

July 2018

Mostly Working Australia's wholesale electricity market

Tony Wood and David Blowers



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Grattan Institute Report No. 2018-08, June 2018

This report was written by Tony Wood, Grattan Institute Energy Program Director, David Blowers, Grattan Institute Energy Fellow, and Lucy Percival, Grattan Institute Associate.

We would like to thank the members of Grattan Institute's Energy Reference Group for their helpful comments, as well as numerous government and industry participants and officials for their input.

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This report may be cited as: Wood, T., Blowers, D., and Percival, L. (2018). *Mostly working: Australia's wholesale electricity market*. Grattan Institute.

ISBN: 978-0-6482307-9-3

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Overview

Wholesale electricity prices rose across Australia's National Electricity Market (NEM) by 130 per cent between 2015 and 2017. The value of electricity traded in the NEM more than doubled, from about \$8 billion to \$18 billion. Household bills increased by up to 20 per cent in 2017 alone. Consumers are not happy, and politicians are under pressure to fix the problem. But fixes are either non-existent or complicated.

Three issues caused the price increases. First, two big, old, coal-fired power stations closed (Northern in South Australia in 2016 and Hazelwood in Victoria in 2017). Although they were low-cost to operate, they faced big maintenance bills that weren't worth paying given low market prices as a result of historic oversupply. Their closure reduced supply and pushed prices up. This accounts for about 60 per cent, or \$6 billion, of the increase in the value of electricity traded annually in the NEM between 2015 and 2017.

Second, the price of key inputs, especially gas and black coal, rose just when the plants they fuel were needed more often. This accounts for up to 40 per cent of the price increase between 2015 and 2017.

Both these issues are largely beyond the control of governments. In both cases, the market responded efficiently to the changing circumstances. Prices have increased to levels that are expected in the long run, closer to the long-run marginal costs of generation including construction and maintenance costs. But prices have not gone so high as to attract much additional investment in the system, beyond the additional supply from subsidised renewables schemes.

The third issue is that generators 'game' the system: they use their power in concentrated markets to create artificial scarcity of supply and so force prices up. Supply in all NEM states (Queensland, NSW, Victoria, South Australia and Tasmania) is concentrated, so a single outage, plant closure or transmission constraint can lead to a supplier

having a high level of transient market power. In these circumstances, generators can temporarily force prices up.

Gaming has occurred in Queensland and South Australia, there are signs of it in Victoria since the closure of Hazelwood, and it could appear in NSW as supply tightens with the scheduled closure of the Liddell coal-fired power station in 2022. Gaming has been a part of the market for years and appears to be permitted by the current market rules. It is notoriously hard to identify, but it may add as much as \$800 million to the price paid for electricity traded in the NEM in some years.

We draw three conclusions from this analysis. First, wholesale prices are very unlikely to return to previous levels of around \$50 per megawatt hour. Over-supply, as a result of historic over-building, is disappearing, and gas prices will stay higher than they were in the past. And new generators, using any technology, including coal, cost more. Additional, subsidised renewable supply could put some downward pressure on prices, but this will be transitory because the 'intermittency' of wind and solar energy will ultimately have to be paid for. This is not good news, but politicians should be honest with consumers about the harsh truth: higher wholesale electricity prices are the new normal.

Second, governments and the market operator should consider additional changes to the bidding rules to reduce gaming. But more drastic actions, such as lowering the cap on wholesale prices or intervening in the market to break up private energy companies, should be rejected because they are likely to create bigger problems.

And third, governments must provide stable energy and climate-change policy so there are clear incentives to invest when supply tightens and prices rise. Australian households and businesses could then get low-cost, high-reliability, and low-emissions electricity.

Recommendations

Recommendation 1: Facilitate investment by providing stable policy

The federal Government – with the states – should provide bipartisan, credible energy and climate-change policy to underpin new investment in the NEM. The National Energy Guarantee would help, and should be endorsed. Government intervention in the market, actual or threatened, should be unnecessary.

Recommendation 2: Ease input cost pressures

State governments should fully implement the recommendations of the ACCC's *East Coast Gas Inquiry* from 2016. These include lifting the current moratoria on gas exploration and instead considering gas development projects on a case-by-case basis.

Recommendation 3: Be honest with consumers about prices

Federal and state politicians should be honest about the likelihood that higher wholesale prices are the new normal, and that intervention to keep ageing legacy assets is a poor long-term solution. Instead

governments should keep pressure on other parts of the electricity bill – such as retail and networks.

Recommendation 4: Stop price gaming

The Australian Energy Market Commission (AEMC) should change market rules to address 'gaming' that results in artificial price spikes. AEMC should reconsider a gate-closure mechanism to eliminate inefficient late rebidding.

Recommendation 5: Monitor market concentration

The ACCC should use its existing powers to continue monitoring the impact of vertical and horizontal integration on electricity market outcomes. The federal Government should not introduce legislation to give the ACCC powers to break up private generation companies and should not reduce the cap on wholesale prices. The AEMC should continue to investigate more fundamental changes to the NEM – such as a pivotal supplier rule, a day-ahead market, and demand-response mechanisms – to ensure reliable, low-cost and low-emissions supply into the future.

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1 Wholesale electricity prices have increased dramatically

Wholesale electricity prices have more than doubled across Australia's National Electricity Market (NEM) since 2015, from between \$30 and \$50 a megawatt hour then to between \$80 and \$100 a megawatt hour now. Increased wholesale prices have inevitably flowed through to consumers: residential electricity bills have increased by up to 20 per cent. Wholesale electricity prices have fallen slightly in 2018, but remain well above the lows of 2015.¹

The increase in wholesale prices has increased revenue for electricity generation companies. The total value of electricity traded annually in the NEM has also more than doubled, from about \$8 billion in 2015 to \$18 billion in 2017.² While about \$4 billion of this increased revenue was needed to pay for increased fuel costs, the remaining \$6 billion appears to have flowed to generators. Although all electricity is traded in the NEM, generators' final revenues would have been determined by their contracted positions. This report looks at why wholesale electricity prices have risen and what might be done about it.³

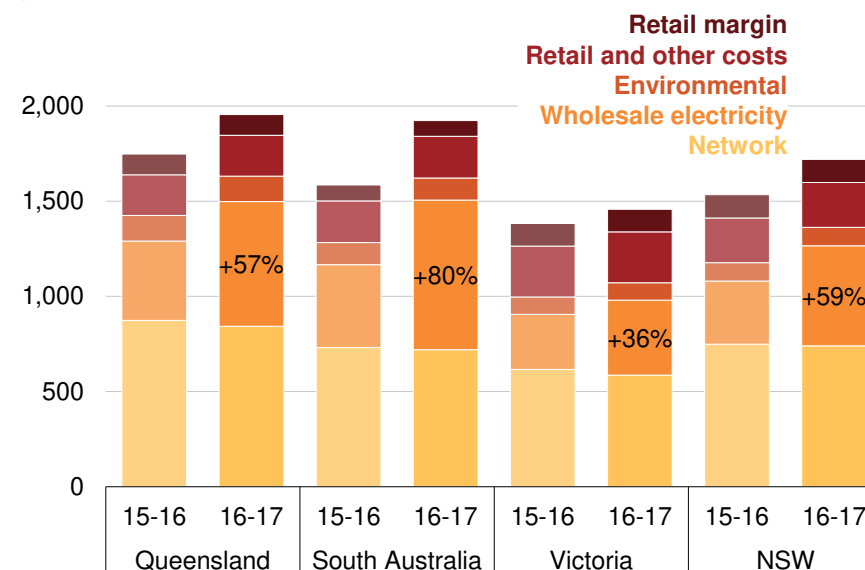
1.1 Rising wholesale costs are increasing household bills

Wholesale electricity costs – what generators are paid for the electricity they produce – are a big and growing component of electricity bills. In

1. The NEM was over-supplied in 2015, which suppressed prices. This is discussed in Chapter 4.
2. These values refer to semi-scheduled and scheduled generation only, which is the majority of supply in the NEM. In this report estimates of input costs and the impact of tightening supply and demand also refer only to semi-scheduled and scheduled generation. Non-scheduled generators usually have less than 30MW capacity.
3. This report will present information in either calendar years or financial years, depending on the most recent information available. For example, 2017 refers to calendar year 2017, while 2016–17 refers to the financial year commencing 1 July 2016.

Figure 1.1: Wholesale electricity costs are a rising share of the average household bill

Estimated contribution to residential customers' annual electricity costs, \$ 2015–16



Notes: Tasmania, the other state in the NEM, is excluded from charts where data are unavailable. The wholesale electricity component of the household bill reflects household usage and retailer-generator contracts in each state. Some states use less electricity, and more gas, and have lower wholesale electricity costs.

Source: Grattan analysis of ACCC (2017).

2015–16, wholesale costs accounted for 22 per cent of a households' electricity bill, an average of \$341 per household per year.⁴ While significant, the wholesale component of the bill was far smaller than network costs, which accounted for 48 per cent of the average bill at \$724.

But a significant shift occurred in the following 12 months. In 2016–17, the wholesale component of the average bill is estimated to have increased to \$530, or 31 per cent of the bill.⁵ As Figure 1.1 on the preceding page shows, this increase in wholesale costs was the main reason that electricity bills increased between 2015–16 and 2016–17. And in South Australia, the wholesale component became the largest component of household electricity bills, costing the average South Australian household more than \$700 a year.

And greater price rises were to come. On 1 July 2017, electricity retailers in South Australia and New South Wales increased household prices by up to 20 per cent.⁶ Victorian retailers followed suit in January 2018, with retailers citing increasing wholesale costs as the reason for price increases of between 10 and 15 per cent.⁷

It has been no different for businesses. The wholesale component for commercial and industrial customers increased by more than 50 per cent between 2015–16 and 2016–17.⁸

1.2 Wholesale electricity prices have increased dramatically

Wholesale costs for consumers have increased because prices in the wholesale spot market have increased. The wholesale spot market is

4. ACCC (2017).

5. Ibid.

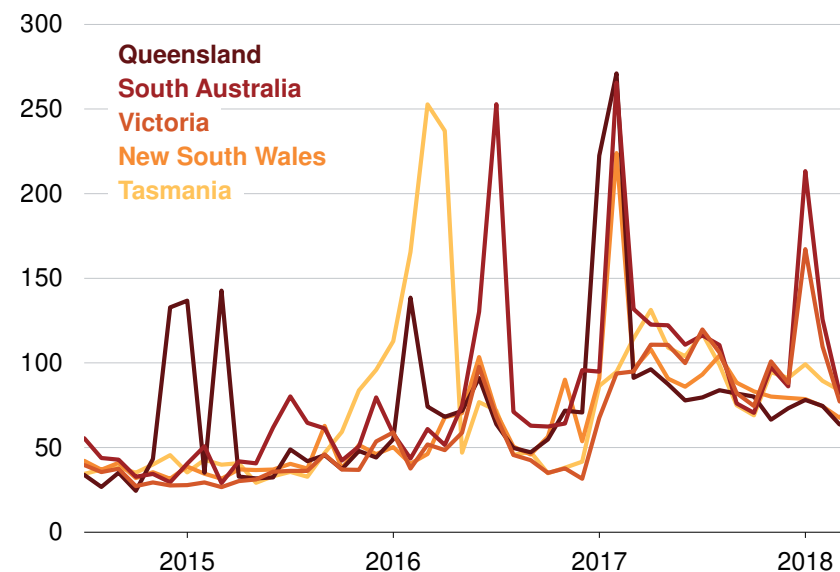
6. Harmsen (2017).

