Electricity storage: the critical electricity policy challenge for our new Government

A policy proposal

May 2022

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VICTORIA UNIVERSITY

Victoria Energy Policy Centre

The **Victoria Energy Policy Centre** (VEPC) is a research centre focussing on policy challenges in energy in Australia, with a particular focus on Victoria. The VEPC's core research discipline is economics, but we encourage collaboration between experts from different academic traditions. We combine academically rigorous research and analysis, with a practical understanding of government processes.

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Acknowledgements: We acknowledge with thanks the many helpful comments we received from members of VEPC's Advisory Committee (Professor Stephen King, Professor Stephen Littlechild, and Anna Skarbek), and also Stephanie Bashir, Professor Ron Ben-David, Roman Domanski, Peter Farley, Dr Gabrielle Kuiper, Professor Iain McGill, Dr Alan Finkel, Christine Milne, Professor John Quiggin, Associate Professor Hugh Saddler, Professor Paul Simshauser, Dr Chris Waring, and Dr Steve Whetton. For the avoidance of doubt, acknowledgement does not imply endorsement of our findings or conclusions.

DOI: 10.26196/23jk-8f47

Publisher: Victoria Energy Policy Centre, Victoria University, Melbourne, Australia.

Citation: Mountain, B.R., Harris, P.N., Woodley, T., Sheehan, P. (2022). "*Electricity storage: the critical electricity policy challenge for our new government*". Victoria Energy Policy Centre, Victoria University, Melbourne. DOI: 10.26196/23jk-8f47

Abstract

Recent developments, both in Australia and overseas, provide sharp focus on the decarbonisation of Australia's electricity system. Global supply shocks have led to escalation in coal and gas prices, with sharp increases in retail electricity prices likely in the near future, due to our dependence on fossil fuels.

The new Australian Government is committed to a 43% reduction in emissions by 2030, with many members newly elected to the Parliament pursuing bigger reductions, as are the States. Achieving such reductions will require even more rapid change in the electricity sector.

As all political parties are opposed to putting a price on carbon, these rapid cuts in electricity emissions must occur through government intervention rather than market transactions. The States are long embarked on this process. Their historic role in the provision of electricity, and their closeness to their own electricity markets provides reason to be hopeful of significant progress.

The central proposal of the new Government is the $20 billion *Rewiring the Nation* (RNC) corporation, to facilitate the transformation of our electricity system to total renewables well before 2050. The central question of this paper is what role RNC might usefully play, given the recent failures of the Commonwealth's direct interventions and the strong private sector interest in the components of a renewable energy system.

We make five main points about this role:

(i) The central role of RNC should be to support the States who have the key responsibility for this transformation, as well as the most intimate knowledge of local market realities, rather than establish a competing source of expertise.

(ii) RNC should not be involved in generation. The private sector has considerable interest in renewable generation, with strong supply chains and intense competition.

(iii) It is likely that the required investment in new transmission will be a modest component of new investment out to 2050, as much generation is localised to markets or can be placed near existing grids (e.g. offshore wind). There is not likely to be a major role for RNC in transmission since the States are best placed to ensure suitable incremental transmission expansion, avoiding past mistakes of over-investment.

(iv) In our view the critical area for Commonwealth involvement is storage. The requirements for investment in new storage capacity by 2050 are very large (of the order of $90 billion). With technologies still changing rapidly and the time profile of future storage needs uncertain (as it is tied to closure of existing power stations) there is a real risk of under-provision through existing mechanisms or poor policy decisions as crises emerge. An important role for RNC could be to establish a market-based mechanism to facilitate provision, by the private sector, of adequate storage capacity.

(v) To this end, we suggest that the Commonwealth Government directs the RNC to establish a Renewable Electricity Storage Target (REST) scheme, following closely the design of the existing RET scheme.

Further details of the proposed REST scheme are provided in the body of the paper.

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1 Introduction

The world is in the midst of an energy supply and price shock that may come to rival that of the 1973 oil crisis. Australia has been late to this crisis, but the recent escalation of gas and coal prices to extraordinary levels is now feeding through into wholesale electricity prices that are at levels that have not ever been sustained for any length of time in the 25-year history of the National Electricity Market (NEM). Substantial increases in retail electricity prices are likely to soon follow.

In addition, policies to ensure rapid greenhouse gas emission reductions can now be expected. The new Australian Government (the "Commonwealth") has been elected on the promise that it will reduce greenhouse gas (GHG) emissions by 43% compared to 2005 levels by 2030. All State governments have emission reduction targets that are comparable or higher (except Queensland).

Particularly rapid and deep GHG reductions are expected from the electricity sector since this sector is by far the largest source of emissions in the Australian economy and also because emission reductions are easier and cheaper to achieve in this sector than in most other sectors.

The centre-piece of the new Government's policy for the electricity sector is the creation of a $20bn Rewiring the Nation (RNC) corporation. This paper contributes analysis, argument and ideas on the role that RNC could play in helping to address the pressing challenges posed by the energy price and supply crisis on the one hand, and the need for rapid and deep decarbonisation on the other.

The rest of this introduction summarises evidence and argument set out in Appendices A to C, that describe the current and historic activities of the Commonwealth and States in the electricity sector, and that evaluate different arguments on the appropriate role of the Commonwealth in the sector. It starts by drawing attention to the profound but largely ignored implications of the Commonwealth and all States' policies to reduce GHG emissions but not to price electricity sector GHG emissions.

The critical consequence of present bipartisan political position to reduce GHG emission (and thus to make them scarce and hence valuable) but at the same time to not allow that scarcity to be expressed in GHG emission prices, is that governments (and investors) can't rely on

electricity prices to signal the value of GHG emission scarcity that is consistent with the Government's GHG reduction policy.

The NEM has been developed pursuant to a policy that electricity prices should be determined in a market, and that investment should follow (mainly) in response to those prices, not in response to government intervention. But if policy makers will not allow prices to reflect costs, it can't rely on market-driven outcomes to achieve emission reduction at the rate that policy makers are demanding.

It is inevitable therefore that to reduce emissions at the desired rate, Government will have to intervene to force the adoption of lower emission technologies in the production, distribution and consumption of electricity. It may well be that technological progress means that only limited "forcing" is needed to achieve the policy objective.

State Governments are now advanced in their efforts to contribute to this process of rapid change in the production, storage and consumption of electricity from lower emission technologies. Specifically, State Governments or their corporations are either building and owning renewable generators and storage or are entering into long term contracts to buy the output from privately-owned generators/storage as an incentive to rapid adoption of renewables and GHG reduction. Many tens of billions of dollars have been committed under this regime and the three states that still have large amounts of coal generation (NSW, VIC and QLD) are all greatly expanding their bureaucracies in order to implement their directions. Appendix B provides more detail on this.

The intent to reduce emissions but not to price emissions has also had the effect of turning many regulatory processes into something of a charade. This is because regulators and market authorities (the Australian Energy Regulator (AER), the Australian Energy Market Commission (AEMC), the Australian Energy Market Operator (AEMO) and the Energy Security Board (ESB) are unable to make decisions that reflect the substance of governments' GHG reduction policies because they are precluded by those governments from putting a price on emissions in the regulatory and market decisions they make.

It has long been suggested that requiring regulators to price emissions (by making emission reduction part of their objective) would solve this problem. But these regulators are meant to be at arms-length from the government and so such emission pricing obligation would need to be transparently stated in the regulator's objectives and then visible also in its subsidiary

instruments, like regulatory investment tests. It can be no surprise that transparent emission pricing obligations for regulators have made no progress: how can it be credible for political leaders to uphold the promises they have made to their electorates that they will not price emissions but then to instruct their regulators to plan to the contrary?

