity existing today by 2033, and 3.3 times by 2050. Included in these figures is storage capacity of 3.4 GW in 2023-24, 23GW in 2032-33, and 61 GW in 2049-50, all used to 'firm' renewable supply as thermal plant withdraws.

Background on Capacity Requirements

Why do we have to overbuild capacity? It's related to the amount of time renewable generation has useful output and relates to the weather and the technology type. When we look at the capacity factor[3] of renewable energy generation technologies in the Australian situation, wind generation at best will provide a 30% to 40%[4] capacity factor, and solar generation at around six hours per day will provide around 20% to 25% capacity factor at most. Even assuming geographic diversity of time and weather so renewable generation output across the National Electrical Market (NEM) is less correlated we will still need much more than 100% of current generation capacity in renewable generation in order to reproduce the generation capacity required[5].

[1] AEMO, 2022 Integrated System Plan, Final, June 2022, .

[2] This assumes the Step Change scenario developed by the extensive 2022 ISP consultation process unfolds as is currently adopted by industry stakeholders (refer: page 7, 2022 ISP).

[3] Capacity factor is the % of time a generation technology outputs useful power on average over a period of time.

[4] Offshore wind can get between 35% to 40% depending on location and season.

[5] Analysis of 60% to 100% renewable penetration in Pacific Island Nations, shows overbuild of around 11 times is required because of low geographic diversity (islands are small compared to cloud and wind occurrence), and while diesel generation use reduces by over 90% thus reducing fuel import costs and reducing emissions,

Over the last 20 or so years a number of different approaches have been explored by the energy regulators and policy makers to advance beyond our 'energy-only' market model[6] to improve the balance in the trade-offs implicit in the energy trilemma[7]. The resulting policy uncertainties have increased the investment risk of 'firmed' renewable generation such that the energy transition to a stable future grid is at risk, as evidenced by the recent market suspension by AEMO. Without rapid policy adjustments, further market suspensions are likely to follow which will increase the risks for additional renewable and in particular energy storage investment.

Investment Headwinds

An energy only market requires wholesale prices to rise to very high levels in order to encourage additional investment in 'firmed' renewable generation capacity. What we are potentially seeing is the emergence of market failure within the NEM, to the detriment of electricity consumers, because energy storage investment has a number of headwinds.

These headwinds include that significant additional global battery manufacturing capacity is required to meet growing global and local demand, for both static grid-connected storage, and mobile battery capacity for EV, train and other transport uses.

In Australia the incentives to invest in grid connected storage are very low with projects being delayed and disadvantaged because projects seeking connection at:

- Transmission voltages have delays through planning, environmental, social concerns, approvals and GPS[8] hurdles, and then uncertain network capacity constraints once connected; and
- Distribution voltages have an uncertain regulatory framework, where DUoS charges may or may not be applied which extract 'rents' by monopolist DNSPs[9], as well as the issues experienced at the transmission level mentioned above.

How then can the necessary 18 times GW investment in energy storage capacity progress before baseload generation is withdrawn and be fully deployed by 2050

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the diesel generators are still required to be available for the 3 to 4 weeks each year when wind and solar generation, firmed by battery storage, ceases entirely or is insufficient to provide reliable electricity to the community over each 24 hour period.

[6] While providing a strong generation cost efficiency mechanism, excessive energy cost increases are required to encourage new investment in any form of generation and in particular all forms of energy storage. The community will not be able to sustain these price increases for extended periods as additional renewable energy is deployed.

[7] The energy trilemma is the balance between security (supply/demand balance and reliability), sustainability (lowering emissions output), and affordability (lowest efficient cost of the system to consumers).

[8] Grid performance standards (GPS) which are AEMO's testing requirements of a newly installed renewable generation or storage project so that its performance characteristics are fully described for dispatch purposes.

[9] Storage at the transmission voltages do not pay TUoS charges in line with current thermal generation plant treatment, but storage at distribution voltages pay NUoS (the sum of TUoS and DUoS charges) which is inequitable and undermines the storage business case by letting the monopoly DNSP extract 'rents' from the energy and firming markets. The AEMC did not resolve this matter in its December 2021 decisions on 'Integrating Energy Storage Systems in the NEM'.

when disadvantaged in the ways highlighted here?