7. Johnston (2017).

8. The wholesale component for commercial and industrial customers was 5.0c per kilowatt hour in 2015–16 and an estimated 7.7c per kilowatt hour in 2017–18 (ACCC (2017)).

Figure 1.2: Spot market wholesale electricity prices have doubled

Monthly spot price, weighted-average \$ per megawatt hour, July 2014 to April 2018



Notes: The weighted-average price used in this report is half-hour settlement prices weighted by energy demand. This is higher than the simple average of half-hour settlement prices. It also reflects the amount generators get paid and consumers pay. Most consumers use more electricity when prices are higher in peak times. The amount consumers pay reflects the demand-weighted average rather than the simple average. Nominal values.

Source: Grattan analysis of AEMO (2018a).

the means by which electricity is traded. Generators sell their electricity to retailers, who then sell that electricity on to consumers.

The NEM is a series of loosely connected wholesale electricity markets that facilitate the exchange of electricity between generators and consumers in eastern and southern Australia.⁹ In the NEM all electricity must be sold through the spot market and all electricity is sold at the spot price, although hedge contracts change how much retailers and large customers actually pay and generators receive.¹⁰

The wholesale spot price for electricity has increased dramatically over the past three years. In 2014–15 – the financial year immediately following the repeal of the carbon tax – electricity prices in NEM states (except Queensland) averaged below \$50 a megawatt hour.¹¹

But after this period, as Figure 1.2 on the previous page shows, spot prices began to rise. In 2015–16 prices in all states except Victoria averaged above \$50 a megawatt hour.¹²

In July 2016, prices spiked in South Australia because of reduced supply: the combination of the recent closure of Northern power station, low levels of wind generation, and maintenance on the interconnector

with Victoria, resulted in average prices for July jumping above \$200 a megawatt hour.¹³

Prices continued to rise in 2017, across all states in the NEM. During 2017, monthly wholesale prices were regularly near or above \$100 a megawatt hour. The result was that – with the exception of Queensland – wholesale spot prices doubled over a two-year period. Prices have fallen since their 2017 peaks, but remain well above the sub-\$50 a megawatt hour prices seen in 2014–15.

1.3 Generators' spot revenue has increased massively

In 2015, generators in the NEM received an average of \$45 for every megawatt hour that they produced. Just two years later, that figure had shot up to \$102, as shown in Figure 1.3 on the following page.¹⁴

The total value of electricity traded through the NEM increased from approximately \$8 billion in 2015, to \$18 billion in 2017.¹⁵ Prices in the first half of 2018 have been lower than in the first half of 2017, so it is likely that the total value traded in the NEM will also be lower in 2018 – but still far higher than the total value traded during 2015.

There are two main reasons for this increase. First, the cost of producing electricity has gone up because of increasing generator-fuel costs and more generation from higher-cost generators. Figure 1.3 on the next page shows that rising input costs – fuel costs and the shift to

9. The NEM has five regions with separate wholesale prices (Queensland, NSW and the ACT, Victoria, South Australia, and Tasmania), but electricity can be imported and exported between regions via long-distance transmission lines known as 'interconnectors'.

10. These contracts that determine the net amount that buyers (retailers and large businesses) pay for electricity and that generators receive for the electricity they produce. This means that, in the short run, the cost of purchasing electricity may not reflect the spot market price. But because the prices in these contracts are linked to long-term price outcomes in the wholesale spot market, the total value of electricity traded through the NEM acts as a decent proxy.

11. The average spot price for Queensland was \$53 a megawatt hour, AEMO (2018a).

12. This report uses nominal prices unless otherwise noted. Change in real price is slightly less than change in nominal price.

13. Wood et al. (2016).

14. Estimate of value traded in the NEM and price per megawatt is for scheduled and semi-scheduled generation only. Most of the generation in the NEM is scheduled and semi-scheduled.

15. All electricity generation is traded through the NEM, which matches the supply of electricity to demand through a centralised process. The level of demand, and the availability of supply in each of the five regions of the NEM, determines prices in those regions. Generators bid into the market to provide electricity for each five-minute interval of every day.

more expensive fuel types – directly accounts for up to 40 per cent or \$4 billion of the increase in the two years from 2015.¹⁶

Second, the supply-and-demand balance has changed because of the closure of power stations. Less supply in the market has forced up prices. Figure 1.3 shows this accounts for more than 60 per cent of the increase in spot prices.

There is also a third reason. About \$250 million was added because of increased 'gaming' – bidding behaviour that is driving inefficient outcomes in the market. Some generators are able to take advantage of conditions in the market and, through their behaviour, drive prices up. While 'gaming' accounts for less than 3 per cent of the total increase in the two years from 2015, such behaviour may add as much as \$800 million to the value of traded electricity in the NEM in some years. And it may become an increasing issue in the future if there is further tightening of supply and increased concentration.

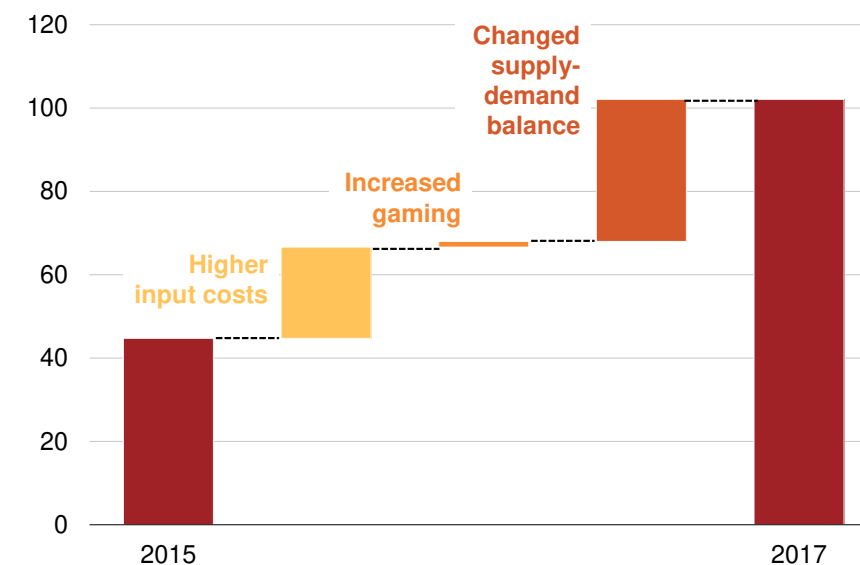
The increase due to the supply-demand balance – \$6 billion – provides an estimate for the additional revenue for generators since 2015. The exact amount that generators earn is determined by the price and quantity of their supply that is covered by hedge contracts. All electricity must be traded through the NEM, but most of it is covered by hedge contracts.

An additional \$6 billion over two years sounds like a lot of money being earned by the owners of power stations in the NEM. But, for the most

16. As brown coal generators exited, more generation was supplied by higher-cost black coal and gas power stations. The estimated increase in fuel costs for coal power stations is based on low-cost legacy coal contracts in 2015 and the export price for coal in 2017. Not all generators will have had such a low input cost in 2015, and generators may have contracts discounted from the export spot price in 2017. However, it is likely that a number of generators transitioned off legacy contracts during this time. Input costs rose by \$2.7 billion, using the higher export price of coal as the base in 2015. The ACCC inquiry into Retail Electricity Pricing is expected to provide greater insight into generators' input costs.

Figure 1.3: Higher input costs directly explain less than half of the rise in wholesale prices

Generator spot price revenue, \$ per megawatt hour



Notes: Price is for scheduled generation only and estimates input costs based on publicly available data. Input costs for black-coal generators based on estimated legacy contract prices in 2015 and quarterly Newcastle Thermal Coal prices in 2017. Input costs for gas generators based on the wholesale gas spot price. Short-run marginal cost estimated at a generator level based on reported thermal efficiency, plus variable operating costs. Input costs for other generators based on CPI increase above revenue in 2015. 'Gaming' cost is the increase in estimated gaming costs in the NEM between 2015 and 2017, see Chapter 3. Supply-demand balance is the residual increase in prices. All values are nominal unless specified otherwise.

Sources: Grattan analysis of ACIL Tasman (2009), McConnell et al. (2018), AEMO (2018a), WorldBank (2018), Origin Energy Limited (2011) and AER (2018a).

part, it has been a result of the market responding to two shocks: gas and black-coal price increases, and the closure of power stations.¹⁷ It reflects the market acting efficiently to provide the cheapest energy available given rising costs and falling supply. This does not necessarily mean that the market is short of supply. The market was previously oversupplied, which is reflected in past prices lower than the long-run cost of building new generation.

1.4 High prices are the new normal

These three phenomena – tightening supply, increased input costs and generator behaviour – explain why wholesale electricity prices have increased. It follows that additional investment in generation, or a reduction in gas and black-coal prices, could bring wholesale prices down.

But it is likely that wholesale prices will remain above historical levels, because Australia's electricity market is undergoing a transition and much new generation capacity will be needed. Wholesale prices will need to be high enough to cover the costs of building all this new generation.

Chapter 2 of this report shows why high wholesale prices can be a sign that the market is functioning efficiently. High prices can reflect higher input costs and signal the need for new generation.

Chapter 3 provides evidence of bidding behaviour increasing prices in the NEM. It identifies where this behaviour is consistent with the way the market is intended to work, and where it is not.

Chapter 4 discusses the circumstance behind historical low wholesale prices in the NEM, and why prices are likely to remain above historical levels in the future.

Chapter 5 outlines what, if anything, government should do to put downward pressure on wholesale electricity prices.

17. An efficient market with over-supply and low input costs will deliver low prices. When both change the efficient market delivers higher prices that reflect higher costs and provide an incentive for new supply. Policy uncertainty on climate change is a barrier to an efficient market response.

2 Higher prices are largely a result of the NEM behaving as it should ...

Higher prices are not necessarily a sign that the NEM is failing. The market has been subject to two significant shocks in the past three years that have resulted in spot prices rising. First, the costs of gas and black coal have risen, increasing the costs to produce much of the electricity generated in the NEM. And second, the closure of two large power stations has limited the supply of electricity available to meet demand.

Recent higher prices are mainly a sign of the market operating effectively in response to high costs or periods of high demand. All generators need periods of high prices to allow them to recover their long-run costs. And while there have been short periods of very high prices over the past three years, their impact on overall prices is usually limited.