A good example of the inevitable incongruity between policy objective and regulatory decision can be seen in the cost/benefit analysis of the Western Victoria Transmission Project, a new transmission line motivated by the Victorian Government's wish to connect new wind and solar farms in Western Victoria in order to reduce Victoria's emissions. The cost/benefit analysis of this line, which followed the rules of the AER's cost/benefit test[1], found that the main benefit of the line would be that it would allow more polluting brown coal generation in Victoria to displace less polluting black coal generation and gas in New South Wales and Queensland. Absurdly therefore, a new transmission line ostensibly motivated by the reduction of emissions was actually justified on the basis of an analysis that it would *increase* (unvalued) emissions.[2] This is an inevitable consequence of Government's instruction that the regulator is not to price emissions. Exactly the same concern will arise with all future cost/benefit assessments undertaken under the regulator's test, including with projects under the RNC unless this matter is explicitly addressed. Inevitably, just as with the Western Victoria Transmission Project, governments can't be confident that transmission augmentations assessed under the test are consistent with those government's emission reduction objectives[3].

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[1] Formally the "Regulatory Investment Test".

[2] In calculating the benefits of this proposed transmission augmentation, the transmission network service provider applied the Regulatory Investment Test specified by the Australian Energy Regulator. This does not price greenhouse gas emissions. Modelling found that the benefit of the transmission line was to increase exports of more emission-intensive brown coal generation in Victoria and reduce less emission-intensive black coal and gas generation in New South Wales and Queensland. By implication the new transmission line was found to *increase* emissions, and make effectively no difference to production from the new wind and solar farms, whose connection to the grid motivated the new line. But the Victorian Government's GHG reduction policy makes emissions scarce and thus valuable. If this was accounted for in the modelling (i.e. by putting a price on emissions) the modelling would likely find that expansion of transmission to Victoria would reduce brown coal generation in Victoria and increase production from the new wind and solar farms in Western Victoria. But it is very unlikely that such modelling (which is consistent with Victorian Government GHG reduction policy) would recommend the project that that is currently recommended (which is premised on greater interconnection to NSW).

[3] It might be argued that governments could instruct the regulator to include a shadow carbon price in its regulatory assessments, even if that carbon prices is not expressed directly in market prices. Environmental advocates have suggested this for some years. We are doubtful that governments will find such approach acceptable. It is likely to require a change to the National Electricity Law and the

Faced with a system of network regulation that is delivering outcomes that are inconsistent with governments' emission reduction policies, State government intervention is now extending also to the planning and approval of new transmission lines and also to the implementation of arrangements for transmission access that have little or no regard to the NEM's arrangements. Though it is not widely discussed, this is occurring in all States with coal generation and will expand greatly in coming years, as bureaucracies gear-up to implement the States' "renewable energy zone" plans. Appendix B provides more detail.

In summary, the combination of emission reduction objectives and a refusal to allow those objectives to be transparently reflected in prices, has rendered the spot market incapable of providing reliable investment signals for generation and storage. It has also rendered the regulation of network monopolies unable to deliver decisions and analysis that is consistent with governments' overriding emission reduction policy objective.

For these reasons it is inevitable that investment in generation, storage and transmission will increasingly be driven by governments directly. The short-term (spot) market may still perform a useful function in generation dispatch, but the spot market (and the contract market that references short term prices) alone can't be relied upon to drive the enormous investments needed to decarbonise the electricity sector.

The failure by regulators to reflect emission prices in their decisions (on governments' instruction it must be recognised) also casts a shadow over the role of these institutions. In the direct intervention of the past Commonwealth Government and in the actual decisions of State Governments, regulators are increasingly finding themselves on the side-lines.

It is in this policy and regulatory context that the Commonwealth's proposal for a $20bn "Rewiring the nation corporation" (RNC) should be understood. RNC is philosophically consistent with the active intervention policy adopted by the previous Commonwealth government. We estimate the Commonwealth has allocated around $30bn of tax-payers' money to the electricity sector over the last decade, much of it in the last few years in the form of active interventions as set out in Appendix A in more detail.

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governments will need to tell the regulators what carbon price to use. Will the governments not consider this to break their promise to their electorates that they will not price emissions?

In its election manifesto, the new Government did not spell out precisely what the RNC will be asked to do, but we understand it is intended that it will focus on a combination of electricity storage and transmission, which it is anticipated RNC will develop and own, or procure from others. The mechanism to determine the choice of projects and the integration of them with other private and State level investment has yet to be clarified.

The Australian Energy Market Operator's analysis of investment requirements to fully decarbonise electricity supply (see Appendix C) consistent with the new Government's targets conclude that storage capacity will need to grow to 59 GW (20 times current), variable renewable electricity will need to grow to 204 GW (6 times current) and the transmission system will need to expand by 10,000km (about a fifth longer than the existing network). Capital expenditure on transmission is by far the smallest part (14%) of the capital expenditure needed to decarbonise the electricity sector (about one third is needed to expand storage and the remainder to build more renewable generation). In dollar terms, AEMO suggests complete decarbonisation by 2050 has a present cost of $87 billion, broken down between $75 billion on generation and storage and $12 billion on transmission.

While it is growing rapidly, the storage sector is by far the least developed part of the supply chain. Storage will play a critical role in storing renewables, in stabilising the power system (Hornsdale Power Reserve is an excellent example of this) and in expanding transmission capacity (the Victorian Big Battery is an excellent example of this)

Our analysis (see Appendix C) suggests RNC is unlikely to be successful as a developer or owner of electricity transmission. Relative to the States, the Commonwealth does not have access to the detailed local information needed to plan effectively, it can't control important inputs such as access to land and it has little expertise in consultative engagement needed to win local community support.

In addition, while it might be argued that a national entity should become involved in transmission because it can co-ordinate nationally in ways that the States may find difficult to achieve, we think such co-ordination benefits are likely to be slim. This is because the electricity market is balkanising and localising in response to technology change (variable renewables and storage costs are similar in all regions of the NEM and diversity in the availability of variable renewable resources is unlikely to be anywhere nearly valuable enough to justify the cost of long-distance transmission expansion).

History also suggests that the Commonwealth's propensity for grand "nation building" projects and its far greater fiscal capacity relative to that of the States makes it particularly susceptible to picking projects that turn out to be losers. Snowy 2.0, the Kurri Kurri Gas Plant and Marinus Link/Battery of the Nation are contemporary examples of this. Appendix C provides more detail.

What then should RNC do? First and foremost, we suggest it should adopt an approach that seeks to support the States rather than usurp them. We also suggest, for the reasons summarised above, the weight of the Commonwealth's effort should be on growing storage. Commonwealth efforts to grow this sector are likely to be valuable and successful. In this report we propose a Renewable Electricity Storage Target, established and administrated by the RNC and the Clean Energy Regulator. The rest of this paper makes the arguments for such an approach and then develops initial ideas on relevant details of a REST scheme.

2 The argument for a national electricity storage target

The introduction and Appendix C argued against *direct* Commonwealth involvement in the electricity sector. How then, if at all, should the Commonwealth be involved in the electricity sector? One option is a national Renewable Electricity Storage Target (REST) established and overseen by the Commonwealth. We explore this option here.

2.1 Context

In the "Step change" scenario in the 2022 Draft Integrated System Plan (ISP), AEMO estimates the variable renewable energy (VRE) and storage (measured in GW) that will be required to 2050. This is summarised in Table 1 below.

Table 1. Variable renewable energy and storage requirements to 2050 in AEMO's "Step change" scenario of its Draft 2022 ISP

	2023	2030	2040	2050
Storage (GW)[4]	3.4	18	46	59
Variable renewable energy (GW)	41	85	138	204
Storage/Variable renewable generation (GW)	8%	21%	33%	29%

Storage and VRE dominate the investment required for the energy transition. AEMO's analysis shows that the VRE requirement is split roughly equally between wind, grid-scale solar and distributed solar. Storage is split, with around 50% for co-ordinated distributed storage (i.e. mostly behind-the-meter or connected to the distribution networks), 25% for utility scale storage and 25% for behind-the-meter storage that is not centrally co-ordinated.

[4] AEMO's Draft ISP estimates that the 57 GW of storage not including Snowy 2.0, will have 300 GWh of storage, or a weighted average storage duration (MWh per MW) of a little over 5 hours. This is consistent with the storage duration studies by the NREL of the storage requirement for full decarbonisation in the United States, prepared for the US Department of Energy – see https://www.nrel.gov/docs/fy21osti/77449.pdf. Page vi.