Proposed Capacity Mechanism

The Energy Securities Board's (ESB's) proposed solution is to use a 'capacity mechanism' which seeks to ensure lack of security of supply does not severely damage our economy through early exit of brown coal, black coal and mid-merit gas, before the enormous overbuild investment can occur in: renewable generation; supporting energy storage for 'firming'; network capacity expansion through renewable energy zone (REZ) transmission connection; and inter-jurisdictional interconnection capacity expansion.

The 'Step Change' scenario in the 2022 ISP highlights the primary concern for the Australian electricity sector as the generation mix changes to reduce emissions particularly in the eastern state NEM. While the exit of brown coal (by 2033), black coal (by 2043) and mid-merit gas (by 2047) are assumed, the huge increase in all forms of energy storage required to stabilise and 'firm' the grid and shift energy to cover the 24 hours of the day, and over the seasons, cannot just be assumed to happen without some form of incentivisation and risk reduction for the investment required. This support is required because storage projects that build surplus capacity early (ie prior to battery energy storage systems or BESS costs coming down) should not be disadvantaged relative to projects that are built later when costs are lower and/or storage service utilisation is higher.

In its simplest form a 'capacity mechanism' seeks to provide a fixed (or steady) income to generators to complement their variable income arising from periods of energy generation which are subject to success in competitive market bid processes[10]. The ESB is exploring how this might be achieved when measured against the criteria suggested by the National Electricity Objective (NEO)[11], and as guided by the Energy Minister's principles[12]. The primary assumption is that variable income can be lowered through competition in the energy market, even as fixed income is raised in a 'capacity auction' process to provide reliable fixed-period payments to ensure delivery of capacity services at lowest overall cost. The use of an auction process has been shown to provide a measure of economic efficiency in regulating monopoly utility services[13]. However the design of the auction or multiple auctions is critical to its success.

The 'capacity mechanism' being an auction process as proposed by the ESB attempts to solve three pressing but counter productive objectives, notably how to

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[10] The energy market tends to operate on short-run marginal cost (SRMC) signals in the energy bidding process, locking participants into loss making dispatch, unless a higher cost technology is dispatched, which allows some generators to recover their long-run or investment costs. Investment is determined by long-run incremental costs (LRIC), or long-run average costs (LRAC), which requires a return on and of capital for sustainable investment.

[11] The ESB's objective criteria are: 1) achieving the optimal level of reliability, 2) appropriate allocation of risk, 3) technological neutrality, 4) minimise regulatory burden, and 5) emissions reduction.

[12] Refer ESB, High Level Design Consultation Paper, June 2022, Box 1 page 5.

[13] References: 1) H Demsetz, Why Regulate Utilities?, Journal of Law and Economics, Vol 11, No 1, April 1968, Pages 55 – 65. 2) S C Littlechild, Competitive Bidding for a Long-term Electricity Distribution Contract, 4 June 2001.

encourage:

1. Existing heavily written-down coal generation plant capacity to stay on-line and invest to provide reliable energy to at least the deadlines assumed in the 'Step Change' scenario being 2043;
2. Existing and new renewable generation to expand capacity by over 3.3 times by 2050; and
3. Existing and new storage to expand capacity by over 18 times by 2050.

Multiple Auctions Required

These outcomes are incompatible to a single auction process. Auction processes are only effective where there are multiple parties that can bid for delivery of services within the time frames, geographies and at the capacities required for reliable and sustainable energy delivery. Clearly heavily depreciated plant will usually underbid new entrant plant which is at the start of its depreciating cycle, so the multiple objectives of lowest cost, reducing emissions, reliable grid, sustainable investment and other are unlikely to be successfully met in the one auction process which includes thermal generation plant.

Therefore a systems based approach is required to deliver the outcomes AEMO believes are required, and a simple market based approach via auction is unlikely to succeed in isolation. What type of storage is built, where it is built and how it is operated are the more significant factors in ensuring a secure cost-effective energy transition than any cost reductions that come from a competitive auction alone. The detail modelling for AEMO's 2022 ISP should be able to identify the systems requirements on the multiple dimensions which form the 'Step Change' scenario. If this is not available, this detail should be mandated for delivery within the 2024 ISP development process which has just commenced through notification by AEMO.