2.1 Gas and black coal costs have increased

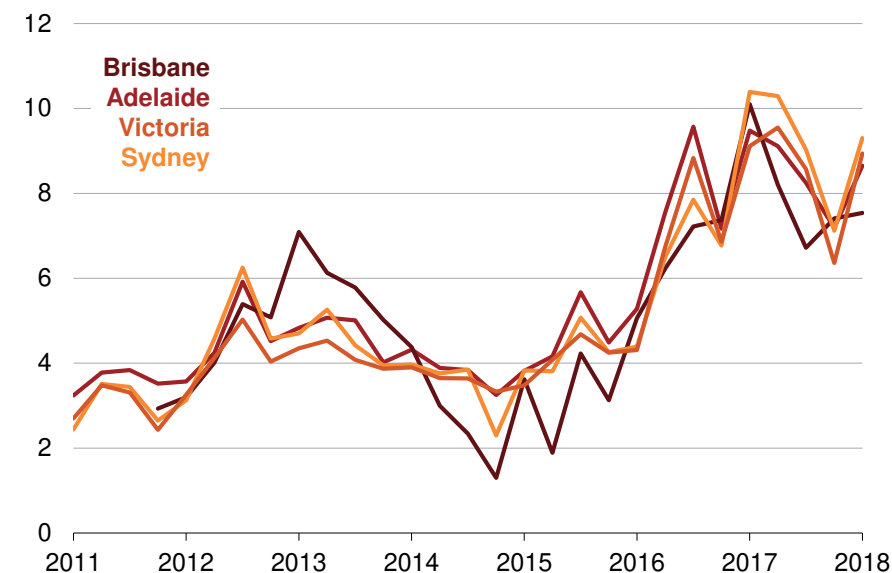
The price of gas – and to a lesser extent black coal – has gone up. As a result, wholesale electricity prices need to increase if gas generators in the NEM are to cover the cost of generating electricity.

With the advent of liquefied natural gas (LNG) export projects on Australia's east coast, the domestic price for gas has risen to compete with international prices. Gas prices are now much higher, increasing from an average of around \$4 a gigajoule at the beginning of 2015 to around \$8 to \$10 a gigajoule now, as shown in Figure 2.1.

As a result, the cost of producing electricity from an existing gas power station – the short-run marginal cost (SRMC) – has increased.¹⁸

Figure 2.2 on the next page shows how the SRMC of different gas

Figure 2.1: Wholesale gas prices have more than doubled
Quarterly weighted average wholesale gas spot market price, \$ per gigajoule



Note: Victorian gas market average daily weighted prices by quarter are shown with the average daily ex ante gas prices by quarter for each Short Term Trading Market hub (Brisbane, Sydney and Adelaide).

Sources: AER (2018a) and AER (2018b).

18. The SRMC is the cost to increase output from an existing power station by one megawatt. It largely reflects the cost of additional fuel, but includes variable

power stations have changed over time and how this aligns with changes in the wholesale market price. Over recent years wholesale prices for electricity tend to be related to the SRMC of gas-fired power stations.

The price of black coal has also gone up, from an average of \$71 per tonne in 2015–16 to about \$130 per tonne at the end of 2017.¹⁹ This equates to a change in marginal generation costs from around \$30 a megawatt hour to \$55 a megawatt hour.

2.2 An increase in the price of gas generation increases the price of *all* generation

The increase in input costs has two impacts on wholesale electricity prices.

Gas generators set their electricity prices higher to cover their higher input costs in response to an increase in the price of gas. But because of the way the NEM is designed, all generators benefit if the spot price of electricity goes up.²⁰

In the NEM, generators bid the electricity they propose to deliver into the market at different price levels.²¹ The Australian Energy Market Operator ranks all bids in order from cheapest to most expensive and dispatches the cheapest set of bids that meets the needs of the

operating and maintenance costs. This report uses data from ACIL Tasman (2009) to estimate SRMC for generators in nominal prices.

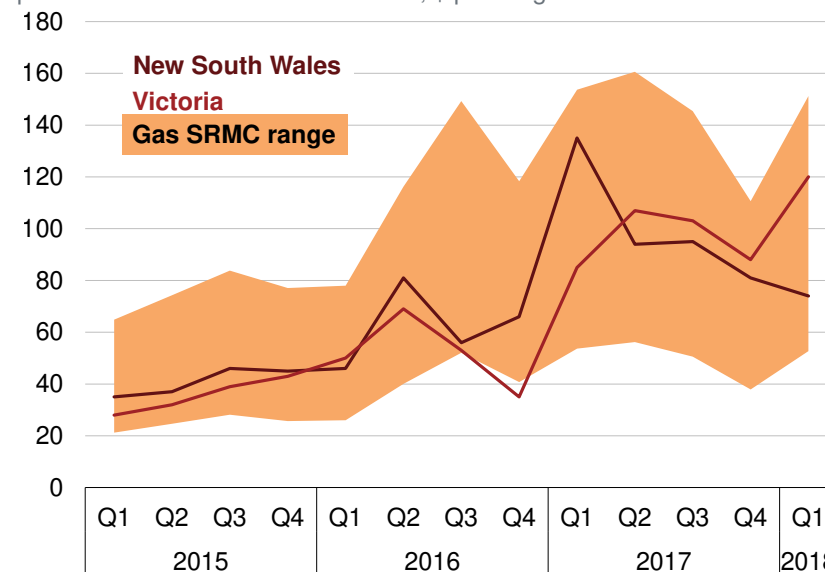
19. NSW coal-fired power stations also experienced periods of supply difficulty for coal, AER (2017a).

20. The estimated direct cost of higher fuel prices in 2017 is included in the 'input costs' increase. Additional revenue from other generators because the price setter had higher input costs is included in 'supply-demand balance' because they are in excess of input costs.

21. A generator is allowed to bid its generation into the market at a maximum of ten different prices, and can allocate a proportion of its generation against some or all of these ten price points.

Figure 2.2: Input costs are pushing up electricity prices

SRMC of gas-powered electricity; and weighted-average quarterly NEM spot price Victoria and New South Wales; \$ per megawatt hour



Note: The gas short-run marginal cost (SRMC) range represents the estimated SRMC derived from the Victorian gas spot price and variable operating costs for gas-fired power stations in the NEM.

Sources: Grattan analysis of WorldBank (2018), ACIL Tasman (2009), AER (2018a) and AER (2018c).

system. The market price is set by the last generator needed to meet demand, and all generators that dispatched electricity also get paid this price. (Box 1 on the following page explains in more detail how electricity is priced in the NEM).

The incentive is for generators to bid at their marginal cost – the cost of producing an extra unit of electricity. If they bid a higher price they risk not being dispatched and therefore not receiving any revenue. If they bid a lower price they lose money on the electricity they produce.

When a generator with high marginal costs sets the price, all other generators benefit from additional revenue. So, in 2015 when a gas generator was setting the price, all generators were getting about \$50 a megawatt hour. But in 2017, after gas costs had increased, when a gas generator was setting the price, all generators were receiving about \$100 a megawatt hour even if their own costs had not increased (see Figure 2.2 on the preceding page).

So increasing black coal and gas prices means that, whenever coal or gas power stations are the price-setting generator, the revenue of all generators goes up.

This is the market working as it should. Generators have an incentive to bid at their marginal cost. But if the price they received was only equivalent to their bid (that is, their marginal cost), they would not earn sufficient revenue to recover the fixed costs. If generators are to be financially viable, the market needs to provide periods when they can earn above their marginal cost.

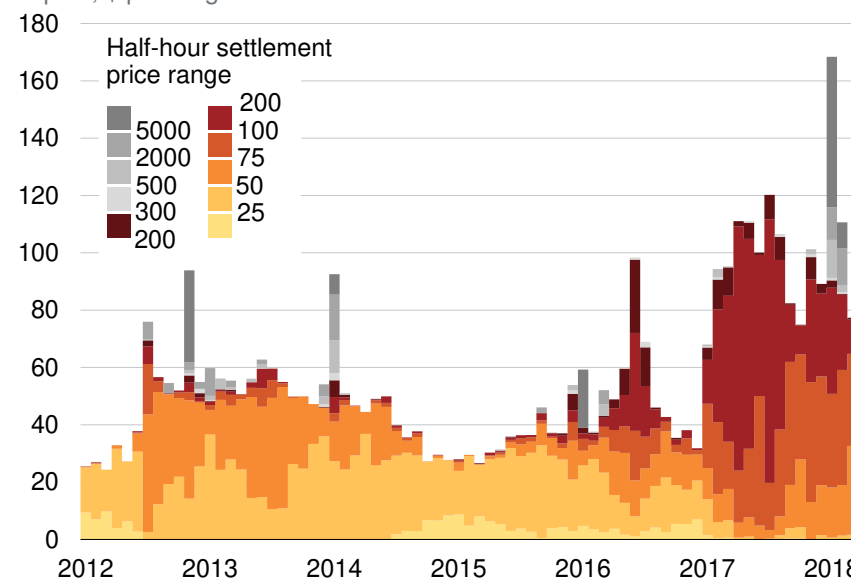
2.2.1 'Shadowing' behaviour

The increase in gas prices reduces the ability of gas generation to constrain the bidding behaviour of coal generators.²² In the merit order,

22. Increased prices in 2017 due to shadowing are included in the 'supply-demand balance' increase because they are in excess of input costs.

Figure 2.3: It's not extreme prices pushing up the average price in Victoria

Monthly average wholesale price by proportional half-hour settlement price impact, \$ per megawatt hour



Notes: The height of each bar represents the cost-range contribution to the average monthly wholesale cost, not the frequency of the cost-range for half-hour settlement prices. So grey sections represent infrequent periods of high cost which have a large proportional impact on the monthly average. Nominal prices.

Source: Grattan analysis of AEMO (2018a).

Box 1: How electricity is priced in the NEM

Electricity generation (supply) and consumption (demand) must constantly be matched to ensure consumers have continuous, reliable electricity. The market operator does this by aligning generators' offers to supply electricity with system demand every five minutes – the dispatch interval. Generators get paid for the total amount of electricity they produce in half-hour blocks – the settlement period.

Generators make offers to supply electricity for each of the 48 half-hour settlement periods in a day. They set their prices anywhere between the market floor (–\$1,000 per megawatt hour) and the market cap (\$14,200 per megawatt hour). These bids are sent to the the Australian Energy Market Operator (AEMO) – the body responsible for managing the NEM – by 12.30pm the day before. A generator's bid consists of 10 price points they set for the day, and for each half hour they nominate the amount of energy they are willing to supply for each of those price levels. The bids are then stacked according to price – the 'merit order'.

AEMO then dispatches this generation, from cheapest first, to meet demand during every five-minute dispatch interval. The dispatch price of electricity for the five-minute interval is determined by the cost of the last unit of electricity dispatched to meet demand.

However, this five-minute dispatch price is not what generators receive. Any electricity produced during that 30-minute period is paid the average of the six five-minute dispatch prices in the settlement period. The price also determines what wholesale market customers – electricity retailers and large industrial businesses – pay for the electricity they consume from the pool during this period.