The last row of the chart shows that as the power system is increasingly dominated by VRE, the proportion of storage (relative to VRE) grows from 8% in 2023 to 29% by 2050, by which time the power system is completely decarbonised.

Assuming an average outlay of $1.5 million per MW of variable renewable generation and $1 million per MW of storage, by 2050 it might be expected that $90 billion will have been spent on storage and $200 billion on variable renewable energy (note that these are total capital outlays, not discounted present costs as discussed in Appendix C).

We would caution against simple extrapolation of these figures to imply new costs for power. As noted earlier, governments are now supplying much of the capital and it is quite unclear what if any price effect will emerge. Section 3.4 examines some of the complexities. Nevertheless, the sheer scale of the investment suggests strongly that much more attention needs to be paid to the analysis of projects before they are announced.

There are already well-established supply chains for the development of renewable energy. Rooftop solar penetration in households and businesses is higher in Australia than other countries. Large scale renewable generation is being contracted directly by customers and also in auctions arranged by state governments. The supply side of this industry is now well established and highly competitive.

By comparison, the storage industry is still at an early stage of development. Other than the Snowy 2.0 pumped hydro behemoth (2,000 MW/350 GWh), there are now six grid scale batteries in operation (560 MW/764 MWh), nine currently under construction (780MW, 979 MWh), 15 announced but not yet under construction (4,035MW/8000 MWh) and 34 proposed but not yet announced (8,000 MW/17,000 MWh).

South Australia Case Study

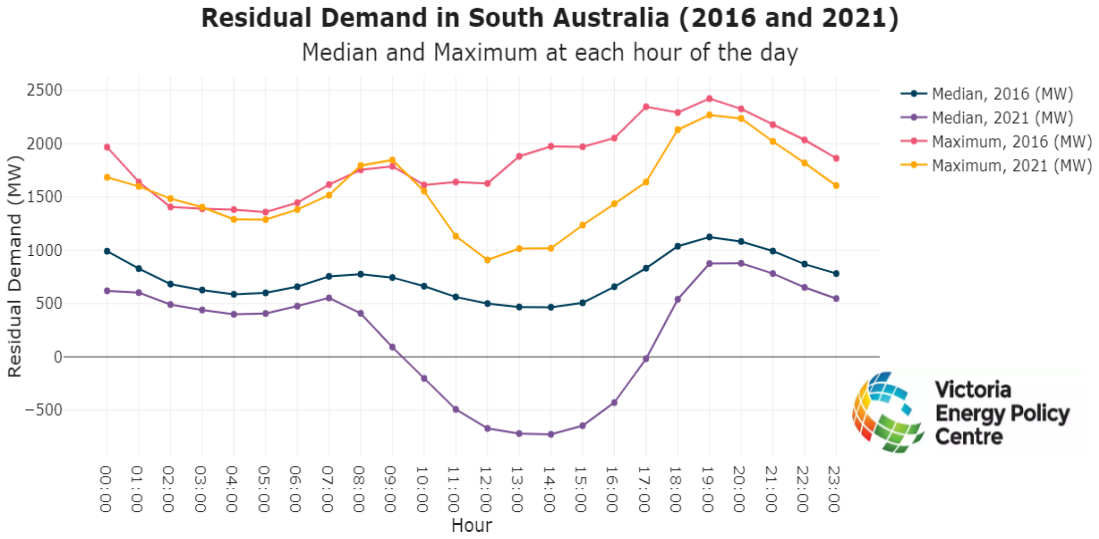
To provide insight into the nature of the storage task and the effect of interconnection on this, the rest of this sub-section presents a study of the situation in South Australia (SA). Variable renewable energy (VRE) supplied 67% of SA's grid Operating Demand in 2021. This is the highest proportion of VRE to be found in any sophisticated, mid-sized electricity market.

We start by focussing on Residual Demand (RD). RD is the difference between demand for grid-supplied electricity and VRE. RD is a measure of the volume of dispatchable production

that is needed to ensure that customers' grid demands are met. Figure 1 shows the median and range (between the minimum and maximum) hourly RD for each hour, using the 365 values over the year for each hour of a day. The chart compares the 2016 and 2021 data. It shows, as we should expect, that RD has shifted downward in the middle of the day (comparing 2021 to 2016) in response to growth in wind and solar generation (particularly the latter).

It is notable how little difference the expansion of wind generation[5] has made to RD (noting the very small change at night when solar generation is absent). The highest RD (at 7pm) was around 2100 MW in both 2016 and 2021. In other words, despite the expansion of VRE over the 5-year period, the requirement for dispatchable generation needed to meet maximum RD has barely changed.

Figure 1. Median and range of Residual Demand in SA in 2016 and 2021



Dispatchable generation could be from fossil fuel (gas, diesel, coal) or hydro generation, or from some form of storage (typically chemical batteries or pumped hydro). Since SA is connected to VIC, this dispatchable capacity could be located in either SA or VIC (or the other states connected to VIC).

What effect has interconnection between SA and VIC had on the requirement for dispatchable capacity in SA? It is possible to isolate the effect of dispatchable production that is exported to

[5] Wind generation met 39% of SA's grid demand in 2016 and 45% in 2021.

VIC (or imported from VIC) by calculating the Adjusted Residual Demand (ARD) by adding exports and subtracting imports in each hour. Comparing the ARD and RD shows the effect of the interconnector on the amount of dispatchable capacity needed in SA. A histogram (frequency distribution) of the 2021 hourly RD and ARD data is shown in Figure 2.

Figure 2. Histograms of Adjusted Residual Demand and Residual Demand in SA in 2021

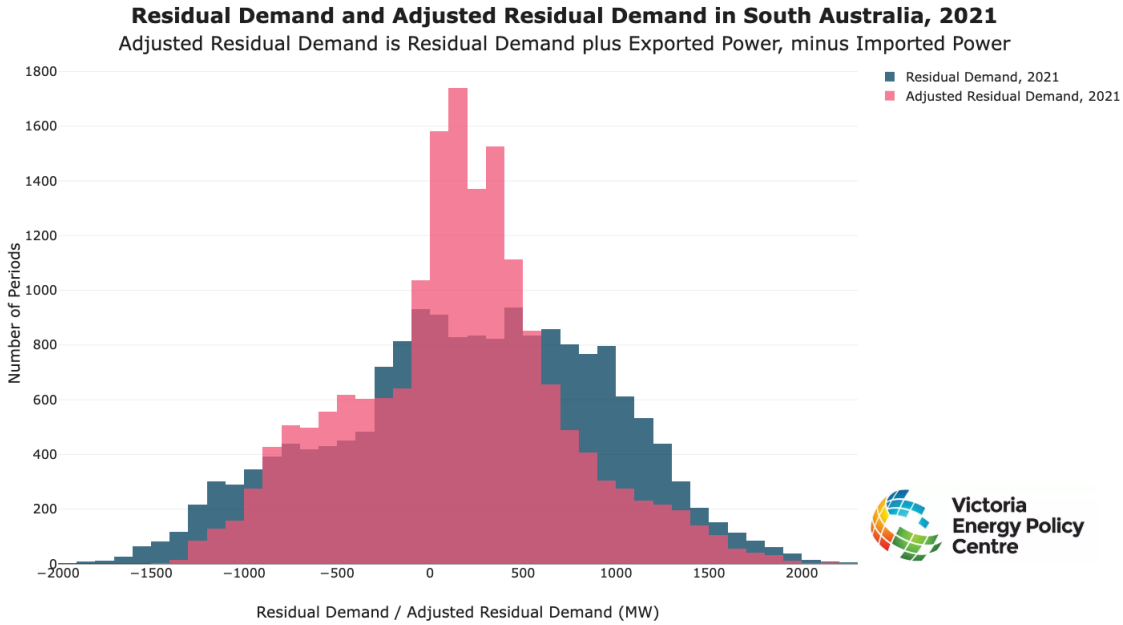


Figure 2 shows that at the highest values (the far right hand tail of the distribution) the number of periods of very high ARD and RD are similar, i.e. the amount of dispatchable generation needed in SA to meet the peak residual demand is much the same with or without the interconnector. We repeated this calculation for the previous five years and found this result in those years too. From this, it is clear that when the demand for dispatchable capacity in SA is the highest, only a small amount of production is being imported.

