

19/10/2020

Dr Kerry Schott AO  
Chair – Energy Security Board  
COAG Energy Council Secretariat  
GPO Box 787  
CANBERRA ACT 2601

Dear Dr Schott;

**ANLEC R&D Response to ESB Post 2025 Market Design Consultation Paper with a focus on the Resource Adequacy Mechanism workstream.**

Thank you for the opportunity to respond to the proposed Market Design Consultation Paper.

This is important work for the electricity system and I commend the Energy Security Board on this initiative. Market design will take on increasing significance as the sector is required to decarbonise to near-zero emissions to address climate change.

Over several years, ANLEC R&D in consultation with its stakeholders has developed and published innovative modelling to highlight considerations for minimum total system cost for the NEM. Our work is guided by an Industry Steering Committee that includes representatives from major Australian generators including Delta Electricity, Intergen Australia and two other power producers.

I submit for ESB consideration two documents to inform the ESB Post 2025 Market Design Initiative.

1. A summary of conclusions and recommendations on resource adequacy for the NEM
2. The underpinning detailed system assessment study from which the summary conclusions and recommendations are made.

It is our view that underpinning the post 2025 Market Design should be an open and transparent systems assessment of the lowest cost for NEM decarbonisation to 2050. Such an assessment should be completely technology agnostic to include all prospective low emissions solutions for energy generation.

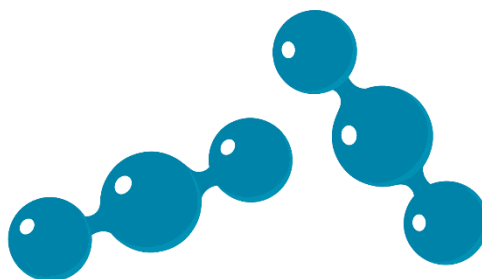
In providing the latest assessment, the major concerns raised from this analysis are:

- To a first approximation, **the economic penalty for a sub-optimal power generation asset fleet is about \$20 billion/per year for net-zero emissions targeted by 2050**. This cost penalty will be incurred if firm and dispatchable low emissions power generation technologies (e.g.: fossil fuel+CCS and/or Nuclear) are not available to the NEM in 2050.
- As decarbonisation proceeds, winter will present the larger vulnerability for a low emissions grid. Dispatchable generation will have to be of sufficient capacity to bridge continental wind-drought events over several days, which occur with regularity.
- Up to 2.5GW of CCS may be deployed to maintain the electricity system on a lowest cost path to decarbonisation with no regrets. Much like Snowy 2.0, these are very large investments in infrastructure that are essential to a minimum cost, low emissions NEM.

We would welcome the opportunity to discuss these results with you or provide any further information you may require.

Yours faithfully;

Dr Noel Simento  
Managing Director



anlec&d

**ANLEC R&D Response to P2025 Market Design Consultation Paper**

**Dr Noel Simento – Managing Director**

**THIS SUBMISSION IS *NOT* CONFIDENTIAL**

# Resource Adequacy for a Decarbonised Electricity Sector - Targeting lowest system cost

This summary responds to the call for submissions on *ESB Post 2025 Market Design Consultation Paper* with a focus on the *Resource Adequacy Mechanism* workstream.

## 1 Context

Acknowledging that the ESB focusses on development of a robust electricity network, the consultation paper does not sufficiently consider network/market changes in the context of “emissions reduction” and minimising its cost in the electricity sector. Resource Adequacy in the context of large-scale emissions reduction cannot and should not be ignored.

This submission delivers an assessment of “**Resource Adequacy**” in the context of **lowest system cost to decarbonise the electricity sector**. The lowest electricity system cost delivers the best prospects for lowest energy prices to the economy.

Studies<sup>1,2</sup> to date have shown that the biggest investment benefit is derived from the enhanced interconnection between the NEM states. This is because it allows the resources of Variable Renewable Energy (VRE) to be distributed in the network more effectively. The government and AEMO have made recent decisions fully consistent with this opportunity. Much more interconnection will be necessary.

With the premise of better interconnection, *the make-up of a transformed power generation asset portfolio for near-zero emissions by 2050 is less intuitive*. As the ESB Discussion Paper<sup>3</sup> acknowledges, grid system requires a larger suite of power generation services that are not all delivered by any one technology.