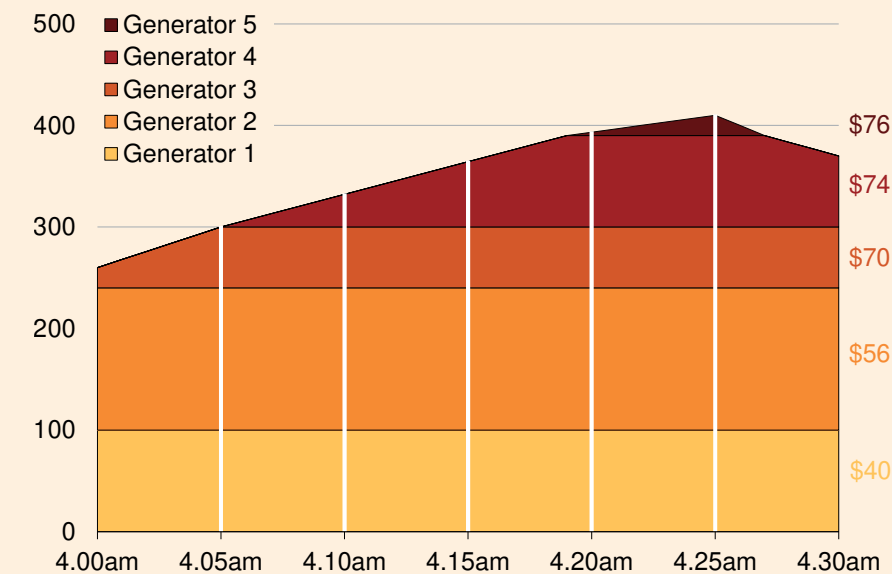
Figure 2.4 provides a simplified example of pricing during a 30-minute period. At 4.05am, demand is 300 megawatts. Generators 1, 2 and 3 are required to be fully dispatched to meet this demand. The dispatch price is \$70 per megawatt hour. Generators 1 and 2 bid into the market

at \$40 and \$56 respectively. Generator 3, because it provides the last unit of electricity dispatched to meet demand, sets the price. This process is repeated throughout the 30-minute period. But \$70 is not the amount Generators 1, 2 and 3 receive for the electricity they generate during that five-minute period. Instead, they are paid the average of the six dispatch prices (\$70 plus \$74 plus \$74 plus \$76 plus \$76 plus \$74 per megawatt hour divided by six, or \$74 per megawatt hour).

It is the merit order that enables generators to make money and recover their fixed costs. Generator 1 receives significantly more than the \$40 per megawatt hour it bid.

Figure 2.4: The merit order

Output dispatched to meet demand, megawatts



Source: Reproduced from AEMO (2010).

gas is normally dispatched after coal because of its higher marginal cost. This means the highest-cost coal generator can bid just less than the marginal cost of the lowest-cost gas plant and be guaranteed to be dispatched.²³ When the price of gas increases, coal plants can increase their bids – and receive higher prices – accordingly.

Combined with an increase in input costs, this explains some of the change in prices in the NEM over the past few years. Figure 2.3 on page 15 shows that in 2015, most half-hour periods settled at prices between \$25 and \$50. Prices are now more likely to be between \$75 and \$200.

The Australian Energy Regulator (AER) confirmed this in its report on the NSW electricity market at the end of 2017. Its analysis of individual generator behaviour showed capacity that was previously being offered at between \$0 to \$30 was being offered to the market at far higher prices in 2017.²⁴

It is difficult to distinguish the impacts of ‘shadowing’ behaviour from the impacts of input-cost increases.²⁵ But such shadowing behaviour is not illegal; it is the market behaving as it should. If generators are able to earn higher profits through shadowing behaviour, it can create market signals for investment in new generation.

But it is not clear that current prices or revenue in the market are sufficient to encourage new generation.²⁶ And there is not yet a

23. A generator's profit-maximising bid will depend on their level of output, and the price, and their costs. Coal power stations still have incentives to bid closer to their marginal cost if a higher bid would reduce their profit because AEMO would schedule less supply from them.

24. AER (2017a).

25. Some generators, especially hydro, may also use shadowing to manage their fuel stocks for periods of higher demand. This ensures they can supply during higher demand intervals and mitigates high prices in those times.

26. Uncertain climate change policy is a barrier to new investment in either high- or low-emitting technologies.

shortage of generation capacity, although this may change after the Liddell power station closes in 2022. All major generation companies in Australia are moving away from coal.²⁷ To build a new coal plant, investors would require expected future revenues over at least a 40-year period to cover the initial investment and operating costs. But uncertain, future constraints on generation with high carbon emissions will reduce expected future revenues for coal and deter investors. Yet the price of alternatives – gas or renewables generation with batteries or pumped hydro – is currently higher than the market expects future prices will be.²⁸ This matter is discussed in more detail in Chapter 4.

2.3 The exit of Northern and Hazelwood

The closure of the Northern power station in South Australia in May 2016, and the Hazelwood power station in Victoria in March 2017, removed more than 2000 megawatts of capacity from the market over a very short period.²⁹ The closure of both brown-coal power stations reduced the supply of low-marginal cost electricity generation directly from the South Australian and Victorian markets. It also reduced the amount of low-cost supply that could be provided to NSW and Tasmania through their interconnectors with Victoria.

Alternative supply has been needed, and it has mainly come from existing higher-cost generation. In South Australia, gas increased from 39.4 per cent of all electricity generated to 59.6 per cent in 2017.³⁰ In Victoria, gas increased from just over 1.5 per cent of all generation to 7

27. Priftakis (2017).

28. To date, new investment has needed the support of mandated subsidies.

29. Alinta initially announced in June 2015 that Northern would close by March 2018. In October 2015, the closure was bought forward to March 2016. The power station finally closed in May 2016. Engie announced the closure of Hazelwood on 3 November 2016.

30. Tran and Kitchen (2018).

per cent – although its usage fell again at the start of 2018.³¹ Figure 2.3 on page 15 clearly shows the result for Victoria.

Immediately before Hazelwood closed, Victoria was a net exporter of electricity to NSW. Now Victoria is exporting less and importing more, and generally at a higher price than was available when Hazelwood was in operation.

The combined impact of closures and higher input costs is also shown for South Australia in Figure 2.5. The supply curve has shifted since the closure of Northern and Hazelwood.³² The curve has shifted left as a result of the reduction in available generation. The uptick in the supply curve now occurs at lower levels of demand. For example, in South Australia, the point at which high price events start to occur is now at 1800 megawatts, whereas previously it had been at above 2000 megawatts. And the supply curve has shifted upwards, reflecting an increase in input costs and shadowing behaviour. However some of this difference can be attributed to overcapacity suppressing prices in 2015. So even at low levels of demand, the price paid for generation is a lot higher than previously.³³

2.4 Increased revenues do not necessarily mean increased profits

The total value of electricity traded annually in the NEM increased by about \$10 billion between 2015 and 2017. But that does not necessarily mean electricity generators are earning super-normal profits:

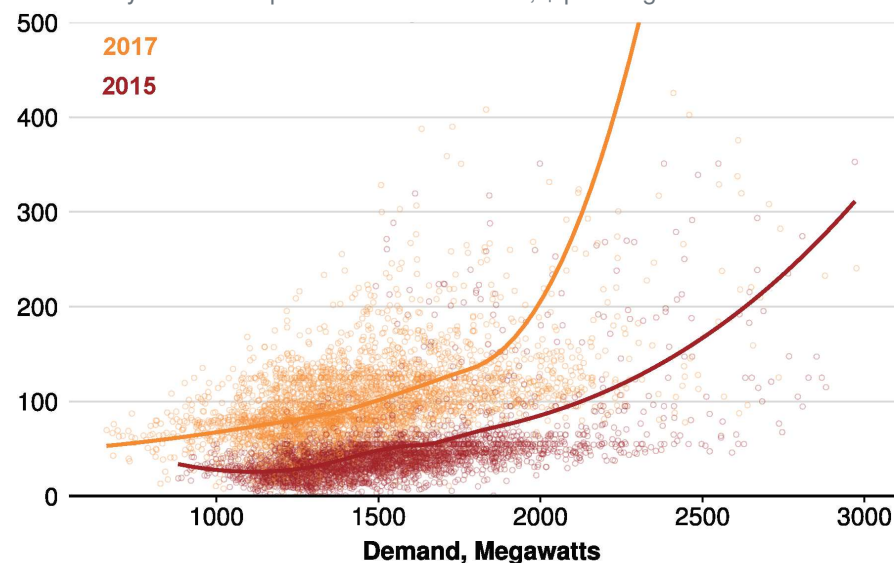
31. AEMO (2018b).

32. Appendix A contains the state-specific charts for each state. The charts that best illustrate each section have been presented in the report.

33. Engie's Pelican Point gas-fired power station's second unit returned to operation in 2017 after being mothballed in 2015. This increased capacity in SA, but at a higher marginal cost per megawatt hour than the exiting Northern power station, Macdonald-Smith (2017).

Figure 2.5: Supply curves have moved up and left in South Australia as input costs rose and generators closed

Half-hourly settlement price in South Australia, \$ per megawatt hour



Notes: The faint circles represent the settlement price and demand for each half hour in that 12-month period. The lines are the average of all these half-hour settlement periods, or the 'supply curves'.

Source: Grattan analysis of AEMO (2018a).

- Value traded in the market does not equate to revenue. Much of a generator's revenue derives from prices agreed in the hedge contracts they sign.³⁴ While these prices are linked to outcomes in the wholesale spot market, they are not the same thing. So generators may receive less revenue than market spot-price outcomes suggest.
- Revenue needs to cover all costs, not just short-run marginal costs. Generators have a range of costs, beyond the day-to-day production of electricity: maintenance costs, fixed operating costs, and long-term costs related to the building of the power station in the first place.
- Revenue in 2015 may have been particularly low. The closure of Northern in 2016 and Hazelwood in 2017 suggests that revenue in the market was not sufficient to cover the long-run costs of running those plants.³⁵ Revenue had to increase if power stations were to remain financially viable.

So far, these increased revenues have not been reflected in unusually high profits. Figure 2.6 shows the profits of the two biggest generation companies in Australia: Origin Energy and AGL.³⁶ While they both increased profit margins in 2016–17, their profits are not particularly high, relative to the ASX 200 median or their historical profit levels.³⁷

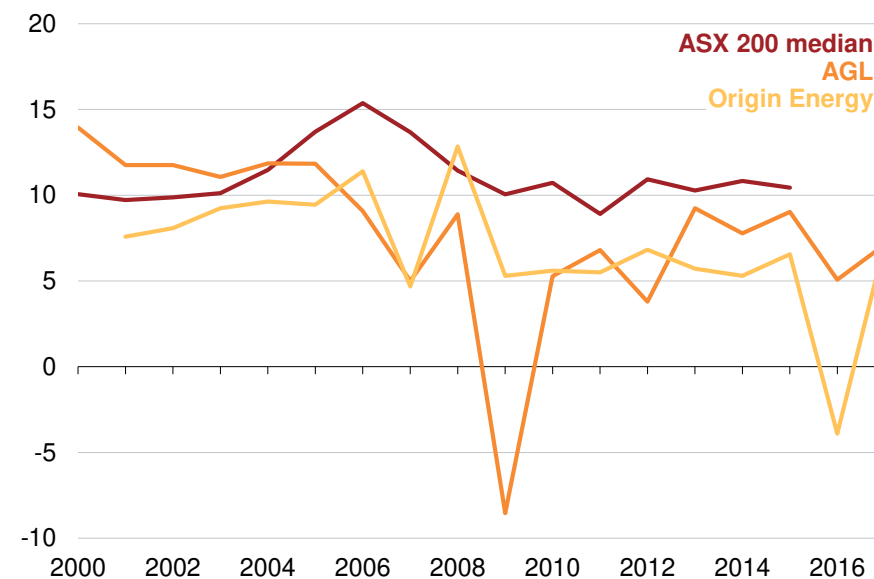
34. Wood et al. (2017a).