The essential point suggested by this analysis is that additional interconnectors are not necessarily likely to make much difference to the demand for dispatchable generation, when the demand for dispatchable generation is at its highest. In other words, expanding interconnector capacity is not likely to have much effect on keeping the lights on at those moments when dispatchable generation is most needed.

At present in SA, dispatchable generation is dominated by gas-fired generation. The decarbonisation of electricity supply in SA will require that this is replaced with storage devices able to store surplus renewable generation. The conclusion from this is that in a decarbonised grid, it is storage capacity, not interconnector capacity, is likely to be the critical factor in ensuring reliable supply.

We repeated this analysis for the other NEM states and reached the same conclusion, albeit that the effect of interconnectors on the residual demand was slightly higher in some states (notably VIC) than in SA. Nonetheless the essential point stands: the key to reliable supply is storage not interconnection.

2.2 Is a national storage policy likely to be valuable?

It might be argued that the energy market, left to itself, will deliver the necessary storage capacity. Indeed, data on the number of batteries already operating, under construction, proposed and announced provides confidence of significant investor interest in the development of storage. Increasingly batteries are being developed without policy support. Might this mean that storage policy is unnecessary? We conclude not, for the following reasons:

1. First, the rate at which major changes to the power system (i.e. coal generation closure) will occur in future is highly uncertain since there is no co-ordinated program for coal generation closure. Uncertainty on the rate of transition is evident from recent generator closure announcements[6]. Coal generators are enormous in relation to demand and their closure can greatly affect the demand for storage. Developing sufficient storage capacity in advance of coal closure in order to ensure reliable supply will therefore reduce reliability (and price) risks associated with unexpected coal closure.

2. Secondly, as we argued in the introduction, the Commonwealth and States are all pursuing emission reduction policies but none allow emission scarcity to expressed in electricity prices. Policy makers can not expect investors to respond efficiency to prices that are not allowed to properly reflect costs. Left to its own devices, the expectation must be that the market will under-provide: intervention is a necessary corollary of policy to reduce emissions but not price their scarcity.

[6] Specifically Origin Energy's announcement to bring forward the closure of the Eraring Power Station by 7 years, to 2025.

3. Thirdly, storage is a necessary complement to VRE in decarbonising electricity supply. A storage policy there has a rationale as an element of emission reduction policy.

4. Fourthly, storage policy may be expected to be valuable in providing confidence in the demand for storage and hence in its supply. This will help to accelerate the development of the storage industry and its supply chains, thus reducing costs and stimulating supply-side competition. The Renewable Energy Target has played a similar role in underpinning the supply chains and business of installers and this helps to explain the globally competitive costs in this sector. We expect an effective storage policy might emulate this success in the development of the storage sector.

5. Finally, battery storage has hitherto depended on frequency control ancillary services (FCAS) income. This is a small and illiquid market. A REST would provide a currency and an associated forward market based on energy market arbitrage.

For these five reasons, we conclude that storage policy has a plausible rationale in economics. Recognising that the States have all supported the development of storage in one way or the other, the next question that arises is whether there is a case for the Commonwealth also involving itself in storage policy? We consider it is not *necessarily* advantageous for the Commonwealth to also get involved in storage policy, considering in particular its propensity to allocated funds to wasteful[7] mega-projects. But, on balance we think the Commonwealth can have a valuable role to play here, by bringing the financial resources of the RNC and the administrative capability of the Clean Energy Regulator in the development of a national market that promotes a rivalrous, locally-focussed discovery process.

If such a scheme is well developed and executed it offers the prospect of reducing wasteful investment in new transmission or generation and of stimulating the location of solar and wind closer to energy users or at places on the transmission system that make best use of the available resources. The preferred locations should be determined by investors and should reflect community and future industrial needs (on which States are better informed, as we have argued earlier) with the Commonwealth responsible for providing a scheme that supports such outcomes. The cost/benefit analysis on which projects are chosen for support should not repeat the past mistakes of failing to express the objective – reduced emissions – in

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7 https://www.vepc.org.au/_files/ugd/cb01c4_3349bfab274c44d9852c39b12535bbba.pdf

explicit terms. In the next section we provide some initial thoughts on how such a policy might work.

3 Initial thoughts on the design and details of a Renewable Electricity Storage Target

3.1 Design objectives

We propose the following objectives in the design of a storage support scheme.

1. It should pay for availability, not output. Output should be compensated in the energy market.
2. It should minimise the discrimination between competing forms of storage on the basis of where that storage is located (e.g. behind-the-meter versus grid—connected in one state rather than another). Some level of discrimination may be necessary (for example between small scale storage technologies whose certificates may be paid upfront (known as "deeming") from those whose certificates are paid annually. While a balance needs to be found between protecting nascent technologies and rivalrous competition, the scheme should preference rivalry as much as reasonably possible.
3. It should not discriminate on the basis of the storage duration of the device (i.e. how long the device is able to produce its maximum output for).
4. It should not discriminate between stationary storage or mobile storage (e.g. electric vehicles with the ability to discharge their batteries to the grid versus fixed batteries).
5. It should provide a subsidy that is inversely related to the income that storage devices will obtain from the electricity market.
6. It should establish a rivalrous process to discover the most cost-effective storage technologies.

The thinking that underlies these objectives is that in the context of rapid technology change, a scheme that promotes rivalrous discovery will be particularly valuable. There will be pressure from various interest groups, and from technocrats and politicians, to prefer one technology over another or to have particular regard to some form of functionality (e.g. remote control). It is important to resist the temptation to design schemes that cater to such centrally-prioritised specificity. Such "fine tuning" can quickly degenerate into a process of picking winners, which almost invariably turn out to be losers.

The objective here is to provide a subsidy that covers part of the cost of the storage device. Those other attributes of a storage device that are valuable – such as location, reliability, cost, functionality, useful life etc. - should then be expressed in the market and if they are indeed valuable, rewarded by the market. In this way the scheme can help to promote storage but at the same time ensure that, as much as possible, resource allocation is determined through rivalry. The objective is to ensure that private capital takes bets on the best ideas not on the best subsidies.

3.2 Scheme details

Mandatory obligation (certificate) schemes, such as has been successfully demonstrated with the Renewable Energy Target, have the potential to satisfy the design objectives listed above. Accordingly we propose a national Renewable Electricity Storage Target (REST) which sets annual targets for storage certificates. Some possible scheme details are as follows:

1. Certificates are specified per unit of power (kilo-watt) that the storage device is able to reliably discharge to the grid.
2. The reliability requirement could be, for example, greater than 95% availability measured annually.
3. Eligible storage devices are those:

a) commissioned after a starting date (which must be in the future so as to ensure additionality)

b) able to synchronise to the electricity grid and capable of producing their full capacity within 5 minutes[8], for at least one hour

4. Eligible storage devices are able to create certificates for a defined period, say 10 years.
5. We envisage that AEMO would advise the Government periodically – every five years – on the annual Storage Certificate Target.
6. Retailers and directly connected large customers would be obliged to surrender a specific volume of these certificates annually with the volume determined based on the grid-supplied electricity that they sell/buy.

[8] This reflects the design of the electricity market (five minute auctions) and that the purpose of storage is to compensate for the variability of renewable resources whose supply can't be predicted with confidence more than five minutes ahead. The storage that is subsidised must therefore be genuinely capable of firming variable renewable generation.

7. We envisage that, as with RET certificates, REST certificates would be traded freely.
8. As with the RET, failure to surrender sufficient certificates to meet obligations should attract a penalty payment.
9. The penalty charge per certificate not surrendered should be set at the level that, if paid every year for 10 years, would be sufficient to cover around 25% of the cost of an efficient grid-scale storage device. This will set a ceiling price on payments with the intention that storage devices should obtain the bulk of their income from the provision of their storage service and thus have powerful incentives to operate efficiently.
10. Voluntary certificate surrender should be allowed.
11. Emission-intensive trade-exposed entities will not be precluded from the obligation.
12. Retailers would be able to recover the cost of their certificate obligation from their customers if they chose to. The Commonwealth could potentially reimburse consumers for some or part of certificate cost that is passed on to them by their retailers (the need for this is discussed in more detail in the last sub-section.

