Energy Policy
INSTITUTE OF AUSTRALIA

Public Policy Paper

Paper 1/2017

HOW TO REFORM THE ELECTRICITY MARKET BEFORE WE REACH THE TOP OF A CLIFF

Stephen Wilson

Cape Otway Associates

February 2017

The Energy Policy Institute of Australia is an independent and apolitical energy policy body.

The Institute advocates that Australia must maintain a secure investment climate and be internationally competitive, whilst moving towards and contributing as much as it can to global efforts to build a low-carbon society.

For further information, please visit the Institute's website
www.energypolicyinstitute.com.au

Key Points

- The Australian National Electricity Market (NEM), burdened by the effect of the Renewable Energy Target (RET) schemes, is no longer capable of delivering a reliable, affordable and sustainable electricity supply. The NEM, or the RET schemes, or both, will need to be changed to avoid serious failure of the power system in the future.

- This paper sets out in plain English a statement of the problem, a diagnosis of the underlying causes at the root of the problem, remedies that have been proposed to solve it, and a vision for reform that would require minimal design changes to create the next generation electricity market.

- Six symptoms of the problem evident in the NEM have been identified, which adversely affect power companies, as well as business and household consumers. The root causes are found in conflicts between the design principles on which the NEM is based and those of the RET schemes.

- Seven possible responses have been identified, which are considered remedies rather than options, as some of them are potentially complementary. Some remedies would involve retreating from the competitive electricity market reforms of the 1990s, while others would take the reforms to a more mature stage.

- The paper makes recommendations that could redress the root causes of the problem, with a minimum of disruption to consumers, the electricity system and the market, and reduce rather than escalate government intervention.

The Overarching Problem: a state of denial while trying to satisfy everyone

There is belated recognition of the impossibility of the NEM providing reliable *and* affordable *and* sustainable electricity supply to satisfy everyone.

Severe wholesale electricity market price spikes and a series of blackouts in South Australia, including a state-wide blackout, have prompted reviews by the Australian Energy Market Commission (AEMC), the Australian Energy Market Operator (AEMO), and Alan Finkel's *Independent Review into the Future Security of the National Electricity Market* for the Australian Government.[1]

Reliability problems appeared first at the 'ends' of the physical grid: in Tasmania, South Australia, and Queensland. If not addressed, reliability problems are likely to worsen and affect the heart of the grid in Victoria, New South Wales and the ACT.

Eastern Australia is now within ten years of the top of a 'cliff': most of the existing thermal power plants in the fleet will reach their retirement dates in the ten to fifteen years after the mid-2020s. The cliff represents an opportunity. But if the market is not reformed to enable it to create the incentives needed for reliable and affordable electricity, then the cliff represents a major threat to the economy. The structure of existing RET subsidies encourages unreliable and high cost electricity. Traditional market economics are accused of encouraging unsustainable electricity.

Robert Pritchard recently wrote that "[t]he increasing penetration of variable renewable energy (VRE) in the National Energy Market (NEM) is causing the closure of coal- and gas-fired power stations, threatening power system security and creating unmanageable risks for investors."[2]

The Diagnosis: six symptoms and their underlying cause

Australia is not alone with electricity market problems: there are striking parallels overseas. The investment issue is one of six problems, or symptoms of problems, identified by Malcolm Keay,[3] who observes that electricity markets are strained and worrying symptoms are appearing in Europe. The symptoms that he identifies are also apparent in Australia:

- falling wholesale prices at a time of rising generation costs;
- physical and financial imbalances between supply and demand, characterised in Australia by extremely high price events and major blackouts and in Europe by the frequent occurrence of zero or negative prices;[4]

---

[1] AEMC, *System Security Market Frameworks Review*, Interim Report, 15 December 2016, Sydney; AEMO, *National Electricity Market Electricity Statement of Opportunities*, August 2016, Melbourne; and Alan Finkel et al, *Independent Review into the Future Security of the National Electricity Market*, Preliminary Report, December 2016, Canberra.

[2] Robert Pritchard, *Investing in electricity infrastructure in a low-carbon era*, EPIA Public Policy Paper No.7, December 2016, Energy Policy Institute of Australia, Sydney.

[3] Malcolm Keay, *Electricity markets are broken—can they be fixed?* OIES paper EL17, January 2016, Oxford Institute for Energy Studies, Oxford.

[4] The problems are most notable in South Australia, which in addition to a state-wide blackout in September 2016, has had a number of smaller blackouts since. Adverse weather has been the proximate cause, but there is widespread agreement that the problems are symptomatic of a system struggling to provide reliable electricity supply following contingencies.