35. Nelson et al. (2015); and Potter (2017).

36. 2017–18 financial results are not yet available. AGL's interim results are higher than their historical average, and Origin Energy's interim results are slightly higher than in most previous years. Estimated full-year profit results are 8.87% ROE for Origin and 12.9% ROE for AGL, 4-traders (2017a) and 4-traders (2017b). ROE for a single year can vary due to a variety of reasons.

37. AGL and Origin have a variety of revenue streams other than generation. 'Profit' in Figure 2.6 includes any profits or losses made by their other business streams, including gas and retail energy markets. 2017–18 financial results are not yet available.

Figure 2.6: Higher prices have not resulted in unusually high profits yet
Return on equity



Notes: ASX 200 firms excluding foreign-headquartered firms, and mining and metals companies. Financial years.

Source: Grattan analysis of Morningstar (2017).

Because these generators are also retailers, their overall profits depend on how much of the higher wholesale price they pass on to consumers.³⁸

2.5 High-price events usually have limited impact on average prices

High-price events have generated significant media scrutiny in recent years.³⁹ When the wholesale price hits the market price cap – \$14,200 per megawatt hour – it creates headlines. But high-price events rarely have a big effect on average prices and, therefore, on how much revenue generators earn. And occasional high prices are the market working normally – they reflect supply scarcity, ensure generators can cover long-run marginal costs, and can be a signal for new investment.

Most of the time wholesale electricity prices are fairly stable, despite fluctuating demand.⁴⁰ Prices rarely exceed \$200 per megawatt hour, but when this happens it can have a big impact on average prices. Figure 2.5 on page 18 shows that above 1,800 megawatts demand in South Australia, the supply curve rises sharply. This change is heavily influenced by a small number of half hours where the price was above \$500 (and which are not visible in the chart). These are effectively ‘scarcity’ periods – periods of tight supply where prices are set far above marginal cost.

Periods of scarcity pricing reflect the market operating normally. High marginal-cost generators rely on scarcity pricing – infrequent periods when they can set the price high enough to recover their fixed costs.⁴¹

38. See Box 2 on page 22 for more about vertical integration.

39. Potter (2016).

40. Despite big variations in demand, more than 95 per cent of the time between May 2017 and April 2018 prices were below \$150 per megawatt hour across all NEM regions.

41. Scarcity pricing is not the same as exercising market power. Scarcity pricing occurs only during periods of tight supply when the marginal generator is the final

All generators benefit from additional revenue during scarcity periods. Energy-only markets rely on high prices during times of scarcity to prompt new investment (or to bring back mothballed capacity). The size and duration of high prices provides a signal to the market, not just for more supply, but also for the kind of generation that is most needed.

Most months there are few high-price events and they don't have much impact on average prices. Historically, in NSW and Victoria high-price events have only infrequently had an impact on the average monthly wholesale price. However, high-price events had an unusually big impact in Victoria in early 2018. Queensland has more often had high average prices because of infrequent extreme prices.⁴² And in South Australia, high-price events have relatively frequently had an impact, and more so since 2016.⁴³

Victoria had an unusually large number of high-price events in the summer of 2017–18. In January and February 2018 half-hour periods with a settlement price over \$500 per megawatt hour had a big impact on the monthly average price (see Figure 2.7 on the next page). In January the monthly average price was \$168 per megawatt hour, much higher than in recent years. Excluding high-price events, the price would have been less than \$100 per megawatt hour. Although there have been high-priced events in the past in Victoria, they have generally been infrequent since 2011.

Historically, Queensland has suffered more from high-price events than Victoria. But in 2017–18, Queensland had its lowest average summer spot prices since 2012, as Figure 2.8 on the following page shows.

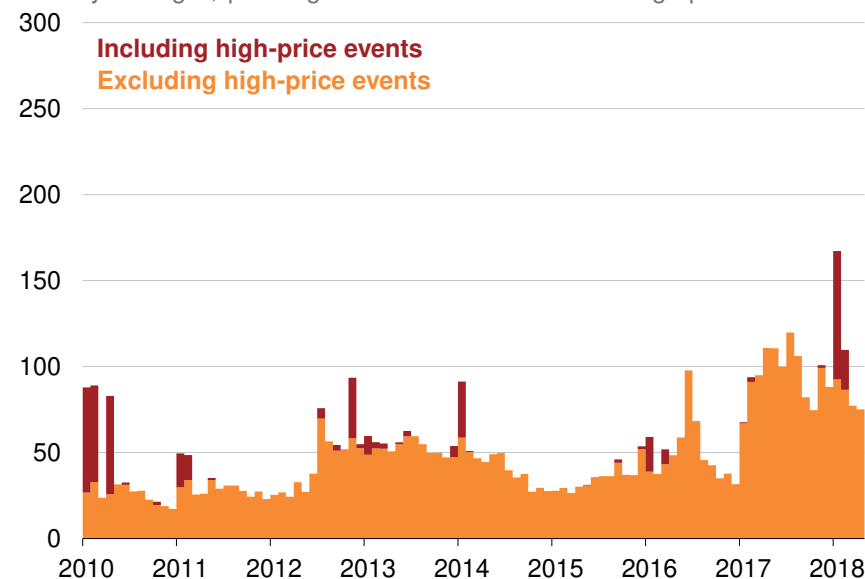
generator available to be dispatched. Exercising market power means artificially increasing prices through behaviour to increase revenue.

42. In this report a high-price event is when the half-hour settlement price is at least \$500.

43. Charts showing the impact of high-price events on NSW and SA can be seen in Appendix A.

Figure 2.7: Infrequent high-price events can have a big impact on average prices in Victoria

Monthly average \$ per megawatt hour with and without high-price events

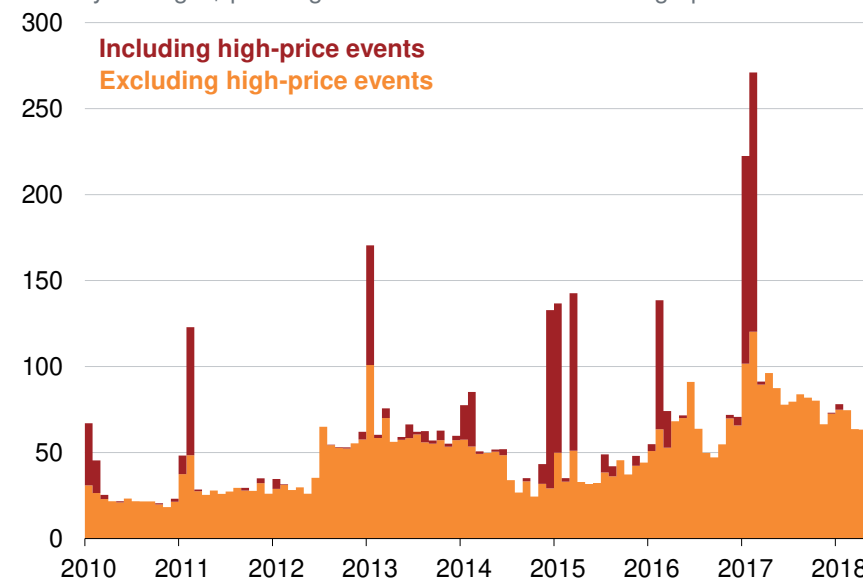


Notes: High-price events are those half-hour settlement periods where the settlement price was \$500 or more. Nominal prices.

Source: Grattan analysis of AEMO (2018a).

Figure 2.8: Queensland was much more affected by high-price events until mid-2017

Monthly average \$ per megawatt hour with and without high-price events



Notes: High-price events are those half-hour settlement periods where the settlement price was \$500 or more. Nominal prices.

Source: Grattan analysis of AEMO (ibid.).

Queensland had almost no high-priced events, despite 2017–18 being Queensland's second-hottest summer on record.⁴⁴

The increasing number of scarcity pricing events in Victoria appears, in part, to be an accurate reflection of genuine scarcity in the market. AEMO's Electricity Statement of Opportunities shows that Victoria was at risk of having a supply shortage over the summer of 2017–18.⁴⁵ A tight supply situation is likely to increase the number of periods where high marginal cost generators can set the price in the market. This is the market working normally.

However, no such risk was identified in Queensland over the summer of 2016–17, despite high-price events having a significant impact on overall prices.⁴⁶ Alternative explanations of these high-price events are discussed in Chapter 3.

2.6 Vertical integration

In addition to a concentrated generation sector, the NEM also has high levels of 'vertical integration' – a single company owning both generation and retail businesses, as described in Box 2. This structure can adversely affect competition. It is an issue that has been raised in the design of the National Energy Guarantee.⁴⁷

The limited analysis in this report has not identified any adverse impacts on the wholesale market, although the final report of the ACCC's *Retail Electricity Pricing Enquiry* may consider such concerns.⁴⁸

44. Bureau of Meteorology (2018).

45. AEMO (2017a).

46. AEMO (2016).

47. COAG Energy Council (2018).

48. ACCC (2017).

Box 2: Vertical integration

Significant vertical integration – a single firm owning both generation and retail businesses – may act as a barrier to entry into the electricity market. A vertically integrated business in effect contracts with itself – the generation arm of the business provides the retail arm with the electricity it needs. As such, vertical integration reduces the number of buyers (retailers) and sellers (generators) in the market.

To secure long-term financing, a merchant generator requires contracts with retailers. But vertical integration reduces demand for such contracts from retailers. The fewer contracts available, the more difficult it becomes for merchant generators to enter the market.^a

The converse is also true. The fewer merchant generators, the harder it is for new retailers to enter the market. The fact that vertically integrated businesses – or 'gentailers' – have less need to purchase hedge contracts, makes new-entrant retailers less cost-competitive.

But this natural hedge that gentailers enjoy provides one of the major benefits of vertical integration. Consumers benefit if the cost savings from vertical integration are passed through to their bills. The question is whether these benefits outweigh the potential costs of reduced competition from vertical integration.

The ACCC's review of retail electricity prices may provide broader commentary and analysis on the impact of vertical integration on competitive retail and generation markets.

a. It is not clear that vertical integration has broader impacts on the generation market. A recent report (commissioned by one of the big 'gentailers') found no evidence that vertical integration resulted in higher bidding, AGL (2017a).

2.7 Summary

High-price events have affected average prices less than rising input costs and the closure of major power stations. But these high-price events can affect prices. And, as discussed in the next chapter, not all such events appear to be consistent with an efficiently working market.

3 ... But some high prices are due to gaming

Price fluctuations added more than \$800 million to the total value traded in the wholesale spot market in 2017, as shown in Figure 3.1. In Queensland and South Australia, large price fluctuations within half-hour settlement periods have increased wholesale prices by around 10 per cent each year since 2013.