3.3 REST versus a capacity mechanism within the NEM

The Energy Security Board has considered the merits of availability payment mechanisms to be administered within the NEM, for some years. There has been a long and vigorous debate on it. Leaving aside the substance of such debate, the main criticism we would have on relying on a capacity mechanism within the existing market rests in our central criticism of the market it itself: i.e. that it is precluded, by government, from including the cost of emissions. The NEM is effectively excluding what is likely to be the biggest cost. It can't be relied upon to provide an efficient investment signal. Exactly the same criticism can be made at a capacity mechanism which, if it exists within the NEM, will suffer from the same fatal flaw: How can a capacity mechanism structured within the NEM ever be credible when it excludes the biggest cost imposed by electricity production?

For this reason we do not think a capacity mechanism is a convincing alternative to a storage incentive scheme created outside the market. In addition, we see advantage in a certificate scheme administered by the Commonwealth through the Clean Energy Regulator, for the following reasons.

1. The administrative infrastructure for a certificate scheme already exists. It is highly regarded and can easily be adapted and extended to accommodate storage certificates.

2. The storage market, according to AEMO, is likely to be dominated by distribution-connected and behind-the-meter generation. There will need to be considerable change to the National Electricity Rules to accommodate small scale storage in a market that is designed primarily for the dispatch of greater than 30 MW generation. The Australian Energy Markets Commission has rejected proposals for the regulation of small-scale distributed energy through the National Electricity Rules, and is likely to be similarly disposed towards small scale storage.
3. A storage certificate scheme will be established through Commonwealth legislation and so targets and design will be determined by the Commonwealth> this is likely to be quicker and simpler than if established under the National Electricity Law.
4. The RET has been remarkably successful in supporting the expansion of distributed generation in homes, small businesses and farms. A storage certificate scheme may be expected to be similarly successful in delivering distributed solutions. Implementation risk (a traditional problem with novel solutions to incentive schemes) is much less than might be imagined

3.4 Affordability

Here we consider the case for Commonwealth fiscal support for REST certificates (by for example covering the cost of such certificates in part or in full).

The regulated asset value of electricity distribution and transmission in 2020 was $78 billion and $22 billion respectively ($100 billion in total). Since the price of electricity distribution and transmission is around half the price of electricity to consumers, we suggest that a hypothetical asset value for electricity production and sales is also around $100 billion. Therefore, the total value of the infrastructure needed to produce, deliver and sell electricity to the 10.7 million customers in the NEM is, indicatively, $200 billion.

Looking ahead, in its Draft 2022 ISP, AEMO estimates that the discounted present cost of capital expenditure on electricity generation, transmission and storage for its "Step Change" scenario (the one it considers most likely) is $87 billion, broken down between $75 billion on generation and storage and $12 billion on transmission.

The $75 billion present cost[9] of generation and storage investment in the period to 2050 might be compared to the asset value of electricity production and sales today (around $100 billion), of which generation is around 80% and so $80 billion. Indicatively therefore the present cost of the capital outlay needed for the production of electricity in future will be similar to the asset value of the production assets today. Furthermore, variable renewable generators use freely available resources (the sun and wind) while coal and gas, the currently dominant fuels are not freely available. Bringing together roughly comparable capital outlays (comparing asset values with present cost of future capital expenditure), and much cheaper variable costs in future, this indicative analysis suggests that there is not a compelling case for Commonwealth involvement on the basis of affordability.

Looking back over the period from 2006 to 2020, we see that the regulated asset value of electricity distribution and transmission increased from $55 billion to $100 billion, in constant currency (the majority of this was in distribution networks). AEMO's estimate of the discounted present cost of the transmission expansion needed to accommodate the Step Change energy transition ($12 billion) is a quarter of this. Leaving aside the merits of the $45 billion historic increase in assets (over a period of around 14 years) or the expected $12 billion (present cost) increase (over a period of around 30 years), we might at the least observe that the projected increase in transmission cost is much smaller than the historic increase in distribution costs, which were absorbed by consumers without Commonwealth subsidy.

Using AEMO's estimates of necessary future expenditures, it follows that lower prices may be expected in future as the industry transitions to renewable resources. Accordingly, *on average*, electricity may become more, not less, affordable in future.

While these numbers provide a broad context, it will be the case that bringing-forward storage development in anticipation of coal generation closure, is likely to impose non-trivial costs. Assuming that the 59 GW of storage that is needed, costs $1m/MW, this translates into an investment of $59bn in today's dollars. Spread over 28 years (to 2050) this should be easily affordable. Yet much of the cost may need to be incurred before benefits arise. In this case,

[9] We recognise that it might be argued that the right number to use is not the present cost in which future expenditure is discounted at an estimate of the weighted average cost of capital of the industry, but rather the present cost based on an estimate of consumer price inflation (so future expenditure is stated in constant currency). But this ignores that society becomes richer over time.

absorbing part of the certificate cost through Commonwealth support merits serious consideration.

Appendix A: The Commonwealth's involvement in the electricity sector

Here we summarise various ways in which the Commonwealth has become involved in the electricity sector over the recent past.

Clean energy policy

The Commonwealth's most enduring involvement in the electricity sector has been through its establishment, in 2000, of the Renewable Energy Target (RET), a certificate obligation scheme[10]. The RET originated as an emissions and technology policy in response to Australia's participation in the Kyoto Protocol. The RET has endured – it will terminate in 2030 – although the target has been contested by successive governments. The scheme is associated with substantial investment in both large-scale and small-scale variable renewable electricity generation.

Emission reduction policy

Perhaps the Commonwealth's most significant policy affecting the electricity industry was the introduction of a fixed price for greenhouse gas emissions in a policy that was adopted on 1 July 2012 but repealed on 1 July 2014.

Research, development and demonstration

The Commonwealth funds primary research in universities that affects the energy sector particularly in engineering and related sciences, it funds the Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC).

ARENA describes its funding priorities as reflecting "an overarching pathway to reducing emissions by growing the share of renewables in the electricity mix, fuel switching to

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10 http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target#:~:text=In%20June%202015%2C%20the%20Australian,post%2D2020%20targets%20adjusted%20accordingly.

electricity, and developing other solutions for hard-to-abate sectors where the electrification pathway is expensive or unworkable" [11]. Its website says that since 2012, it has "supported 612 projects with $1.81 billion in grant funding, unlocking a total investment of almost $7.9 billion in Australia's renewable energy industry".

Up to 31 December 2021, the CEFC[12] had drawn $5.4 billion from its original $10 billion funding allocation from the Commonwealth. It says that in addition it has access to a further $4.6 billion in capital from the Commonwealth, as well as funding arising from returns from its existing investments. The CEFC has invested in electricity transmission ($295 million in a new interconnector between NSW and SA currently under construction), $5.7 billion in renewable energy and $3.8 billion in energy efficiency).

Industry regulation and governance

The Commonwealth does not have any direct responsibility for the regulation of the electricity industry. However it appoints two of the five members of the Australian Energy Regulator and nominates the Chair (for endorsement by the states). Also, in its role as chair of the council of energy ministers, the Commonwealth has input into the nomination of 60% of the Board members of the Australian Energy Market Operator. The Commonwealth also created the Energy Security Board and funds half of its expenditure (the States fund the other half).

The Finkel Review[13], commissioned by the Commonwealth, has also had a significant impact on many aspects of the regulation of the industry.

Electricity provision

Until March 2018, the Commonwealth's main direct interest in electricity provision was a share (13%) in Snowy Hydro Limited (the NSW and VIC governments' shares were 58% and 29% respectively).