- early plant closures;
- financial problems for utilities, which are nonetheless expected to engage in the biggest investment programme in history to meet carbon targets;
- debates over the need for market reforms, in particular the introduction of capacity mechanisms to underpin investment in the plants needed to maintain supply security; and
- complaints from consumers about constantly rising retail prices.

The symptoms are clearly inter-related, although not necessarily in simple ways.

Unlike markets for other commodities, competitive electricity markets are 'contrived': they do not arise spontaneously, but need to be legislated into existence and require detailed and highly technical rules. By contrast, the rules for renewable energy markets tend to be relatively simple. Whereas demand for electricity arises spontaneously, renewable energy markets artificially create demand for electricity generated from wind, solar or other sources by laws requiring certificate purchases.

The design of the NEM is based on the two implicit principles: (i) that the value of electricity does not vary with the source, while (ii) the value of energy can vary enormously throughout the day and year, including the lead-time before delivery, and according to location.[5] Capacity is not priced, but energy prices rise when generation and interstate transmission capacity are in high demand.

The RET is comprised of two schemes: the Large Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). Both schemes are based implicitly on two principles: (i) that renewable energy has a higher value than other energy sources, for which it receives a large premium, but (ii) the premium does not vary throughout the day and year, nor with the lead-time before delivery, nor according to location in the network.

Clearly, *the principles on which the RET is based directly oppose those of the NEM*.

The conflicting design principles were not apparent when the share of variable renewable energy (VRE) in the NEM was small. But as the VRE has increased and become large in some regions, practical problems have begun to appear.[6]

Conflicting design principles should not be confused with the productive tension between the interests of producers and consumers in a market, where competition and choice lead to efficient prices. The principles on which the NEM is based reflect the intrinsic attributes of electricity and well-established economic principles.

The NEM is an elegant, 'energy-only' market design emphasising operational efficiency. Wholesale prices are formed through competition between generators: some are private companies and others are government-owned. When demand falls below available capacity,

[5] Lion Hirth, Falko Ueckerdt, and Ottmar Edenhofer, 'Why Wind Is Not Coal: On the Economics of Electricity Generation,' *The Energy Journal*, 2016, Vol.37, No.3, IAEE

[6] In South Australia, VRE generation is approaching 50 per cent of annual energy, varying from zero at some times to more than 100 per cent of demand at other times. This places proportionately large balancing requirements on remaining thermal generation and interstate transmission lines.

prices tend to be driven down towards the fuel and variable operating cost of the last generator needed in that half-hour (which may be as low as $20/MWh). At times and locations where a zero variable cost plant, such as a wind farm, is the marginal generator, the price can be zero or negative. Typical NEM wholesale spot electricity prices are $40 to 60/MWh at present. However, when demand approaches available capacity, prices can be driven extremely high (spot prices are capped at $14,000/MWh).

Table 1 summarises the locus of responsibility for reliability, affordability and sustainability, prior to and following the market reforms of the 1990s and the introduction of renewable energy schemes in the 2000s.

Table 1: Reform and development of the electricity market

Policy goals:	Reliability	Affordability	Sustainability
Correspondng primary activities	Planning & Investment [7]	Dispatch & Operation	Investment & Dispatch
Pre-1990s: monopolies	Planned	Planned	Not considered
1990s: market reforms	**Market**	**Market**	Not applied
2000s: renewables	Hybrid	**Market**	Planned
Future: consumer-centred	**Market**	**Market**	**Market**

Prior to the market reforms of the 1990s, all of the functions of providing electricity supply were centrally planned and operated. This reflected the *essential service* nature of electricity. The competition reforms of the 1990s — accompanied by asset privatisation in some states — introduced market forces to generation, facilitated by a market operator who coordinated bids and a system operator responsible for dispatch. Competition in retail supply was subsequently introduced. Transmission and distribution networks remain as regulated monopoly functions.

The 1990s market reforms emphasised affordability and the *commodity* nature of electricity. Based on energy market price signals and information in the form of an annual *Electricity Statement of Opportunities* from the market operator, AEMO, the market was expected to provide additional capacity adequate for reliability. Occasional extremely high prices were expected by market designers to signal a need for investment in new capacity, removing the need for central planning of generation. This expectation is now in question, based on recent experience.

The introduction of centrally-determined renewable energy targets that are intended to reduce CO_2 emissions has changed the dispatch and operation of the market, affecting affordability; and has reintroduced a degree of quasi central planning to investment, affecting reliability. The national target influences the type, timing and quantity of capacity

[7] The emphasis in the table is on generation investment. Reliability actually involves the whole value chain. With the exception of merchant interconnectors, transmission and distribution investment is predominantly an activity centrally-planned by the network owners and overseen by the Australian Energy Regulator.

decisions. All new generation investment in the NEM in 2015 and 2016 and capacity committed for 2017 has been either wind or solar power.[8]

Problems in gas supply have made matters worse, but are a topic for another paper.