The lowest cost combination of low emissions power generation assets is necessary.

Such a suite of technologies is best determined by a NEM asset optimisation strategy that meets viable build schedules but is not encumbered by artificially imposed technology and policy choices. These are long lived assets and are not easily un-wound after deployment.

## 2 Setting the Target Electricity System for near zero emissions

Attached for your consideration, one of the first publicly available studies that optimises to the lowest cost decarbonisation<sup>4</sup>. This report suggests what a lowest cost power generation asset portfolio might constitute for the NEM in 2050. Its modelling assumptions are unencumbered by policy impositions and therefore it delivers a lowest cost target portfolio for a competent grid system.

The following conclusions from the study are evident:

- The low emissions grid will be dominated by VRE power generation - though all low emissions power generation technologies are necessary for a competent grid.
- The importance and value of firm dispatchable\* low emissions power generation like CCS become increasingly evident beyond 60% decarbonisation of the NEM.

**\*Firm dispatchable power generation** is that which is not subject to any intermittency. It is available on demand, when required and in the quantity necessary. Traditional fuel sources such as coal, gas, and nuclear meet such criteria.

<sup>1</sup> <https://anlecrd.com.au/projects/value-flexible-firm-capacity-decarbonising-australian-grids/>

<sup>2</sup> <https://anlecrd.com.au/projects/the-role-of-electricity-systems-modelling-in-optimising-planning-decisions/>

<sup>3</sup> ESB Post 2025 Market Design Consultation Paper, September 2020

<sup>4</sup> [The Impact of NEM Constraints on the System Cost to decarbonise the grid](#)

- To a first approximation, the economic penalty for a sub-optimal power generation asset fleet is about \$20 billion/per year for net-zero emissions targeted by 2050. This cost premium will be incurred if firm dispatchable low emissions power generation technologies (e.g.: fossil fuel+CCS and/or Nuclear) are not available to the NEM in 2050.
- Much like Snowy 2.0, these are very large investments in infrastructure that are essential to a minimum cost, low emissions NEM.
- Up to 2.5GW of CCS may be deployed to maintain the electricity system on a lowest cost path to decarbonisation with no regrets.

At a lower cost bound, an optimised net-zero asset portfolio for the NEM may be delivered at a system cost less than \$100/MWh and a carbon abatement cost of less than \$112/t CO<sub>2</sub>.

For lowest system cost, firm and dispatchable low emissions coal electricity generation is necessary to underpin grid stability. This does not mean that all power stations will need CCS. However, this study identifies that CCS services will be absolutely essential for some of them, if net-zero emissions reduction targets are to be met at minimum cost to the consumer.

If the community is to accept the necessity of technologies like CCS, governments must take the long-term view. The most valuable outcome from such assessment is that it identifies essential firm dispatchable power generation technologies like fossil fuel+CCS (and/or Nuclear) that are necessary in the 2050 timeframe. *These types of technologies cannot be deployed at short notice and require governments to prioritise continuing investment for deployment now* – if they are to be available in 2050 with community licence to operate.

### 3 The Post 2025 Market Design

Underpinning the post 2025 Market Design should be an open and transparent systems assessment of the lowest cost for NEM decarbonisation to 2050. Such an assessment should be completely technology agnostic to include all prospective low emissions solutions for energy generation. While driven by emissions reduction aspirations, the *assessment should deliver a target low emissions power generation asset portfolio for 2050 to guide national and state-based policy development.*

#### 3.1 Differences Evident in Underpinning Analysis

The AEMO Integrated System Plan 2020 (ISP 2020)<sup>5</sup> is a substantive strategic analysis for the future of the NEM grid. It is also underpinned by the intent to minimise “total systems cost” - a commendable objective. While it aims to acknowledge emissions reduction as a priority, there are some results that differ substantially from the attached systems assessment.

The proposed post 2025 market design initiative may be used to address these differences which may be summarised as follows.

#### 3.2 Modelling Strategy:

##### 3.2.1 Conventional Scenario Analysis

ISP 2020 adopts a scenario-based modelling approach. The scenarios are developed around emissions reduction rates – slow, central, fast, etc. These are essentially assumptions around generation asset deployment rates. It is important to acknowledge; ***an embedded asset deployment rate does not necessarily lead to a lowest cost decarbonisation outcome.*** Imposing an asset build rate into modelling can embed a higher cost asset portfolio resulting in a higher system cost.