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[11] https://arena.gov.au/about/

[12] https://www.cefc.com.au/media/k52khw2o/cefc_investmentupdate_10b.pdf

[13] Formally, "The Independent Review into the Future Security of the National Electricity Market". https://www.energy.gov.au/government-priorities/energy-markets/independent-review-future-security-national-electricity-market

The Commonwealth announced its intention to purchase all of Snowy Hydro from NSW and VIC in May 2017, shortly after it announced its intention to build Snowy 2.0. The Commonwealth valued Snowy Hydro at $7.2 billion (35 times the average of its 2016 and 2017 dividends). At the time Snowy Hydro Limited's net asset value was $2.1 billion. The NSW Government called the sale "a huge win for NSW" and "a boon"[14].

Since the purchase of Snowy Hydro, the Commonwealth has injected a further $1.4 billion into Snowy Hydro (for Snowy 2.0), and announced that it intends to fund the Kurri Kurri gas-fired generator in NSW ($0.6 billion has been announced so far but it is likely to cost at least twice this[15]).

The Commonwealth has also committed to direct $295 million (through the CEFC) for the Project Energy Connect interconnector between SA and NSW, $75 million (as grants) to both Marinus Link (a proposed interconnector between TAS and VIC) and VNI West (a proposed western interconnector between VIC and NSW), and $65 million (as a grant) to re-power the Tarraleah hydro power station in TAS.

Adding up the Commonwealth's outlays to-date (i.e. not include the RNC), we estimate that a total of about $30 billion of tax-payers funds have been committed to the electricity sector, most of which has been in the last five years.

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[14] https://www.nsw.gov.au/media-releases/boon-for-bush-%E2%80%93-regional-nsw-to-reap-4154-snowy-transaction

[15] https://reneweconomy.com.au/kurri-kurri-gas-folly-cost-blowout-limited-operation-not-hydrogen-ready/

Appendix B: State governments' involvement in the electricity industry

Here we summarise the States' involvement in the electricity sector.

Tasmania (TAS)

Most electricity produced in TAS is from hydro resources owned by the Government through its corporation, Hydro Tasmania. Hydro Tasmania has also contracted for the output from three privately owned and operated wind farms and for the use of a privately owned interconnector (Basslink). TAS has essentially zero net trade with VIC (measured annually) but the electricity imported from and then exported to Victoria is equivalent to around 10% of Tasmania's electrical demand.

The Tasmanian Government has legislated a renewable energy target (the "TRET") of 15 TWh of renewable generation in 2030 and 20 TWh by 2040, contingent on the development of the 1500 MW Marinus Link transmission cable to VIC. If implemented the TRET will roughly double electricity generation in TAS by 2040 (compared to 2020 levels).

The Tasmanian Government and the Commonwealth are currently funding the exploratory stages of Marinus Link and the major re-development/refurbishment of a hydro generator (Tarraleah). The construction of Marinus Link is a necessary precursor to the implementation of the TRET

South Australia (SA)

SA has, until the last few years, had by far the highest wholesale and retail electricity prices in the NEM. This may be explained by its historic dependence on gas and coal, and market concentration. The Rann (2002-2011) and then Weatherill (2011-2018) governments actively supported the development of renewable electricity in SA to increase supply diversity, stimulate competition, reduce emissions and reduce reliance on imported electricity.

SA now has the highest proportion of variable renewable energy in its production mix (67% in 2021) of all states, and the State is now a net exporter of electricity (measured annually).

Wholesale electricity prices have declined so that SA's weighted average spot market prices were the second lowest (after VIC) in 2021.

In addition to its active facilitation of renewable generation, major government interventions in the electricity sector in SA include:

1. Buying and then selling around 250 MW of gas/diesel reciprocating engine capacity.
2. Contracting a large part of the output of what was the world's largest lithium ion battery (Hornsdale) when it was commissioned in December 2017.
3. In partnership with ARENA and CEFC, funding the expansion of the Hornsdale battery.
4. A $200m home battery subsidy and allied virtual power plant scheme.
5. Facilitation of major interconnection expansion (Project Energy Connect) and of regulations to allow remote control of rooftop photovoltaics.

Victoria (VIC)

Victoria has the highest absolute and second-highest (proportionate to grid demand) penetration of variable renewables in its energy mix (29% of grid-supplied electricity in 2021). Since 2014 successive Labor Governments have pursued policies to promote the development of renewable electricity and storage in VIC. In particular:

1. In 2017 the Government conducted reverse auctions to procure the production of 928 MW of additional variable renewable generation, for 15 years.
2. In 2017 the Government legislated the Solar Homes program to enable the installation of solar panels, solar hot water systems or batteries on 770,000 homes across the State, resulting in over one million Victorian homes powered by renewable energy.
3. In 2021, the Government contracted for control of most of the capacity of the 300 MW/450 MWh Victorian Big Battery.
4. In 2021 the Government negotiated the early closure of the Yallourn Power Station (2028, from a previously announced closure of 2032). As part of the agreement, Energy Australia agreed to build a 350 MW battery by 2026.
5. In 2021, the Government committed $540 million to establish a fund to invest in transmission network infrastructure and establish VicGrid, an entity tasked with the development of the transmission grid in VIC.

6. In 2022, the Government will conduct its second reverse auction for the procurement of 600 MW of variable renewable generation.
7. In 2022 the Government announced an off-shore wind target of 2GW by 2032, 4 GW by 2035 and 9 GW by 2040. This can be expected to cost around $35 billion and produce as much electricity as Victoria's existing coal generators.

New South Wales (NSW)

The NSW Government progressively sold out of the electricity sector over the period from 2011 to 2017 (retailers in 2011, generators from 2013-2015, transmission in 2015, and 50% of two of its three distributors in 2016 and 2017). However, at the end of 2020, the NSW Government passed the Electricity Infrastructure Investment Act which will re-establish the Government at the heart of future renewable energy and storage development.

The Electricity Infrastructure Investment Act enables the Government's "Electricity Infrastructure Roadmap". The Roadmap seeks to attract $32 billion of private investment in electricity generation, storage and transmission by 2030 and thereby reduce greenhouse gas emissions by 90 million tonnes by 2030. This means at least 33.6 TWh per annum of new renewable electricity production by the end of 2029, and 2 GW of storage that is able to discharge continuously at its maximum capacity for at least 8 hours.

The Government's role is to co-ordinate such new generation and storage and to procure its production through long term off-take agreements. A Consumer Trustee has been appointed to run tenders for such agreements to procure renewable electricity production and to make availability payments to storage providers.

The Energy Corporation of NSW has been established to co-ordinate where generation, transmission, long duration storage and firming capacity will be built.

Queensland (QLD)

Queensland has the lowest renewable penetration in the NEM (16% of grid-supplied electricity), but it also has one of the highest penetrations of rooftop solar. Most electricity generation in the state is from coal (59% of QLD's demand in 2021), which is mostly owned by the Government. The Government has recently established "Cleanco" to contract for variable renewable (mainly wind) generation and to own and operate its run-of-river hydro, pumped

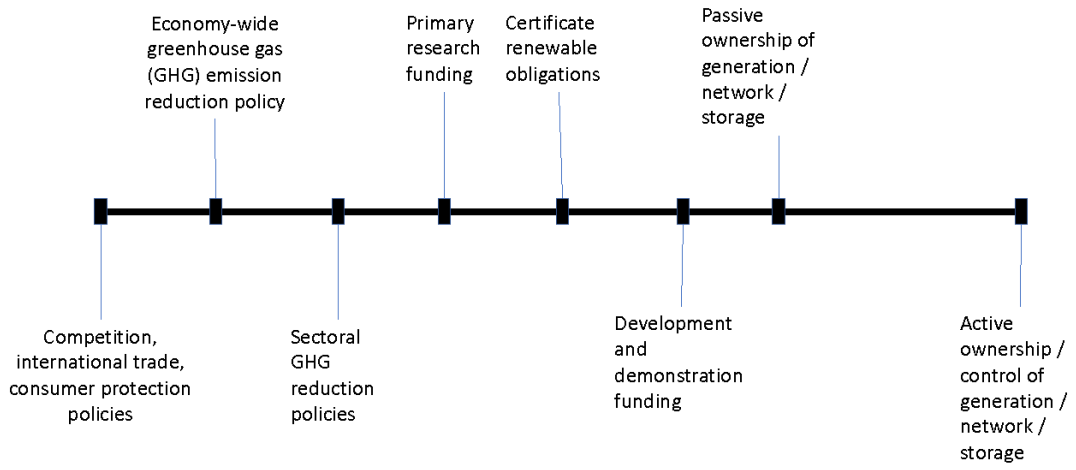
hydro and combined cycle gas generation plant. The Government has also funded a transmission extension for the privately developed pumped hydro power station at a disused gold mine in Kidston in North QLD.