Future demand for a power plant's output is uncertain; and, while wholesale prices vary half-hourly, sometimes enormously, most demand does not (currently) respond to prices in real time. The risk-and-return equation varies very widely between generation technologies, depending on their fixed and variable cost structure.

VRE investors have a simple price-taker strategy: build, then bid zero (or negative).[9] Revenues from renewable certificates are received for each MWh generated, topped up by NEM prices. If the future market share of VRE is high, the likely result is wholesale prices that jump sharply between zero (or negative) and extremely high levels. Unstable and unlikely to be politically acceptable, such commercial outcomes are the market reflection of the engineering problems of "The Pressure Cooker Effect."[10] Continuous system balancing of a system with high VRE shares is likely to become increasingly difficult and expensive to achieve, requiring large scale centrally dispatched storage, or mass market price-responsive customer storage. It is not known whether the latter would behave in a stable or unstable way.

Remedies: seven possible responses

Keay has identified seven possible responses to the market problems for further consideration and discussion, paraphrased as:

1. drop support for particular low carbon sources;
2. abandon markets and revert to central planning and system control;
3. create a separate, long-term investment market for generation capacity;
4. refine energy-only markets, for example using capacity mechanisms;
5. introduce more flat rate or demand-related elements into pricing;
6. radically decentralise markets by merging wholesale and retail markets; and
7. allow customers to choose between 'as available' and 'on demand' electricity.

Some of these remedies have been discussed in Australia; others are new to the debate. None of the possible remedies is perfect: each has advantages and disadvantages. The first four focus on the wholesale market, the last three on the retail market.

Response 1 is under debate. The Prime Minster has said that "The next incarnation of our national energy policy should be technology agnostic." And, responding to the question "…if you were going to be completely agnostic about energy, you wouldn't have a Renewable

[8] AER, State of the Energy Market, 2015, February 2016 update, Melbourne.

[9] Risk-and-return for investors can be thought of in terms of a two-period model: invest-then-operate; or build-then-generate; see Thomas-Olivier Léautier, *The "demand side" effect of price caps: uncertainty, imperfect competition, and rationing*, Working Paper No. TSE-460, Toulouse School of Economics, Toulouse, France, January 27, 2014; see also Thomas-Olivier Léautier, 'The Visible Hand: Ensuring Optimal Investment in Electric Power Generation.' *The Energy Journal*, 2016, Vol. 37, No. 2. IAEE

[10] Simon Bartlett, *The "Pressure Cooker" Effect of Intermittent Renewable Generation in Power Systems*, EPIA Public Policy Paper No.6, September 2016, Energy Policy Institute of Australia, Sydney.

Energy Target at all would you?" the Prime Minister recently said, "The Renewable Energy Target was never intended to be perpetual."[11] Response 2 would be a retrograde step, 20 years after the NEM was established. Response 3 attempts to introduce market processes to central planning of capacity. Response 4 offers the prospects of an evolutionary, minimal change, but has significant problems. The attempt to create a market for firm capacity in the UK is not working as expected: 'the supply secured so far is from fossil fuels and includes a large number of small diesel generators. Professor Hepburn, Professor of Environmental Economics at the University of Oxford, noted that this is "inconsistent with ultimate decarbonisation objectives".'[12] Capacity markets tend to be complex, expensive and also represent a partial reversion to central planning.

That the shadow of central planning looms over Responses 2, 3 and 4 reflects the fact that the generation-transmission grid is a large, complex integrated system. The existing configuration was optimised for a fleet of large, centrally-dispatched thermal and hydro power plants. It is easy to forget that the existing system was largely centrally planned. The current approach is to transform the system via a series of increments, driven by market forces, to integrate high shares of VRE peripheral to the existing network, without a master plan or long-term vision. It is more an article of faith than an established conclusion that this will result in an optimal system.[13]

Response 5 also has the appeal of an evolutionary, minimal change, and could provide part of the solution. It has been criticised because of its social impact, problematic incentives and because it may fail to address market distortions.

There has been some discussion in Australia of Response 6: the emergence of electricity producer-consumers or 'prosumers' — such as households with solar panels and batteries, trading electricity with their neighbours. However, it has significant disadvantages and hurdles outlined by Keay. Protecting against increased vulnerability to cyber attack would be essential.

In Response 7, Keay proposes that consumers be offered the choice of 'as available' power and 'on demand' power. 'On demand' (guaranteed 'firm') power would tend to be served from dispatchable plants. 'As available' (interruptible) power would tend to be served from VRE generation. Retail businesses would match a portfolio of owned or contracted generation with a portfolio of the two types of customer contracts. The prices of the two levels of service would reflect their value to customers and the cost of providing them with a commercial return.