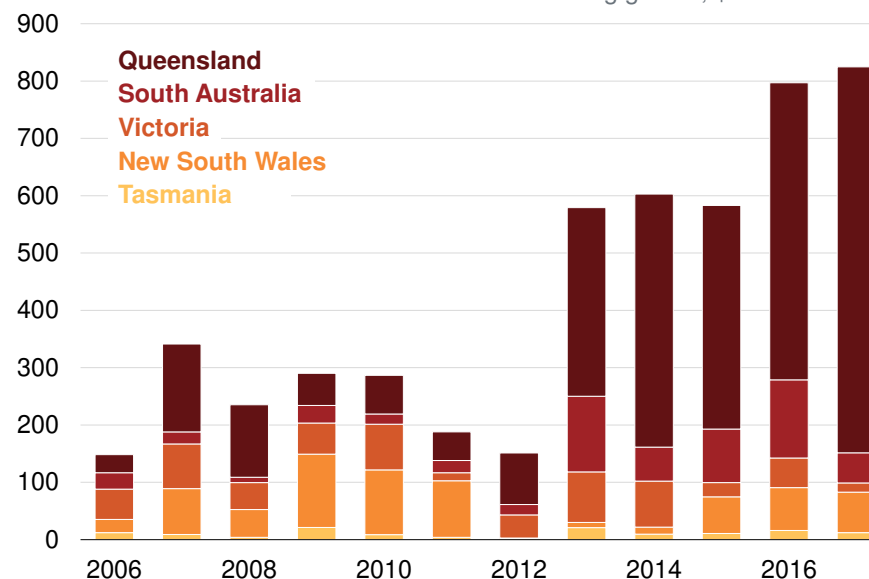
When a generator is suddenly unavailable, generators need to be able to 'rebid'. But rebidding also enables generators to change their offer at the last minute, which can cause big price fluctuations. Particularly in Queensland and South Australia, prices sometimes jump from less than \$100 per megawatt hour to more than \$14,000 per megawatt hour and back again within a half-hour period. This occurs even when demand is not particularly high. These price fluctuations are less frequent in NSW and Victoria, where there is more competitive pressure from multiple interconnectors and local generation.

Some of this 'gaming' may be justified by genuine supply constraints.⁴⁹ But external constraints – such as a generator outage – often last longer than five minutes in a half hour. And most of the time the system is flexible: it responds to changing conditions with little change in price. Scarcity pricing is also not the result of gaming. When demand is extremely high and supply is scarce, prices are more likely to be consistently high throughout the half hour – rather than bouncing up and down.⁵⁰

49. See Box 4 on page 26 for a discussion of why this report calls this behaviour 'gaming'.

50. Appendix A includes charts showing the change in price given a change in demand. These charts show that even during high demand, changes in demand typically have a small impact on price. When supply is scarce and prices are very high, prices do not fluctuate much, but tend to stay high for the duration of the high-demand period. These periods are not gaming but scarcity pricing – a feature

Figure 3.1: The value of gaming has been growing
Increase in total value traded in the NEM from bidding games, \$ millions



Notes: See Box 4 on page 26 for the methodology used to estimate the increase in value traded in the NEM due to gaming. Nominal prices. Each state has different conditions conducive to bidding games. Some of the value may be caused by a change between bidding price bands – associated with a change in generation type – within a settlement period. Some of the increase in the total value traded of gaming in the NEM will be because of the increasing market price cap, rather than only an increase in the frequency of gamed intervals.

Source: Grattan analysis of AEMO (2018a).

Previous rule changes have thus far been ineffective at reducing 5-minute price spikes. But gaming has largely disappeared in Queensland due to a policy change. This indicates that the problems are not inherent to the market, and a structural change to the rules could reduce price spikes across the NEM. Action should be taken quickly, because supply is likely to tighten in Victoria and NSW in coming years, and market concentration could increase, which will give generators more opportunities to game prices.

3.1 How generators create artificial scarcity

When supply is scarce, even temporarily, the price will spike. Supply can be temporarily constrained because offline generators take time to warm up, online generators take time to ramp up their output, or there are capacity restrictions on transmission lines which limit the number of generators that can supply the market.⁵¹ The NEM rules allow rebids close to the dispatch time so generators can respond to outages and to encourage competition on prices. But sometimes, generators use the rebidding provisions to create artificial scarcity (see Box 3).

There are two ways generators can create artificial scarcity for a five-minute interval: by reducing their output offered to the market, or by rebidding some of their output to a higher price band.⁵² In both cases, if

of the NEM – which signals for new investment and ensures generators can cover their LRMC.

51. Boyd (2015).

52. See Box 1 on page 16 for a description of how bidding operates in the NEM. Late rebids may be submitted in response to an unplanned constraint – such as a generator outage – which tightens supply and provides an opportunity for gaming. Generators may consider that rebidding in these circumstances is a competitive outcome because it is a profit-maximising decision. But if they have, in good faith, previously bid their available supply at a low price, then a late rebid due to market concentration and technological constraints is an inefficient market outcome. Late rebidding can also drive prices down, which is consistent with competitive market outcomes. This report identifies extreme price fluctuations which are inconsistent

Box 3: Bidding, rebidding and merit order

Box 1 on page 16 discussed how generators' bids submitted a day in advance determine the spot price of electricity in the NEM. But to take account of changing conditions, such as unplanned outages, generators may resubmit bids.

Generators can rebid up to 67 seconds before the dispatch interval starts. The dispatch instructions are issued 8 seconds after the dispatch interval starts, as a target for generators for the end of the dispatch interval.

AEMO notifies generators of the amount of electricity they have been successful in bidding into the market. AEMO schedules the lowest-priced generation that is fast enough to meet demand. AEMO must ensure demand is met when either supply or demand changes unexpectedly. For most generators, supply is not instantaneous. So AEMO may schedule generation out of merit order, if it is too late to schedule a cheaper generator or there is another constraint in the system such as transmission capacity.^a

Generators need time to synchronise after receiving dispatch instructions, and time to ramp up to the required generation amount. Many generators that are already online can increase their output more quickly than even a fast-start generator can come online.^b

Fast-start generators are those that can come online within 30 minutes of receiving dispatch instructions. Even most fast-start generation is not fast enough to respond to late rebids.

a. AEMO (2017b).

b. AEMO (2014); and Clements et al. (2016).

Box 4: Price 'games' in the wholesale spot market

Gaming is behaviour that is within the prescribed rules but results in highly favourable outcomes for some of the players. Gaming is contrary to the intent of the system.

Gaming in the NEM can cause extreme price fluctuations within a single half-hour settlement period which do no more than add revenue. This would not generally be expected in a competitive market.^a

For this report, we identify a 'gamed' half hour as one where the difference between the highest and second highest 5-minute dispatch interval prices is more than the half-hour average, and the half-hour average is less than \$5,000. Half hours where the average is more than \$5,000 are already investigated by the AER and are more likely to be associated with genuine scarcity.

For example, a half hour in which the six dispatch interval clearing prices were \$105, \$115, \$108, \$112, \$200, \$2500 would be a 'gamed' half hour, because the difference between the two highest prices (\$2300) is more than the average of the half hour (\$523).

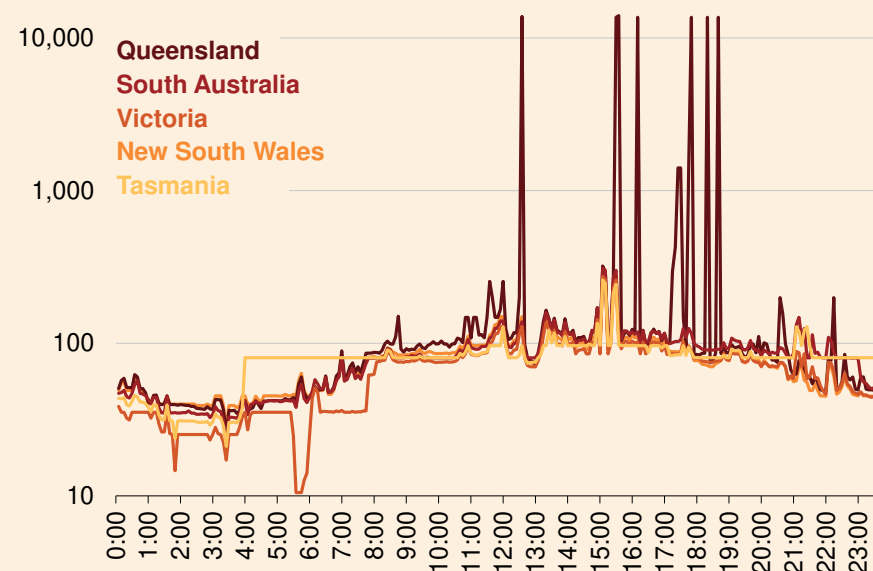
The methodology provides a systematic estimate of gaming and does not pick up most normal fluctuations due to outages, system constraints and high demand. However some genuine supply constraints may be captured, and some gamed intervals are also likely to be excluded. But the differences between states and between years indicates that generator behaviour is contributing to extreme price fluctuations.

a. Gaming behaviour is often called 'strategic bidding'. A generator can submit a late rebid to cause a price hike. This generally occurs in only one of the six dispatch intervals in a half hour, Dungey et al. (2018) and Clements et al. (2016).

Figure 3.2 shows a number of half-hour settlement periods which are captured in our definition of gaming.

Figure 3.2: A day of games – 12 January 2017

Five-minute dispatch interval price, log scale, \$ per megawatt hour



Source: Grattan analysis of AEMO (2018a).

no other generator can respond quickly enough, the 5-minute dispatch interval price will spike, to ensure enough supply to match demand. One high-priced dispatch interval increases the half-hour settlement price – the price all generators are paid for the electricity they supplied in that half hour. The generator that causes the high price will benefit from the higher half-hour settlement price for the total quantity of electricity they supplied in that half hour – even if they reduced their supply for a five-minute interval.

Some periods of supply scarcity are caused by unusual conditions and events beyond the control of the generators. But it is rare that supply scarcity is only for five minutes in a half hour. Generator outages, transmission constraints, and weather changes usually last for more than five minutes.

Figure 3.2 on the previous page shows the 5-minute dispatch interval price by state for 12 January 2017. In Queensland there were seven dispatch intervals at or near the market price cap of \$14,200 per megawatt hour, while most dispatch intervals were around \$100 per megawatt hour in Queensland and the other NEM regions.

3.2 Gaming the NEM can cost consumers \$800 million a year

Gaming the NEM has emerged as a problem in recent years. Figure 3.1 on page 24 shows that gaming increased dramatically in 2013.⁵³ In 2012 gaming increased the value traded in the NEM by around \$150 million. In 2013 it jumped to nearly \$600 million. By 2017 gaming added more than \$800 million to the total value traded, most of which was in Queensland.⁵⁴

with competitive market outcomes, Dungey et al. (2018) and Clements et al. (2016).

53. The total value of gaming passed through to consumers will depend on generators' and retailers' hedging contracts, however higher prices in the NEM will tend to flow through to contracts and futures prices.

54. AEMO (2018a).

Generators have always been required to bid 'in good faith'. But they were still able to game the system. In July 2016 the bidding in good faith rule was replaced with a prohibition against making false or misleading offers. The new rules also required changes to be made as soon as practicable and required a record of the reason for late rebids.⁵⁵ There was no reduction in price spikes due to this change, as shown in Figure 3.1 on page 24.⁵⁶

But extreme price fluctuations have nearly disappeared in Queensland since the middle of 2017, when the Queensland Government directed the government-owned generators to "reduce volatility and put downward pressure on wholesale prices".⁵⁷ However, this does not solve the underlying problem; it could re-emerge in Queensland, and it could get worse in other states.