In 2021, the Queensland Government established a $2 billion fund for Cleanco, Stanwell and CE Energy to access (i.e. in order to pursue joint venture VRE projects). The Government has also partially funded a transmission extension for the privately developed pumped hydro power station at a disused gold mine in Kidston in North QLD. Additionally, the Government has set aside requisite equity contributions for the state-owned TNSP (Powerlink) to establish Renewable Energy Zones (REZ's) in North Queensland, Central Queensland and South Queensland. Powerlink has reached financial close on two REZs – in Far North Queensland (c.500MW) and South Queensland, on the Southern Downs (c.2000MW). Two more REZs (in South Queensland and Central Queensland, c.2000MW each) are expected to reach financial closure over the 2023-2024 period. Importantly, none of these REZs will enter Powerlink's RAB – all have been co-ordinated with private and/or government-owned renewable projects as anchor tenants.

Appendix C: Should the Commonwealth participate in electricity production, storage and transmission?

There are many possible ways for the Commonwealth to be involved in the electricity sector, as depicted in Figure 3. The left end of the spectrum is characterised by general, (i.e. not sector-specific) policy but that nonetheless affects the sector. The right end is characterised by active control and ownership of corporations that produce/transmit/store/supply electricity.

Figure 3. Possible ways the Commonwealth can be involved in the electricity sector



Policies on the left side of the spectrum include competition, consumer protection and international energy trade policies. Through the Australian Constitution, the Commonwealth is responsible for international trade and competition and international commitments on greenhouse gas emissions.

Economy-wide, then sector-specific, emission pricing and certificate-based renewable energy obligation schemes (such as the RET) allow involvement in the electricity sector, but without active intrusion in the promotion of particular projects or technologies.

Moving further to the right, by funding primary research in universities/CSIRO and then demonstration and development through agencies such as ARENA and the CEFC, the Commonwealth becomes increasingly involved in outcomes in the electricity sector, albeit one

step removed from active participation. Finally at the right side of the spectrum through active ownership and control of electricity corporations, the Commonwealth can directly affect outcomes in the sector.

Prior to the NEM's beginnings (i.e. the 1994 reform initiatives) the Commonwealth had virtually no direct involvement in the electricity industry – save a passive investment in Snowy Hydro. Over the 25 years since the creation of the NEM, the nature of the Commonwealth's involvement has gradually shifted towards the right of this spectrum, then more rapidly in the last five years. This is evident from the purchase of Snowy Hydro from NSW and VIC, commitment to Snowy 2.0 and Kurri Kurri gas power station, and most recently in early-stage funding of transmission interconnectors between the jurisdictions (Project Energy Connect, Marinus Link and VNI West) and part of the redevelopment of a hydro generator in TAS.

The proposal for a $20 billion "Rewiring the Nation Corporation" would be situated on the far right of the spectrum. It would be consistent with the direction of travel of the previous governments who, as discussed, have now committed around $30 billion of taxpayers' money to the sector, most of which is over the last five years.

In the evaluation that follows, we consider arguments for greater central direction by the Commonwealth. Three possible arguments for central direction come to mind:

1. It will better co-ordinate the development of the power system.
2. It will result in better project selection (i.e. a central entity has a better chance of "picking winners").
3. It will stimulate innovation.

Are these plausible?

3.5 C.1 Will central direction improve co-ordination?

An argument for central direction (which may take the form of active facilitation) is that without it the development of the power system will be un-coordinated. Those persuaded by this argument would observe that since the Constitution obliges the States to provide electricity and since the states are not obliged to pursue the national interest, a central co-ordinator is valuable in overcoming State parochialism.

First, we test the parochialism hypothesis by examining the creation of the NEM. We then question whether central direction is likely to be successful having regard to information constraints and State governments' prerogative to set land use and industry development policies. Finally, we observe that technology change is providing economic incentives for regionalisation and localisation.

The NEM

The NEM itself is an example of co-ordination through a process of co-operative federalism. Comparative advantage in international trade theory provides the rationale for its creation. The National Electricity Rules and National Electricity Law, its core institutions, exist in State legislation and are overseen by a body, the Australian Energy Markets Commission, appointed by the States. While the Commonwealth assisted in the creation of the NEM by providing a national policy direction focussed on productivity improvement through microeconomic reform, the NEM itself is a creation of the States, not the Commonwealth.

Information access, land use policy and industry development policy

A national planner does not know the risk appetite of local (i.e. site specific) investors, micro-siting advantages or social licence-related constraints, let alone regional planners' local information. Each State has its own transmission network service provider which is responsible for planning the development of transmission in their States. These State-based entities have detailed information on demand, supply, capacity and operational constraints on their networks– and are also the first entities to be approached by investors with regards to their solar/wind/storage projects (i.e. network access is a key go/no go power project condition precedent). The States have no obligation to report this detailed information to a national entity. Without access to such detailed information, a national planner is several steps removed from information that is vital for effective central co-ordination. Even AEMO's Integrated System Plan (ISP), the most comprehensive central plan, suffers from all of these information shortfalls and is therefore far from an 'investment grade' document, although it provides valuable generic insights nonetheless.

State land use policy and industry development policy have been in the past, and even more so in the future, major considerations in electricity sector development. Whereas power was once best produced by locating large generators adjacent to coal and cooling resources and transferring power to various centres of demand, the future lowest cost generation and storage

options will often be most cost-effectively located close to or at loads. States, via land use decisions, planning and zoning laws and industry development policies, control these decisions, e.g. where new housing estates will be and obligations for rooftop solar and storage; where new high-demand power use industrial precincts will be; and where easements for new transmission development will be most easily obtained. Sterilising land corridors on both public land (e.g. State Forests and National Parks) and private land to build transmission lines will require thoughtful local solutions.

For these reasons a national co-ordinator will be hindered by information shortfalls and a lack of jurisdiction over policies that will affect the development of the electricity sector. Such information shortfalls and jurisdictional limitations can't be addressed in any meaningful sense without taking away the Constitutional authority of the States in respect of electricity supply.

A recent example of such information shortfalls is the Victorian Government's announcement, just a couple of months after AEMO's Draft 2022 ISP, of a policy to develop 9 GW of offshore wind generation (which is enough to produce, annually, as much electricity as all of VIC's existing coal generators). This policy will radically alter the use of the Victorian transmission grid and interconnector power flows. The ISP had not predicted any off-shore generation capacity for the next 30 years and is known to have excluded projects very close to (or that had reached) financial close when the Draft ISP was released. In a rapidly evolving market, numerous similar examples can be found[16].

Technology change

The rise in low-cost renewable energy and the rapidly declining cost of storage has eliminated the comparative advantage of large, constantly-operating generation facilities located adjacent to coal resources and water for cooling.

In a power system that is dependent on variable renewable generation, supply diversity (i.e. the wind blowing at different times of the day in different states) is perhaps the only substantive source of value underlying long-distance inter-regional transmission. There is no

[16] Other examples include the early closure of announcements of Yallourn and Eraring coal-fired power stations, the NSW Roadmap and the expected rise in batteries.

evidence of substantive anti-correlation of wind generation in different regions (with the possible exception of Far North QLD – which is simply too far from load centres to be worthy of substantive additional interconnection).

Evidence of the rapidly changing economics can be seen in the cost-benefit analysis that AEMO completed in 2019 for the largest transmission augmentation in VIC over the last two decades (the Western Victoria Transmission Project (WVTP) from Melbourne to west central Victoria).