[11] Malcolm Turnbull, 2017, *Address to the National Press Club*, February 1st, Canberra https://www.pm.gov.au/media/2017-02-01/address-national-press-club

[12] House of Lords Select Committee on Economic Affairs, *The Price of Power: Reforming the Electricity Market, Westminster*, 24 February, 2017

[13] The challenge of reinforcing the transmission system, including the case for transforming the long, thin radial system to a meshed 'ring' via a new Queensland-South Australia interconnector may be considered in a future EPIA paper.

Recommendations for reform: a vision for the future market

Finkel has placed consumers at the centre of the challenges:

> *Consumers are at the centre of the energy trilemma and the core of this Review. While consumers rightly expect a secure and reliable energy system, they also want to find ways to better manage their energy costs, and help reduce our emissions.*[14]

Giving customers a reliability/price choice is one part of doing this. It would:

- enable continued support for low carbon sources, consistent with market choice;
- avoid discarding the market reforms and reverting to central planning;
- improve price signals for long-term investment without creating another market;
- more robustly refine the existing market than 'bolting on' capacity payments;
- allow better flexibility than flat rate or demand-related charges alone; and
- improve customer participation by integrating wholesale and retail markets.

In other words, enabling consumers to trade off reliability and price would bring some of the benefits of all six other remedies, without all of their costs and disadvantages.

Offering customers a reliability-and-sustainability choice at different prices would really put the customer at the centre of the energy trilemma. It would remove the distortions plaguing the market. The national trade-off between reliability, affordability and sustainability would represent the collective decisions of all household and business consumers, not a one-size-fits-all government decision.

According to Bartlett, "The scale-up of intermittent renewables not only diminishes the robustness of a particular power system but can also magnify the short and long-term risk of investing in non-renewable generation assets and the power grid itself."

Keay concludes that "electricity market prices have ceased (or are ceasing) to perform their main functions of providing incentives for **efficient operation and investment, remunerating energy resource providers and providing effective price signals for consumers** – and the situation can only get worse as the penetration of more policy-supported sources increases, [hence] markets are broken."

Pritchard has written that "EPIA has for some time advocated the need for a national energy vision to align Australia's energy and climate policy and provide long-term policy stability and certainty" and suggested that "the focus of reforms should be the formulation of a truly national energy vision."[15]

Such a vision for Australia's electricity sector, inspired by the consumer-centric and technology-enabled view in Finkel's *Preliminary Report,* may be:

- technology neutral or 'technology agnostic';

---

[14] Alan Finkel et al, 2016, *Preliminary Report of the Independent Review into the Future Security of the National Electricity Market*, Commonwealth of Australia, Canberra, 9th December, p.16
http://www.environment.gov.au/energy/publications/energy-market-preliminary-report

[15] Pritchard, *op.cit*.

- national and suitable for all states;
- genuinely transformative but requiring minimal changes to the NEM rules;
- consistent with a bipartisan national consensus on competition and choice;
- built on earlier electricity market reforms; and
- implemented with existing technology and open to innovation.

Reform focusing on the retail market offers the greatest opportunities for problem-solving for a number of reasons. The retail side is currently the least developed part of the electricity market. Technology applicable 'behind the meter' on the retail side offers greatest opportunities for new applications and is advancing the fastest.

Allowing all consumers to choose the sustainability level of their grid electricity supply is already possible today. The technology to allow customers to choose the reliability level of their service already exists. Customers choosing 'as available' power at a lower cost would make demand more price-responsive.

If a retail market reform approach were to be pursued in the NEM, retailers could offer customers products providing a choice of 'on-demand' or 'as available' power combined with customer preference for the share of renewable energy or other sources. The tariff structures would reflect the underlying costs of each retail product.

This recommendation could reduce the apparently intractable problems in the NEM, and may be the next logical step in the development of the electricity market.

The reforms recommended in this paper would build on the competitive wholesale and retail electricity market reforms of the past 25 years. Beyond addressing the immediate problems confronting the NEM, they would facilitate innovation and optimize the use of new technologies. As Finkel defines it, "innovation involves the introduction of new products, processes and business models."

February 2017

About the Author

Stephen Wilson *is Managing Director of Cape Otway Associates, which provides commercial and policy advisory services on energy and resources, economic analysis and strategy. An energy economist, he has 25 years of experience advising companies, banks, regulators and governments in Europe, Asia, Africa and Australia, on electricity and gas. Stephen has worked along the value chain from primary resource extraction through generation and transmission to energy efficiency and demand management, including regulation and electricity market design issues.*