What does this mean? Most conventional modelling approaches to future build, develop their grid asset portfolios taking account of asset deployments and retirements faithful to a sequential passage of time. Therefore, if an assumed asset build rate (e.g.: VRE) precludes (or excludes) selection of a higher cost CCS asset, this essential asset is not added to the developing portfolio. Thus, it is not available when it is most required to play out its role in minimising the “system cost” in 2050. The high cost and high

<sup>5</sup> <https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp>

value of Snowy 2.0 to the NEM system is precisely a very good example of this argument. It is no less true of CCS and nuclear technologies.

### 3.2.2 Modelling Electricity Grid Services (MEGs)

The MEGs approach in the attached study **does not** embed pre-determined asset deployment assumptions in its method. Rather, it sets a “lowest system cost” objective for emission reduction to near-zero and at each step along the way determines the “optimum asset portfolio” that will deliver the required decarbonisation at that point. What does this deliver?

- Firstly, it delivers the end-point target portfolio to achieve the low emissions objective pursued at lowest system cost.
- Secondly, it delivers the deployment capacity (share) envelope for all available technologies, to ensure any one technology is not “over-built” into the system to compromise the future lowest system cost outcome.

This approach is complementary to strategic planning so as to ensure the lowest cost path to decarbonisation is tracked as the grid decarbonises. Reviewed regularly this will ensure the technology deployment targets may be continuously revised to take account of any advances in science, technology and R&D.

Importantly, this approach identifies those large “high cost assets” that are essential to a “lowest cost system” on a trajectory to near zero emissions. The current market structures are either not designed or will fail to deliver these essential assets.

#### **Recommendations:**

##### ***The Post 2025 Market design initiative should be underpinned by:***

- A systems assessment that goes beyond the current ISP 2020 to exclude imposed assumptions such as “build scenarios” or policy prescriptions. It should deliver a transparently optimised target power generation asset portfolio for low emissions in 2050.
- The lowest cost system wide decarbonisation outcome for the NEM is best determined through modelling that is technology agnostic and transparently inclusive of all known low emissions power generation options e.g.: CCS and nuclear.
- The application of a target portfolio for 2050 to inform the design of future policies and market structures.

## 4 Technology Candidacy and Cost

### 4.1 Firm dispatchable generation - CCS and Nuclear

In forward looking modelling that goes into decades beyond, low emissions technology options should not be excluded. The ISP 2020 does not include technologies like CCS and Nuclear. The value of these technologies - as firm and dispatchable generation for the NEM system - warrant their inclusion in the system models is essential.

The value of a technology to the system is not exclusively set by its “deployment price”. The attached system assessment shows that the benefit of technologies like CCS and Nuclear to the NEM system far outweigh their high installation cost by underpinning the strength and resilience of a VRE heavy grid.

### 4.2 Storage – Batteries and Pumped Hydro

One of the largest uncertainties to achieving lowest system cost for the NEM is cost of energy storage. The ISP 2020 publishes power asset portfolios with substantial energy storage resources in 2042. This is premised on a cost reduction rate of learning for storage technologies that are both aggressive and unproven. Importantly, behind-the-meter generation and storage costs are not delivered to the economy free of charge. Any system cost optimisation should include the cost of these resources to the economy.

### Recommendations:

#### The Post 2025 Market design initiative:

- Should especially take account of and be informed by a sensitivity to the price and availability of energy storage resources available.
- Market design should target a specific portfolio of “no-regrets” asset build to ensure lowest systems cost for the grid in 2050.
- Should include market design structures that assist deployment of higher-cost higher-value firm and dispatchable generation technologies like fossil fuels with CCS and Nuclear that will be essential to the system.

## 5 Policy

It is very possible that policy development by individual State Governments can cruel the delivery of the lowest cost decarbonisation of the National Electricity Market<sup>6,7</sup>. This is especially true if VRE technologies are “over-built” into the system. It generates a couple of focus questions: Is a particular State Government emissions reduction policy target for renewable energy generation in the best interests of the lowest cost NEM system? Where and how is this lowest cost objective managed?

