A New Approach to Valuing Reliability in Australia's National Electricity Market

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Introduction

The Australian National Electricity Market (NEM) is an interconnected electricity market which operates in the five eastern and southern states of Australia, as well as the Australian Capital Territory. Its basic market supply chain involves:

- a competitive wholesale market where market participants (for example generators and retailers) trade electricity through a gross uniform clearing pool, operated by the Australian Energy Market Operator (AEMO),
- a restructured competitive retail market where retailers manage price risks in the wholesale market and provide electricity retailing services to consumers, and
- network services provided by monopoly network businesses, which are economically regulated.

This article focuses on reliability in the competitive parts of the supply chain: the provision of sufficient generation to meet demand at any given point in time and the role of retailers in managing these risks on behalf of customers[1]

The Provision of Reliability in the NEM

In the NEM, reliability is primarily provided through competitive markets. As a gross pool, all market customers are settled at the spot market price for all electricity delivered through the system.[2]

Retailers buy electricity from the gross uniform price pool on behalf of their customers (end consumers). The price can be inherently volatile, rising from $-1,000 to over $14,000 in a half-hour pricing period. Retailers typically enter into retail contracts with end consumers for the delivery of an unknown quantity of electricity at a price which does not vary dynamically with the wholesale market spot price. As a result retailers take spot price risk, arising from the difference between the spot price (highly variable) and the retail price (typically largely fixed through annual or longer-dated contracts).

Retailers then manage this significant financial risk by entering into financial hedging contracts (or vertically integrating) with generators or demand respond providers (or financial intermediaries), which provides revenue certainty to these entities. In turn, these entities manage the risk of their own contractual positions through the physical provision of generation or demand response. The financial contract market is therefore a crucial mechanism through which physical generation and demand response capacity is provided and hence a reliable supply of electricity is delivered to consumers.

No electricity system can guarantee that there will be zero unserved energy (USE), as this would require sufficient generation to be available at all times to meet any conceivable level of demand. Instead, the NEM has a reliability standard of a maximum expected USE in a region of 0.002% of the total energy demanded in a region for a given financial year. The Australian Energy Market Commission's (AEMC's) Reliability Panel recommends to the AEMC the appropriate level for the market price cap (MPC) and other reliability settings with regard to the USE standard.[3] The market price cap limits retailers' and generators' spot price exposure, and so limits their incentives to contract for, and invest in, generation capacity. The MPC is currently $AUD14,500/MWh.

Reliability outcomes in the NEM have historically been high, as measured against the reliability standard. Furthermore, between 2007-08 and 2016-17, only 0.23% of supply interruptions were as a consequence of reliability, as distinct from network or security related interruptions.[4]

Despite this strong historic performance, there has become increasing concern that the reliability framework of the NEM will not remain fit-for-purpose in the future. Rapid technological change in the energy sector and government policy has resulted in material additional very low short-run marginal cost renewable generation. The 'merit-order effect' of an energy-only market design created a comparatively low wholesale electricity pricing environment and economic pressure on ageing surplus coal-fired generation led to 10 coal-fired power stations being permanently retired, with more than 5000 MW of capacity with-drawn from service. The cheapest form of energy in Australia is now wind or solar PV and declining underlying energy demand has resulted in conditions being unsuitable for investment in higher capacity factor thermal plant. Australia is now grappling with the challenge

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All views expressed in this article are those of the authors and not those of the Australian Energy Market Commission or Griffith University. The potential mechanism in this paper was first discussed in an Australian Energy Market Commission discussion paper - https://www.aemc.gov.au/sites/default/files/2018-11/Consultation%20paper.pdf

See footnotes at end of text.

of integrating high proportions of large-scale and distributed renewable generation within its electricity system in a manner than ensures reliable, affordable, and low-emissions supply is forthcoming.[5]

Concerns about reliability have led to short-term solutions being adopted. For example, in the summer of 2017/18, for the first time, AEMO procured reserves as a precautionary measure under the NEM's strategic reserve market intervention mechanism (the Reliability Emergency Reserve Trader (RERT)). With the considerable benefit of hindsight, these reserves were not needed. The approximately $AUD52m of direct costs relating to the RERT were ultimately recovered from consumers.[6] Indirect costs due to market distortions may also arise from the use of such interventions.

It is in this context that we consider a new potential longer-term reliability framework reform option: a load shedding compensation mechanism (LSCM).

Possible Issue Due to the Allocation of the Risk of Load Shedding

When there is insufficient generation to meet demand at any given time, the market operator (AEMO) initiates involuntary load shedding of consumers. When this occurs, the spot price rises to the market price cap but retailers are not liable for the electricity that would otherwise have been consumed by their customers. Consumers, not retailers, bear the risk of load shedding for reliability reasons through the loss of value that they would otherwise derive from the consumption of electricity (e.g., not being able to produce widgets or power their homes).

Retailers take account of their expected exposure to the spot price when determining their contractual positions. Given that retailers are not exposed to the spot price for load that is shed, this may be resulting in inefficient under contracting for generation or demand response because retailers may have a financial incentive to hedge with regard to their expected exposure (i.e., the expected load served) rather than with regard to the level of demand including USE. By not contracting for as much generation or demand response than would otherwise be the case, the overall level of reliability may be sub-optimal from the perspective of economic efficiency.

How the Load Shedding Compensation Mechanism Addresses this Issue

Under the LSCM, in the event of involuntary load shedding as a result of reliability issues (i.e., a lack of supply to meet demand), retailers would be exposed to the volume of load that they would otherwise have purchased, at the market price (the MPC).

This would shift risks of load shedding from consumers to retailers, who may be better placed to manage it than end consumers because they are better able to participate in risk management activities such as entering into financial contracts with generators or demand response providers. In order to manage these risks, it is likely that retailers would choose to contract more with generators and demand responders to manage the financial risk, which lessens the probability of load shedding since there would be more resources available in the market.