This project is motivated by the expansion of new renewable generators located in the north and west of VIC. However AEMO's cost-benefit analysis[17] showed that by far the biggest source of benefit from that augmentation was the substitution of more expensive (and less greenhouse gas intensive) black coal generation in NSW and QLD, by cheaper (and more greenhouse gas intensive) Victorian brown coal generation[18]. AEMO's analysis actually shows that WVTP in fact made almost no difference to renewable generation in VIC: its benefit according to AEMO's analysis was in replacing more expensive fossil generators with other cheaper fossil generators[19]. But if fossil (coal) generation soon leaves the market (as AEMO now suggests will happen), wherein lies the justification for that transmission augmentation?

3.6 C.2 Will the Commonwealth pick winners?

A key point from the previous sub-section was that the Commonwealth or "national" agents (such as AEMO) are unable to co-ordinate effectively because they lack the necessary information and jurisdiction over relevant parts of the economy and society affected by electrical infrastructure. A corollary of this information and "jurisdiction" deficit, is that the Commonwealth and its agents, are even less likely to "pick winners", than the states (who at the least have much better access to such information, and control over local factors of

[17] Formally the Project Assessment Conclusions Report (PACR).
[18] This conclusion relies in the assumption – which the Australian Energy Regulator required AEMO to make in AEMO's application of the AER's cost/benefit test, that greenhouse gas emissions have no cost.
[19] Interestingly, the analysis also showed that the transmission expansion would make no meaningful difference to the amount of wind generation in Victoria. AEMO's analysis reflected assumptions of generation closure that have long since been superceded – it is now expected that almost all of NSW's coal generation will have exited the market by the early 2030s, whereas AEMO expected that coal generation in Victoria and NSW would remain operating at the level expected in 2032/33 all the way until 2074/75.

production). A particular concern is the Commonwealth's propensity to develop for mega-projects[20] that skew investment incentives for any other party (State or private) through the Commonwealth's indifference to negative returns.

Other aspects of the Commonwealth's incentive structure, relative to those of the states, are inimical to the selection of economically sensible projects. Specifically, the Commonwealth's far greater fiscal capacity diminishes the relative significance to it, but not the nation, of errors it will make in its electricity interventions, and by implication that discipline that it feels in its investment decision-making. This was put to us by an interlocutor debating the merits of Snowy 2.0: "does it really matter if the Commonwealth wastes billions on Snowy 2.0, after all they waste tens of billions on the military all the time." The Commonwealth is also particularly susceptible to the politically valuable notion of "nation building" (e.g. "Snowy 2.0" and "Battery of the Nation"). The pursuit of such notions diminishes its appetite (and accountability) for the often tedious work involved in protecting the public from waste.

The distortions and inefficiency arising from Commonwealth intervention are quite clear in the Commonwealth's flagship project, Snowy 2.0. The cost-benefit analyses undertaken by both TransGrid and AEMO of Snowy 2.0's necessary transmission connection (HumeLink) concluded that the benefits of HumeLink would exceed its costs. TransGrid's and AEMO's analysis provides the basis for the conclusion that the cost of HumeLink (currently estimated to be $3.3 billion +50%/-30%) being recovered from NSW electricity consumers in regulated charges. Assuming a cost of $3.3 billion, we have estimated that this will result in transmission charges in NSW increasing by 40%[21].

But both TransGrid's and AEMO's analyses of HumeLink exclude the cost of Snowy 2.0, without which the main benefit provided by Snowy 2.0 (avoided storage development elsewhere) would not arise. When properly including the cost of Snowy 2.0, the benefit of HumeLink falls far short of its cost. In other words, much cheaper options are available. A proper accounting of the costs and benefits of HumeLink would therefore not support treating HumeLink as a regulated asset. Instead the cost of HumeLink would need to be borne by

[20] See for example, https://grattan.edu.au/wp-content/uploads/2020/11/The-Rise-of-Megaprojects-Grattan-Report.pdf

[21] https://www.vepc.org.au/_files/ugd/92a2aa_52bec342cb1e4c2292c4d259f4049f6d.pdf

Snowy Hydro, whose actions (in building and needing to connect Snowy 2.0) have caused the cost to arise.

Why then has the NSW Government failed to demand that the Commonwealth, through Snowy Hydro, should pay for the cost of HumeLink? Perhaps this might be linked to the agreement for the sale of the NSW's 57% share in Snowy Hydro to the Commonwealth. That agreement stipulates that NSW would not pursue the Commonwealth or Snowy Hydro for any transmission costs associated with Snowy 2.0.

Bringing these strands together, the Commonwealth's intervention in Snowy 2.0 is resulting in a project that is much more expensive than alternatives and it is electricity customers in NSW who will be required to pay for its transmission connection.

Although at an earlier stage of development, the Commonwealth's involvement in the "Battery of the Nation" and its necessary transmission link to Victoria (Marinus Link) also attests to the Commonwealth's picking of probable losers. Marinus Link is a proposed 1,500 MW interconnector between TAS and VIC and is essential in justifying the doubling of electricity production (the "TRET" as discussed earlier) and the expansion of storage in TAS in a development known as the "Battery of the Nation". Like Snowy 2.0, "nation building" superlatives apply to Marinus Link: it will be even longer and more than three times bigger than the current cable between VIC and TAS (Basslink) which was described as the world's longest subsea cable when it was commissioned in 2005.

In its assessment of the costs and benefits of Marinus Link, AEMO excludes most of the cost needed to double generation capacity in TAS, without which Marinus Link would have limited value[22]. Like AEMO's analysis of HumeLink, AEMO's analysis of Marinus Link shows benefits exceeding costs because most of the cost of expanding generation and storage in Tasmania, without which the transmission expansion would have little value, has not been counted. The Tasmanian Government points to AEMO's calculation to argue that most of the benefit of Marinus Link will be captured by VIC and the other mainland states and so they should pay for most of it. But VIC and the other states evidently do not agree and none have agreed to pay for any of it.

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[22] This in despite of the Tasmanian Energy Minister telling the Tasmanian Parliament that the TRET is contingent on Marinus Link.

Tax-payers money in funding Marinus Link may be justified if there is convincing evidence that benefits exceed costs. The Tasmanian Government and its corporations insist that such evidence exists, but the mainland states evidently don't agree. So far the Commonwealth, in contributing around $150 million for the pursuit of the Battery of the Nation and Marinus Link, has sided with the seller (Tasmania) rather than the buyer (the mainland states). Indeed, it would seem that several interconnectors are only likely to proceed if the Commonwealth funds them entirely or largely[23].

3.7 C.3 Will federal involvement stimulate or impede innovation?

The standard rationale, in economics, for the public funding of research is that the private sector will under-invest because the benefits of the research spill over, they are not exclusive. That the Commonwealth has a vital role in funding primary research in academic institutions, and funding the demonstration and early deployment of innovative solutions through organisations such as ARENA, is not in question. Rather the issue here is whether *direct* federal involvement in the electricity sector will stimulate or impede innovation.

It might be argued that direct federal government involvement in the development of electricity infrastructure may be advantageous if the investment was in novel technology with large potential productivity benefits, but a scope potentially beyond the ability of any one market participant to develop in a commercially sustainable fashion. Federal funding of the National Broadband Network is an example of this.

However transmission is not a novel technology with an uncertain level of consumer interest, both of which were essential to the case for such a major public investment in telecommunications. While power transmission is technologically improving all the time, it is a well-known technology and does not offer large productivity benefits provided regulatory settings have been calibrated appropriately. Neither is it beyond the ability of any one market participant to develop in a commercially sustainable fashion. As such, risks in the electricity

23 https://www.afr.com/policy/energy-and-climate/canberra-has-failed-us-on-energy-d-ambrosio-20220509-p5ajui

transition that might justify major government intervention and investment are not similar to broadband and the transition to a digital economy.

As described earlier, state governments are pursuing a variety of approaches to the development of their electricity industries. The diversity of their policy approaches and implementation arrangements provides valuable information to discover and learn. This improves the prospect for rivalry in contestable activities, and competition by comparison in monopoly activities. If a single national entity comes to dominate infrastructure development, it may undermine such discovery and experimentation.