The deployment of VRE technologies is being stimulated through off-market mechanisms like the Renewable Energy Target (RET) and other State government initiatives. These mechanisms while necessary to sustain the massive build required will become counterproductive if not supplemented by similar initiatives to deliver essential low emissions firming capacity like CCS. Unidimensional RET policies will increasingly work against achieving the lowest cost decarbonisation system for the NEM. State Government Policy settings for VRE targets that are not informed by NEM requirements are a recipe for high cost outcomes that are damaging to the national economy.

In a National Grid that is rapidly evolving, it is essential that state emissions reduction targets for energy generation are informed and shaped by a National Strategy for the NEM.

### Recommendations

The post 2025 market design should:

- Take opportunity to assess and critique state government policy aspirations in the context of a lowest cost national electricity system.
- Take opportunity to re-structure the market and governance systems to better inform regional power generation resources and requirements. This is best achieved by rigorously scheduled inter-state interconnection design and deployment plan to 2050.

## 6 Operational Vulnerabilities

The current market design and the AEMO ISP 2020 gives high priority to the networks supply, strength and resilience vulnerabilities going forward. Therefore, emphasis is often placed on the coming summer<sup>5</sup>. As a result of several conventional fossil generation assets exiting the system over the last decade, Victoria has faced supply shortage last summer while NSW recognises it will be a net importer of electricity supply post the closure of the Liddell power station in 2023.

The attached modelling shows that the vulnerability for a low emissions NEM grid is **not summer** – rather it is the winter. It is prudent for long term market design to take account of such vulnerability. In a grid that is dominated by VRE, the attached analysis shows there is a minimum “firm and dispatchable” generation asset component that is required to keep the grid competent.

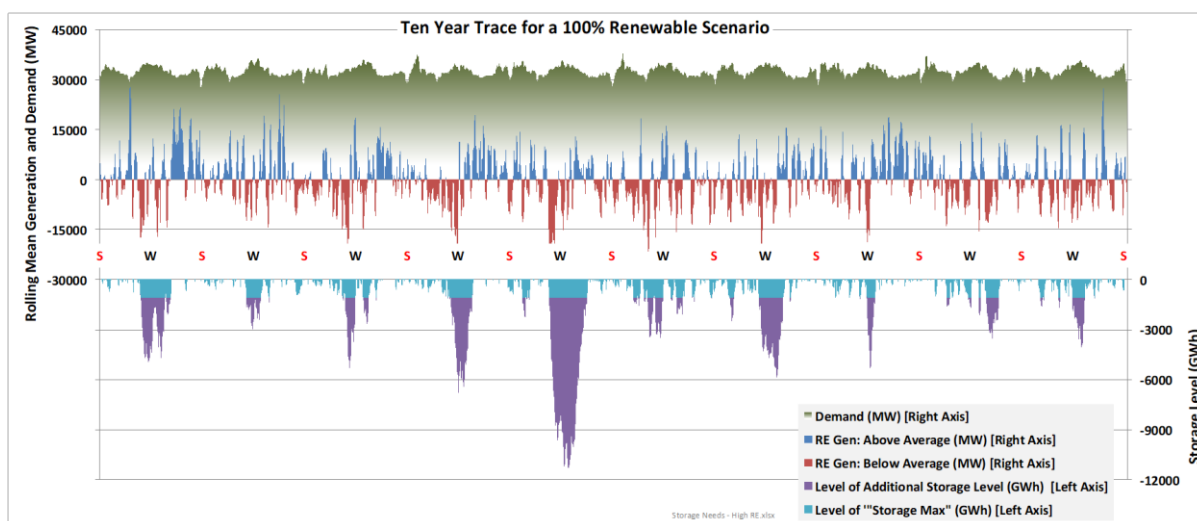
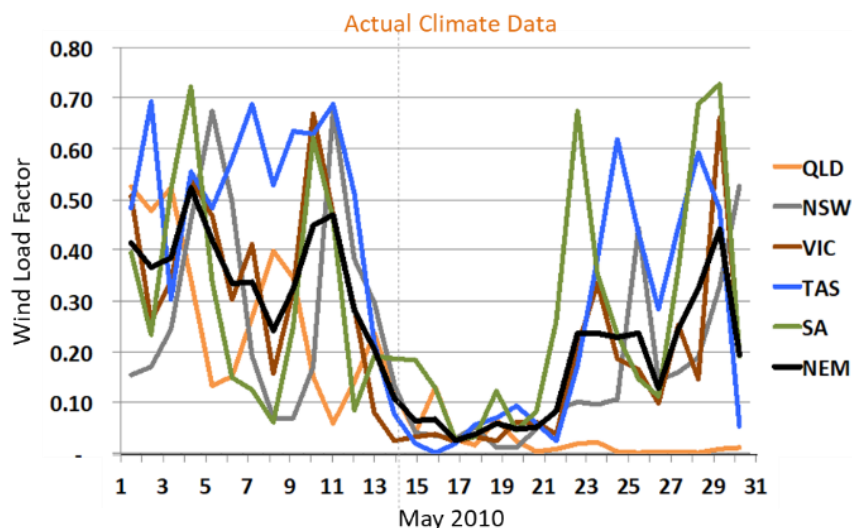
<sup>6</sup> <https://www.energy.vic.gov.au/renewable-energy/victorias-renewable-energy-targets> (accessed 15/10/20)