Gaming could increase in NSW as supply tightens with the closure of the Liddell coal-fired power station in 2022. There are already signs this is happening in Victoria after the closure of Hazelwood in 2017. Gaming has added 4.6 per cent to the wholesale price in Victoria so far in 2018, whereas it was much smaller in previous years, as shown in Figure 3.3 on page 29.

3.2.1 Queensland and South Australia have suffered from gaming for several years

Gaming in the NEM has been most prevalent in Queensland and South Australia. Gaming has increased wholesale prices in those states by around 10 per cent in recent years, as shown in Figure 3.3 on page 29.

55. AEMC (2015); and AEMC (2017a).

56. The rule change did not reduce the amount of gaming in the NEM, but shifted some of the gaming to earlier dispatch intervals in the half-hour settlement period. This resulted in 'piling in' after the price spike, as other generators rushed to take advantage of the high half-hour settlement price. Although this lowers the final settlement price, it is an inefficient market outcome.

57. Palaszczuk et al. (2017).

Queensland and South Australia have fewer links to the rest of the NEM, and higher concentration of generation asset ownership, than the other NEM states.⁵⁸

Queensland

Queensland accounts for most of the increase in the total value traded in the NEM due to gaming. In 2017, \$673 million of the estimated \$825 million value traded in the NEM due to extreme price fluctuation was in Queensland.

Queensland is a large, concentrated, and isolated energy market.⁵⁹ It has less interconnector capacity than either NSW or Victoria and this, in conjunction with the high concentration of generation ownership, means generators have more opportunities to create artificial supply constraints.

This increases generator revenue above what would occur in a competitive market. Queensland's government-owned generation companies, Stanwell Corporation and CS Energy, provided 71 per cent of all electricity in Queensland in 2016–17, and reported record profitability in that year: Stanwell reported 30.4 per cent return on equity (ROE), and CS Energy reported 58.9 per cent ROE.⁶⁰ By contrast, the publicly listed electricity 'gentailers', Origin Energy and AGL, typically report ROEs between 5 and 10 per cent (see Figure 2.6 on page 19).⁶¹ Some of the record dividends paid by Stanwell and

CS Energy to the Queensland Government are now being returned to households through rebates.

Consumers, and the economy, would have been better off if the electricity price had been more competitive initially. Households and business will have responded to the higher electricity prices in Queensland by reducing their consumption. And businesses, especially large energy consumers, will have been less competitive because of the higher electricity prices.⁶²

Bidding games have abated since the Queensland Government directed the government-owned generators to increase supply and reduce prices. On 5 June 2017, the Queensland Government announced the *Powering Queensland Plan*, which included a directive to Stanwell Corporation to "undertake strategies to place downward pressure on wholesale prices".

Figure 3.4 on the following page shows the reduction in gaming events between the summers of 2016–17 and 2017–18 in Queensland. It shows that it is easier to game when demand increases. But the dramatic reduction in the summer of 2017–18 indicates that, when generator bidding behaviour is moderated, the system is able to meet these small increases in demand without price spikes.

Government directives are not a long-term solution because they do not address the structural cause of gaming. Queensland's recent experience is evidence that under the right circumstances – market concentration and supply constraints – the market rules permit gaming. Gaming could re-emerge in Queensland or increase in other states unless the market rules are revised.

58. ACCC (2017).

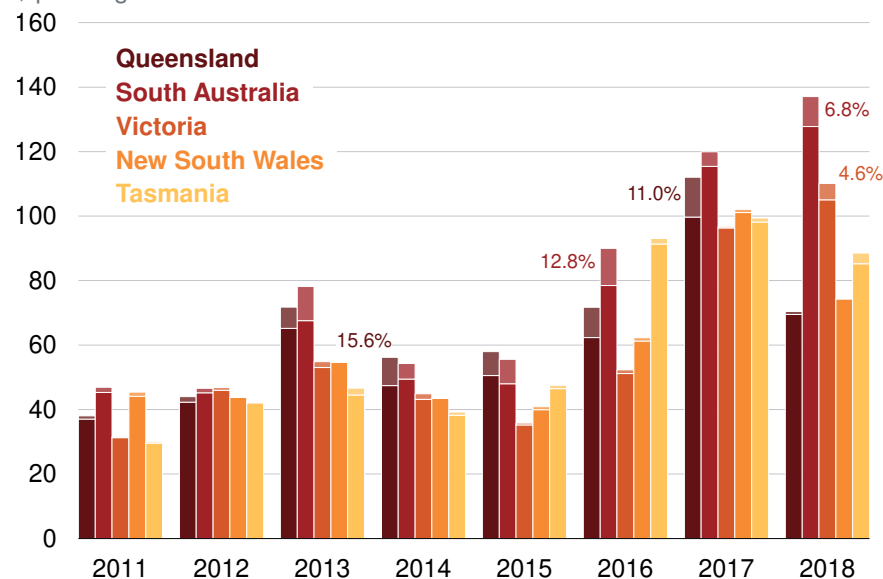
59. Queensland consumes 29 per cent of the electricity produced in the NEM. It has the highest two-firm market share, and it has limited external pressure from interconnectors. AEMO (2017c), ACCC (2017) and AEMO (2018a).

60. Stanwell reported 12.9 per cent ROE in 2015–16, and 18.4 per cent in 2014–15. CS Energy reported -7.8 per cent ROE in 2015–16, and 30.6 per cent in 2014–15. Profitability can fluctuate year on year due to external factors, such as accounting adjustments. (CS Energy (2017) and Stanwell Energy (2017)).

61. The ASX 200 median ROE is usually around 10 per cent, Morningstar (2017).

62. Queensland Government (2017); and Palaszczuk et al. (2017).

Figure 3.3: Gaming has increased wholesale prices by up to 16 per cent
Weighted-average wholesale price and increase due to gaming,
\$ per megawatt hour

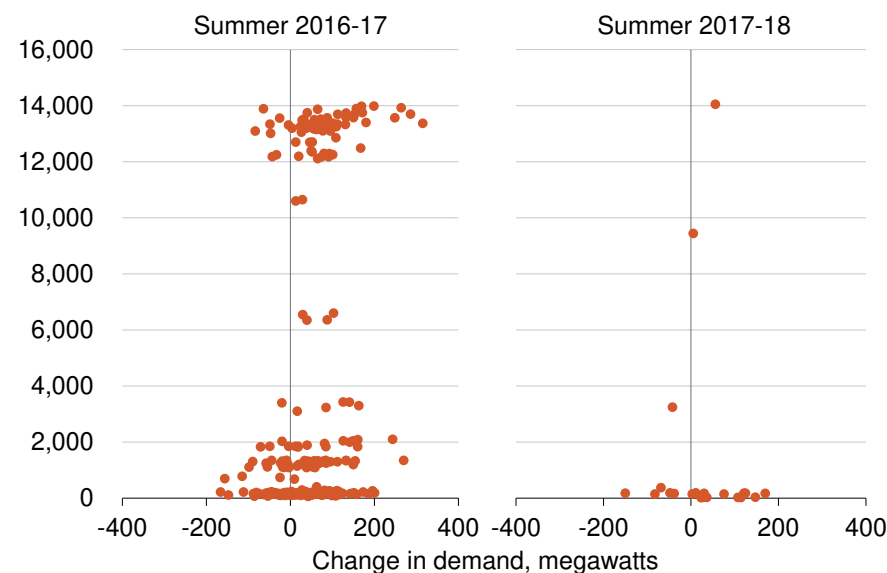


Notes: Shaded area is the estimated contribution to the weighted-average wholesale price from gaming bids. Gaming bid increases are the difference between the highest and second highest bids in a half-hour period where the difference is at least equal to the half-hour average and the half-hour settlement price is less than \$5,000. 2018 part year to end of April.

Source: Grattan analysis of AEMO (2018a).

Figure 3.4: Gaming almost disappeared in Queensland over the summer of 2017–18

Gaming incidents by change in price per megawatt hour between top two dispatch intervals



Notes: Each dot represents a period meeting the gaming criteria in Box 4 on page 26. The x-axis shows the difference in demand between the highest-priced interval and the second-highest interval in the half hour when a gamed interval occurred. The y-axis shows the increase in price above the second-highest price for the gamed interval in that half hour. Data from November to April, inclusive, for each summer. Nominal prices.

Source: Grattan analysis of AEMO (ibid.).

South Australia

In 2016, bidding games increased the value traded in the NEM in South Australia by \$136 million, or 12.8 per cent. South Australia, like Queensland, has high concentration of generation ownership, and has less competitive pressure from the other states through interconnectors. Two firms (AGL and Origin) controlled 67 per cent of all electricity generated in South Australia in 2016–17.⁶³

South Australia's high share of renewable energy increases gaming opportunities. When the sun shines and the wind blows, there is abundant electricity at near zero marginal costs. But when the share of renewable energy is low and the interconnectors are constrained, there is less spare supply and more opportunity for generators to create artificial scarcity.⁶⁴

The value of bidding games fell slightly in South Australia in 2017. Figure 3.3 on the previous page shows that in 2017, gaming increased wholesale prices by 6.8 per cent, compared to 13.7 per cent in 2015 and 12.8 per cent in 2016. Supply increased after Engie reinstated Pelican Point's capacity back up to 479 megawatts and the capacity of the Heywood interconnector was increased from 460 megawatts to 650 megawatts.⁶⁵

63. ACCC (2017).

64. Peak prices in South Australia are exacerbated by the high proportion of intermittent wind and solar energy. But the sun and the wind do not tend to turn on and off in five-minute bursts, so genuine scarcity pricing is unlikely to be captured in this report's estimate of the impact of gaming.

65. AEMO (2017c); and Macdonald-Smith (2017).

3.2.2 Victoria and NSW are likely to see more games as supply tightens

In Victoria and NSW, about 2 per cent of the average wholesale price can be attributed to gaming since 2005.⁶⁶

Victoria and NSW have slightly lower generator ownership concentration and more competitive pressure from interconnectors than either Queensland or South Australia.⁶⁷ Higher competition and less-constrained supply has kept gaming low in NSW and Victoria until now.

But gaming increased in Victoria over the 2017–18 summer as supply reduced after the Hazelwood power station closed. Figure 3.5 on the following page shows that there were more than five times as many incidents of gaming, where the price spiked by over \$4,000 for one 5-minute interval, in the 2017–18 summer than in the 2016–17 summer.⁶⁸ In the first four months of 2018, gaming increased the average Victorian wholesale price by 4.6 per cent. Between 2015 and 2017 gaming increased the price by only 1.4 per cent.

Gaming may increase in NSW and Victoria, if supply tightens with the planned closure of Liddell power station in 2022.

3.3 Three factors contribute to price games

Three factors contribute to gaming in the wholesale electricity market:

66. An estimate of gaming around 2 per cent may represent normal market volatility. Because some price spikes may result from infrequent, 5-minute supply constraints which are normal market conditions.