This suggests at a minimum there needs to be two separate auctions:

- The first to ensure brown and black coal and mid-merit gas plant stay connected and deliver services within the time frames specified in the AEMO 2022 ISP through a reverse-auction subsidy process (with all the safeguard penalties which apply if services are not delivered when required, including a regulated maximum rate of return because of the reduction in capital risk provided to these existing businesses); and
- The second to facilitate new storage connection at locations, capacities, service specifications and within timeframes which are identified as needed by the grid in the AEMO 2022 ISP through a reverse-auction process which provides a location connection right and/or a subsidy to connect (these have franchise characteristics which are well delivered through the appropriate auction process, but safeguards to avoid issues such as 'location banking' or lack of progress in BESS capacity delivery need to be factored into the auction contracts).

What about renewable generation projects?

The current approach under the NER is market based, where the risk of the financial sustainability for any renewable generation, wind or solar farm investment is bourn by the project proponent, and new connections may constrain existing connections.

Without providing franchise or queuing rights, the emerging REZ developments seek to encourage the better location of new renewable connections and reduce the network investment required to support these renewable zones. It is unlikely the industry would agree to a franchise or queuing model by location as existing or near completion projects will likely be disadvantaged in such a process, unless there was some form of grandfathering (and this would be economically inefficient). Nonetheless a suitably designed REZ access process could work and appears to be a potential focus of the State based REZ development processes and AEMO's 2022 ISP.

Where there is no competitive tension because not everyone has access to technologies which can provide the same grid support, firming, system strength and/or inertia services sought by AEMO, an auction process will fail to deliver the desired outcomes at the economically efficient cost.

Of prime concern is how to use the 'capacity mechanism' to incentivise the retention of existing dispatchable generation in line with the 'Step Change' scenario until its defined exit points, at the same time as providing more certainty to new entrant investment in renewable energy generation within the defined REZ (to reduce average transmission costs) and in particular incentivise energy storage (of short, long, inter-day and inter-seasonal durations[14]) required to firm the expansion of renewable energy generation within the NEM, at locations which support the further integration of new renewable generation.

Auction Elements

Without expanding on all of the elements of a 'capacity mechanism', the following points are suggested as primary elements of a multiple auction system which will achieve Australia's energy transition in the energy sector at an economic cost which the community and the economy can support in a sustainable manner.

The capacity auction process[15] should be offered as two auction processes and be offered as a menu of service delivery markets with the following dimensions defined by AEMO:

- By state jurisdiction because of interconnector capacity constraints;
- With a bias for new grid connected storage to be located beside existing thermal generation plant or to be within clearly defined REZ;
- For storage to be incentivised for longer energy duration availability because energy shifting and firming capability deployment is lagging frequency control

[14] Lithium-ion based batteries are the better technology for short duration storage up to 4 hours, flow-battery is the better technology for long duration storage up to around 12 hours, and pumped hydroelectric energy storage (PHES) technology is better for multiple day and inter-seasonal storage. Other emerging technologies including thermal, fly-wheel, concentrated solar power, chemical, fuel cell and many alternative new storage processes are emerging but unlikely to be at manufacturing scale within the time frames envisaged for the energy transition by 2050.

[15] In reality a reverse-auction process where the lower 'risk-adjusted' bids within the particular menu slot to meet the reliability requirement defined by AEMO are the winners, subject to delivery during defined times or periods.

and restoration capability within the NEM [16];

- With a stepped generation capacity reward scheme where the steps are defined by the inverse of the plant emissions intensity[17];
- Payment for each auction certificate won on a quarterly basis in advance for the period of the certificate, with recovery through the AEMO settlement process (alternatively a process similar to the existing RET process could work and be deployed by the CER in a shorter period of time that through NEM settlement); and
- Different capacity certificate (or contract) durations related to the investment risks of different technologies with expiry periods so that location 'capacity banking' cannot occur by participants who seek the economic rent of the capacity mechanism and are not serious in delivering the technology slot they have secured at auction[18].