<sup>7</sup> [https://www.dnrme.qld.gov.au/\\_data/assets/pdf\\_file/0008/1253825/powering-queensland-plan.pdf](https://www.dnrme.qld.gov.au/_data/assets/pdf_file/0008/1253825/powering-queensland-plan.pdf)



## 6.1 Wind and storage

Australia regularly experiences high pressure weather systems that sit over the continent and deliver a quietude to wind generation that can last for several days. Actual data in the figures below show that this weather impact over the past decade is most evident annually in winter and to varying extent (2010 is the worst year shown).



Under such climatic conditions, if wind systems are not generating to their potential across several days, the grid has to be underpinned by firm dispatchable capacity to bridge such episodes. The energy storage requirements to support the grid across 7-9 days are prohibitively expensive and unlikely to deliver the lowest cost grid system.

### Recommendations:

- The new market design rules are best informed by wind-drought vulnerability to the NEM grid.
- The design should ensure that sufficient (about 25%) of generating capacity can be derived from firm dispatchable low emitting technologies such as fossil fuel+CCS or nuclear.

## 7 A Structural Discrimination against Large Investment Risk

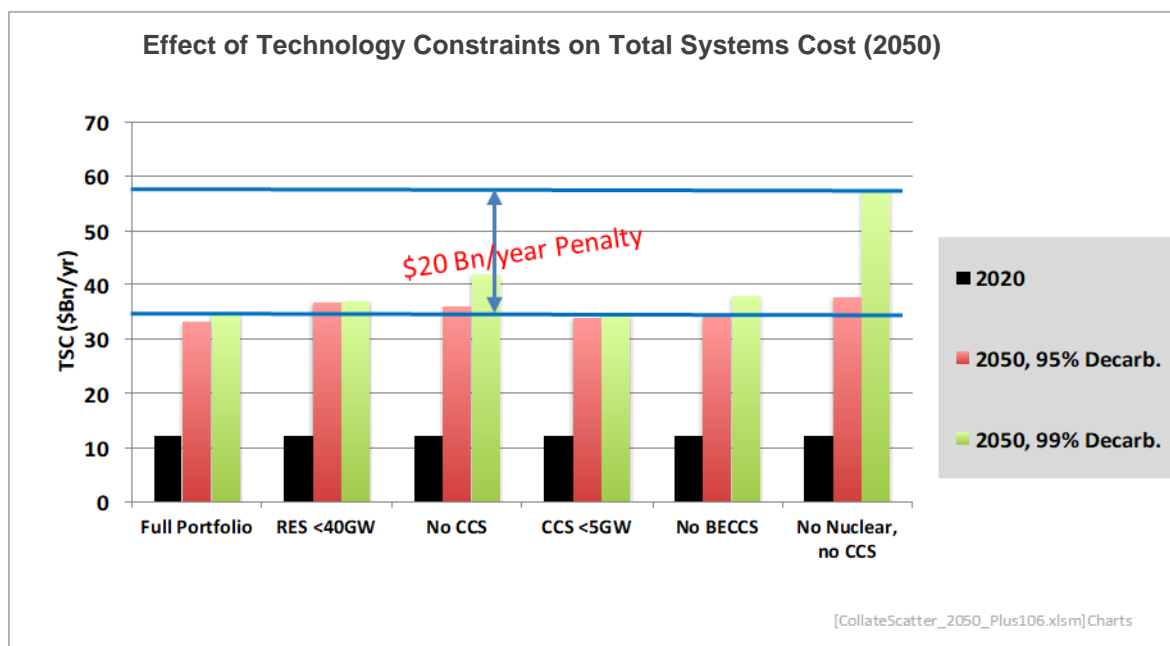
The current investment support systems discriminate against such large capital investment risks even if they deliver a disproportionate benefit/reward to the total cost of the system.