In the event of reliability related load shedding, a baseline would be used to determine the amount of electricity expected to be consumed by a consumer were it not for the load shedding.

Retailers would be settled on the baseline quantity of electricity, at the spot price (MPC). The actual amount of electricity delivered multiplied by the spot price (MPC) would be paid to generators (as is the case currently), while the difference between the actual and baseline amount multiplied by the spot price (MPC) would be provided to the end users whose load was shed, most likely through a rebate in their next electricity bill. Each consumer supplied via a particular feeder that is load shed might be compensated the average amount related to that feeder, or a more sophisticated division of compensation could be used, particularly in a market where all customer consumption is monitored through digital interval metering.

This mechanism shares many characteristics to an insurance mechanism suggested by Billimoria and Poudineh (2018).[7] Their mechanism involved a third party providing financial insurance to a consumer in the event of load shedding. In the model proposed in this article, it would be the retailer, not a third party, which would provide the insurance.

The LSCM would not compensate consumers for non-reliability related outages such as any outage resulting from network failures. As noted earlier in this article, non-reliability related outages constitute the vast majority of supply interruptions experienced by consumers in the NEM.

Possible Benefits and Issues of the LSCM

As noted above, the LSCM provides an incentive for retailers to manage the financial risk of load shedding. By managing the risk more efficiently than end consumers, a more efficient level of generation and demand response is likely to be forthcoming and thereby facilitate a more efficient level of reliability, or allow for a reduction in prices for a given level of reliability.

While each individual retailer might initially pay compensation to their consumers if they are load shed, they will not ultimately be exposed to the cost of that compensation if they are sufficiently hedged. It is those parties (retailers, generators, or financial intermediaries) which are short in the market which will ultimately pay the compensation, once all the financial positions have been accounted for. Indeed, if no party is short then by definition there will be no load shedding because sufficient generation, demand response or other services will have been provided to meet demand.

There are a number of possible issues with the LSCM that would need to be carefully considered. These include:

- Errors in the baseline would result in inefficient incentives for retailers, although there may be a lower risk of systemic bias in LSCM baselines compared to baselines used in some demand response mechanisms internationally.
- It would have to be possible to accurately distinguish between load shedding as a result of wholesale market reliability and other causes of load shedding, such as network outages or system security events. Retailers should not be liable for any risks that they themselves cannot manage.
- In the current arrangements, there is nothing stopping retailers providing compensation to end consumers in the event of load shedding. Arguably, provided the retail market is sufficiently competitive and end consumers are sufficiently sophisticated buyers, retail offerings which provide compensation (or insurance) in the event of load shedding should emerge, to the extent that consumers value it and are willing to pay for it through an amendment to tariffs. This would suggest a regulatory solution to this issue may not be necessary.

The LSCM may have a number of other consequential impacts on the NEM's reliability framework. For example:

- Since the risks of load shedding would be on retailers, there would be additional costs placed on these parties through entering into more hedging contracts. As a consequence of the increased cost of entering into hedging contracts, it might be expected that retail prices go up if the reliability settings such as the market price cap remain unchanged. It may therefore be appropriate that the market price cap is reduced, to counteract this effect, with the intent of reducing prices for any given level of reliability.
- Providing the level of compensation for consumers was set at the value of consumer reliability (i.e., providing the market price cap was set at the value of consumer reliability), consumers would be indifferent between having their load shed (with compensation) and continuing to have access to electricity. Implementing the LSCM may allow for less reliance to be placed on out-of-market solutions such as the RERT. Retailers and market participants, and not the market operator through the RERT, would be managing the risk of load shedding. Retailers would have financial incentives to manage the risk efficiently, and, to the extent that they do not, it is they and not consumers who primarily bear the cost. As such, the LSCM seeks to allocate costs and risks more efficiently than an out-of-market solution such as the RERT.
- The reliability standard: Under the LSCM, retailers would be incentivised to deliver the lowest cost combination of generation, voluntary demand response and compensation for involuntary load shedding. This in turn should deliver the level of unserved energy that minimises the combined cost of load shedding, demand response and generation. This could effectively deliver the optimal amount of unserved energy. The implications for the reliability standard would require further thought.

Conclusion

A compensation mechanism in the event of involuntary load shedding, paid for by retailers, may better allocate the risk of load shedding to those well placed to manage it. In turn, this may be expected to improve reliability outcomes (or reduce costs for a given reliability outcome), and reduce the NEM's reliance on out-of-market intervention measures such as the RERT.

Footnotes

[1] In the NEM, reliability (the provision of sufficient capacity to meet demand) is distinguished from 'security', which relates to whether the system is operating within certain limits for technical parameters (for example, voltage or frequency). This paper does not consider security or network reliability issues.

[2] The NEM is divided into five interconnected pricing regions, corresponding to the five states. The Australian Capital Territory is an enclave of the state of New South Wales, and so is in the New South Wales region of the NEM.

[3] The AEMC makes and revise the energy rules and provide advice to Australian federal and state governments. The Reliability Panel is comprised of members appointed by the AEMC who represent a range of participants in the national electricity market, including consumer groups, generators, network businesses, retailers and AEMO.

[4] AEMC, Reliability Frameworks Review, Final Report, 26 July 2018, pp. 12-13.

[5] See https://www.sciencedirect.com/science/article/pii/S1040619017303500

[6] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/RERT-Update---cost-of-RERT-2017-18.pdf

[7] F. Billimoria and R. Poudineh, Decarbonized Market Design: An Insurance Overlay on Energy-Only Electricity Markets, the Oxford Institute for Energy Studies, 2018.