This approach will allow alignment with current State jurisdiction arrangements and encourage a better coordinated approach to the transition of the NEM and other electricity markets within Australia, recognising a larger geographic coverage and energy transfer capability will reduce the generation and storage overbuild required for a stable and reliable electricity delivery to balance demand from consumers and industry.

It is critical that competition in the energy, ancillary and emerging[19] services markets continue through a jointly optimised dispatch process, as this will place continued downwards pressure on energy prices which will drive overall costs to a lower level when combined with 'capacity market' mechanisms.

Supporting Mechanisms

There are other supporting mechanisms outside of the ESB's current 'capacity mechanism' focus which will advance the energy transition in Australia. These include:

- Further transmission and distribution tariff reform to include demand and energy pricing incentives for energy saving via DSM and BESS technology at transmission level and BESS and DER at distribution level;
- The need to ensure that storage at the distribution connection level does not pay TUoS and DUoS, in line with the current approach that PHES and BESS

[16] Investment in long-duration has manufacturing hurdles to solve, and inter-seasonal storage is extremely difficult given environmental, planning and connection complexities, other than large capital cost requirements.

[17] Preferably in measured objective emission terms (eg tonnes CO2e / MWh), starting with (say) a 25% benefit factor for brown coal, 35% for black coal, 45% for mid-merit gas, 55% for natural gas turbines, 65% for hydrogen gas turbines & fuel cells, around 75% for storage based on round-trip efficiency (RTE), 80% for solar PV & CSP, and 85% for on-shore wind, and 90% for off-shore wind to reflect their capacity factor availability.

[18] For example PHES might be offered for 20 years, long-duration storage for 10 years, short-duration storage for 5 years, on-shore wind for 10 years, off-shore wind for 20 years, grid-scale connected solar PV at 10 years, distributed solar PV at 3 years (to cover the aggregation cost investment), nuclear for 30 years, each fossil fuel plant through to its 'Step Change' closure point. But allow early surrender of the certificates where withdrawal is financially required.

[19] For example an inertia market open to grid-forming renewable generator inverter technology deployment, as well as gas turbines and emerging hydrogen based fuel cell and other technologies.

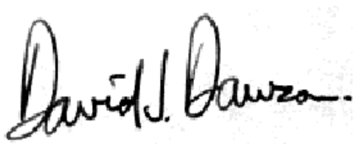
grid scale storage at the transmission level which do not pay TUoS.
- In State jurisdictions where there are other green and city/rural subsidies factored into wholesale and retail tariffs, ensure that any ‘capacity mechanism’ framework does not over-compensate network businesses (for example in Queensland the need to consider how to reduce the community service obligation (CSO) through the creation of secure micro grids in western regional areas to ultimately reduce need for SWER[20] lines, involves the deployment of smaller community, rural or provincial township storage which may or may not be included in the ‘capacity mechanism’).
- Investment in smart meter and DER control technology to assist customer control over their energy usage and costs, and aggregation through VPPs to allow additional competition in the NEM;
- An eastern state gas reservation policy which has been shown to work in Western Australia to curb the international energy price being seen unfiltered by Australian consumers and industry; and
- Other initiatives currently in consultation or planned by the energy regulators.

Concluding remarks

Thank you for the opportunity to provide comments on the ESB’s Capacity Mechanism. In short it is suggested that capacity mechanisms be implemented through three separate auction processes to incentivise:
- Existing thermal generation plant to continue electricity supply through to their currently retirement dates as notified to AEMO before 31 December 2021;
- Existing and new electricity grid-connected storage to locate at locations which support AEMO’s 2022 and subsequent ISPs, including State REZ initiatives within regions as defined before 30 June 2022; and
- Existing and new renewable energy generation plant within State REZ initiatives within regions as defined before 30 June 2022, and identified in AEMO’s 2022 ISP.

If there are any queries please let me know on 0417 285 194 or via d.dawson@carisbrookeconsulting.com.au.

Yours sincerely,



David Dawson
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[20] Single-wire earth return distribution systems have frequently been used in rural areas to provide grid electricity supply, but as they become increasingly unreliable and costly as they approach their engineering life and require replacement, renewable energy generation with BESS and diesel plant backup are likely more economically efficient to deploy, as is currently being pursued in Western Australia, New South Wales and Queensland.