## 7.1 The Cost of not deploying National Low Emissions Infrastructure

The narrative above shows the importance of firm dispatchable power generation assets on the grid. It also shows that while these are not required to be “pervasive” on the system – they are identified as “essential” for lowest system cost in the longer term.

There is no argument that asset candidates like fossil+CCS, Nuclear and Snowy 2.0 incur higher cost to deploy and much longer planning times. These technologies would be multibillion-dollar investments. Since disaggregation of the electricity sector, existing generator companies engaged in the NEM do not have the financial capacity (balance sheets) to take on such large investments<sup>8,9</sup>. Further, there is no current support mechanism that reduces the investment risk sufficiently to attract such assets onto the NEM.

**In the absence of firm dispatchable fossil fuel+CCS and Nuclear as part of the system, the economy is estimated to be penalised an additional \$20 billion/year in a near zero low emissions world (2050).**



With such a large public and economic liability at stake, there is a strong argument for government to deliver and regulate carbon capture and storage (CCS) as part of national infrastructure services. This will minimise the cost of emissions reduction.

*Low emissions electricity generation is an investment in national low emissions infra-structure. **It is a very important enabler for delivery of regional development and low emissions industrial precincts.*** The value of such assets as fossil fuel+ CCS is not limited to their electricity generation capacity.

Rather than being considered as investments in electricity generation, it is time to view them as broader industrial infra-structure. Infrastructure that is necessary to address our national response to climate change and our international emissions reduction commitments. (It is noteworthy that countries like Norway are today partnering with gas industry companies and Microsoft to deploy CCS technology<sup>10</sup>.)

*Features for low emissions electricity as enabling national infra-structure*

- A target national power generation asset portfolio for minimum system cost
- Mechanisms that deploy essential firm dispatchable power assets that are not accommodated within current markets and structures

<sup>8</sup> [https://en.wikipedia.org/wiki/Petra\\_Nova](https://en.wikipedia.org/wiki/Petra_Nova)

<sup>9</sup> <https://www.power-eng.com/2013/11/14/edwardsport-power-plant-makes-history/#gref>

<sup>10</sup> [Oilfield Technology, 15<sup>th</sup> October 2020 \(accessed 19/10/20\)](#)



- Underwriting investment risk<sup>11</sup>
- Guaranteed dispatch of essential low emissions firm assets e.g.: **a capacity market that is informed by winter vulnerability to bridge continental wind-droughts**
- Recognises that natural gas will remain a flexible peak load supplier
- Market structure that both minimises curtailment and usefully absorbs any excess capacity.

**Any capacity market created must be of a design to attract new firm dispatchable power generation assets that are both low emissions intensity but also able to back-up loss of VRE in the duration of at least 7-14 days rather than “hours”.** In the case of assets like CCS and/nuclear these structures are needed immediately. This is because they require much longer time to assemble investment interest and gain community licence to operate.

The post-2025 market design framework should facilitate the deployment of essential firm dispatchable low emissions infra-structure assets. For large investments like Snowy 2.0 and CCS, it is incumbent on the national energy strategy to provide the means to ensure their timely deployment.

#### **Recommendation:**

The post-2025 Market Design Initiative should - as a priority - take account of emissions reduction requirements into the future. Specifically, it should identify those areas where the market may not be expected (or even fail) to deliver sufficient investment to secure competitive electricity pricing for a low emissions electricity sector.

<sup>11</sup> [Financial Incentives for the Acceleration of CCS Projects](#)