67. AEMO (2017c).

68. In 2017–18 there were 11 occasions where one of the 5-minute dispatch intervals was more than \$4,000 higher than the second-highest priced dispatch interval. In 2016–17 there were two such occasions.

1. **High concentration** of generation ownership, so there are relatively few competitors;
2. Heavy reliance on **generation technology** that cannot respond rapidly to outages or spikes in demand; and,
3. **Market rules** which allow rebids at the last minute, when few, if any, generators can respond.⁶⁹

Bidding games could be reduced by changing any one of these factors. But the easiest one to change is the market rules.

3.3.1 Concentration of generation ownership

In a perfectly competitive market, with many small producers, one producer would have little impact on the marginal price. But when a market is concentrated, firms tend to have more market power. This means they can set prices higher than would occur in a more competitive market without losing all their sales to a competitor.⁷⁰

Australia's energy markets are moderately concentrated. Just two government-owned corporations, CS Energy and Stanwell, were responsible for 71 per cent of energy generated in Queensland in 2016–17. Two private companies, AGL and Origin, were responsible for 67 per cent of energy generated in South Australia in 2016–17.

Two-firm generator concentration is also high in NSW and Victoria (at 67 per cent and 65 per cent respectively), but these markets have more competitive pressure from interconnectors.

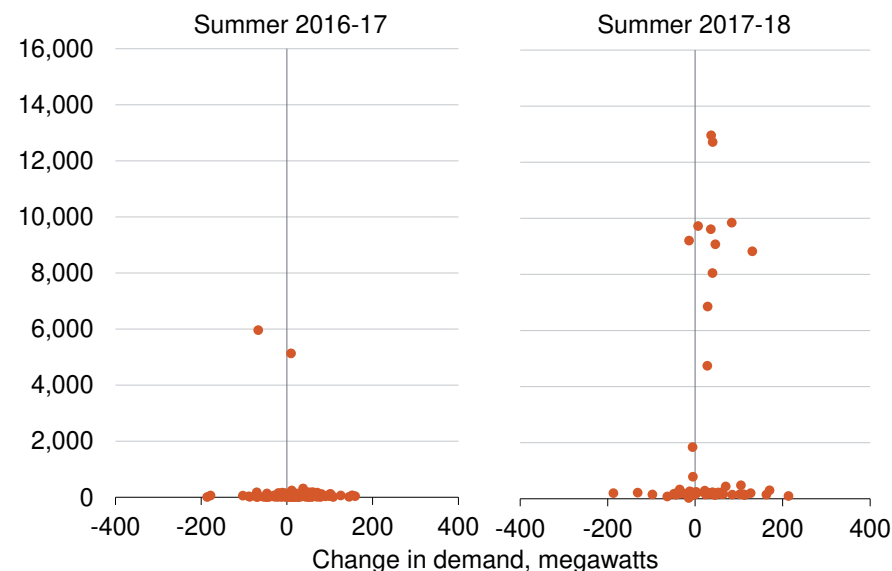
Concentration of ownership will continue to change over time as older power stations close and new plant is constructed. Engie's closure of Hazelwood increased the relative concentration of the two biggest generation owners in Victoria (AGL and EnergyAustralia). However

69. Clements et al. (2016).

70. Motta (2004).

Figure 3.5: Gaming is increasing in Victoria

Gaming incidents by change in price per megawatt hour between top two dispatch intervals



Notes: Each dot represents a period meeting the gaming criteria in Box 4 on page 26. The x-axis shows the difference in demand between the highest-priced interval and the second-highest interval in the half hour when a gamed interval occurred. The y-axis shows the increase in price above the second-highest price for the gamed interval in that half hour. Data from November to March, inclusive, for each summer. Hazelwood closed at the end of March 2017.

Source: Grattan analysis of AEMO (2018a).

AGL's planned closure of Liddell may reduce the market share of the top two firms (AGL and Origin) in NSW.⁷¹

Some concentration of ownership benefits consumers. Large generation companies have economies of scale, which is good for consumers if the savings are passed on. But too much concentration can increase prices. The forthcoming ACCC Retail Electricity Pricing Enquiry is expected to investigate this further.⁷² Either way, there are simpler ways to reduce gaming than by changing the ownership structure of the industry, as discussed in Chapter 5.

3.3.2 Technology constraints

Most of the time the NEM is very good at responding to changing conditions with very little change in price.⁷³ But sometimes conditions in the NEM mean that very few of the generators are available to respond rapidly. In this case, very little, or no, supply is able to come online or ramp up to undercut late rebids.⁷⁴ As a result, generators already online or with fast response rates are able to game prices when they know others cannot respond.

Currently, few generators can turn on or off in less than five minutes.⁷⁵ Some generation technology requires hours to start and few generators can feed electricity into the network from a cold start in less than five minutes.⁷⁶ When demand is high, or there are unexpected system

constraints, many generators will already be generating electricity. And they may have little additional capacity available.

Fast-start technology, such as batteries and new generation gas peaking plants, can respond quickly to changes in demand and prices. This makes them well suited to mitigate gaming by base-load generators, but also well placed to play games if there is high ownership concentration.⁷⁷

Intermittent generation, such as wind and solar, does not respond to short-run price signals. Intermittent generation is making up an increasing amount of the total generation portfolio. This may increase other generators' ability to play games in the future. But increasing investment in firming generation – which ensures supply when renewable generation is not available – may increase the future responsiveness of generators to gaming.

Changing the mix of generation technologies in the NEM to reduce gaming depends on market signals to encourage investment in fast-response generation.

3.3.3 Market rules

Gaming is possible because the market permits rebids too late for most generators to respond. The market rules are not well suited to the mix of generation technologies and ownership concentration in the market.

Generators need to be allowed to rebid. When an unforeseen outage means generation capacity is unexpectedly unavailable, generators need to alter their offers to supply the NEM. Rebidding feeds necessary information to AEMO about the availability of supply.

71. Future concentration will depend on what replaces Liddell, and the mix of new generation ownership.

72. See also ACCC (2017).

73. See Appendix A charts chart showing change in price and change in demand in each state in the NEM. Most of the time the change in price between five-minute intervals is clustered around \$0 despite changes in demand.

74. AEMC (2015).

75. AEMC (2017b).

76. AEMO (2014); AEMO (2018a); and Clements et al. (2016).

77. AEMC (2017b).

But generators should not be able to use rebids to game prices simply to increase revenue with no market benefit.⁷⁸ In most markets, consumers and producers agree on a quantity and a price before trading, and either party can choose not to trade. But in the NEM, the market must instantaneously align supply and demand every five minutes – much faster than consumers can respond to prices. Late rebids change prices too late for either the consumer or other generators to respond. If late rebids were allowed at a farmers' market, a seller could increase the price after the consumer has committed to the sale, with no time for any other producer to make the buyer a better offer.

Changing the market rules is the cheapest and simplest way to minimise gaming behaviour in the NEM. Aligning bidding rules with the current mix of generation technologies will improve the efficiency of the NEM. Section 5.2 on page 44 discusses potential rule changes to prevent gaming.

3.4 Previous rule changes haven't solved the problem

Regulators have previously changed and tightened rules to try to stop gaming, or strategic bidding. But price spikes, which are symptomatic of gaming, have been persistent.

Generators have always been required to bid 'in good faith'. But they were still able to game the system. So in mid-2016 the Australian Energy Market Commission replaced the bidding-in-good-faith rule with a prohibition on making false or misleading offers. Generators adjusted their tactics and continued to game the system. In late 2017 the AEMC announced a further change: a '5-minute settlement rule' will be introduced in 2021.⁷⁹

78. If generators only want to dispatch a portion of their capacity when prices are very high, in their initial bid they can set some of their capacity at a very high price, AEMO (2017d).

79. The 2016 'bidding in good faith' rule is similar to a gate closure mechanism which requires justification for late rebids that increase prices. But the rule change did

At present, the dispatch interval is five minutes but the financial settlement period is half an hour. Aligning the two periods should improve some behaviour, but could make other behaviour worse.

The 5-minute settlement rule will eliminate the incentive for a generator to drop supply for a 5-minute interval to push up the price of that generator's supply for the five other dispatch intervals in the half hour. But if a generator can create a price spike without dropping *all* their supply, they could still benefit from this behaviour after the rule change.

3.4.1 Where the 5-minute rule will help

Under current rules, a marginal generator with only a small capacity may be able to create an artificial 5-minute supply shortage by dropping supply in one of the 5-minute dispatch intervals. And they still benefit from the high half-hour average price.

But under the 5-minute settlement rule, marginal generators that drop supply will no longer benefit from the high-priced interval.⁸⁰ This will improve the efficiency of the wholesale market.

The 5-minute settlement rule will also reward consumers that can alter their demand in response to price signals. They will no longer get caught out by using a lot of electricity in early dispatch intervals with low 5-minute prices, only to end up having to pay a high half-hour settlement price.

not reduced the value of gaming. A 'hard' gate closure mechanism should limit price-increasing rebids to equipment failure and increase the burden of proof on generators to provide sufficient justification, AEMC (2015) and AEMC (2017a).

80. For example, if a 150 megawatt generator drops all their supply for five minutes, forcing a \$14,000 interval while the other intervals are \$100, they earn the half-hour settlement price of \$2417 per megawatt hour for five intervals. After the rule change they will earn \$100 per megawatt hour for five intervals.

3.4.2 Where the 5-minute rule could make things worse

Under the 5-minute settlement rule, a large generator that creates an artificial shortage by dropping a small portion of their supply will continue to benefit from the high-priced interval. Under present rules, they benefit from the high half-hour average price. After the rule change, they will benefit from an extremely high 5-minute settlement price.⁸¹

And generators may be able to alternate 5-minute prices between competitive levels and near the market-price cap. In this way, they could actually increase the reward for gaming under the new rule.⁸²

3.4.3 5-minute settlement and investment incentives

The 5-minute settlement rule is intended to encourage investment in fast-response technology with a clearer price signal when supply is scarce.⁸³ But if high prices are caused by artificial supply shortages, then the 5-minute settlement rule will not encourage new investment in response to bidding games.⁸⁴

Rising prices and high profits should encourage new investment in generation capacity. When scarcity pricing events increase and prices

rise from limited supply, then the market is indicating there is enough demand for new generation to cover the cost of capital investment and marginal operating costs.

But potential new generators know the bidding games will stop if they build new fast-start capacity. The incentive to build a new generator disappears if the potential investor believes that after they build new capacity, the incumbent generators would always supply sufficient capacity at a lower, competitive 5-minute settlement price.⁸⁵

If the market price, without bidding games, is below a new generator's long-run marginal cost, then they will not enter the market.⁸⁶ So long as new entrants anticipate that existing generators will drop their average price if there is more competition in the market, then they have no incentive to enter. Because the incumbent generators know this too, they can continue to play bidding games without fear of new entrants.

In Queensland and South Australia, prices have fluctuated dramatically even when demand is moderate and relatively stable.⁸⁷ This indicates that gaming the NEM is not due to genuine supply shortages, and there is no reason to believe the market is not already capable of supplying electricity for that level of demand. So the 5-minute settlement rule will not incentivise new generation capacity to capture, or eliminate, gaming revenue.

81. For example, if a 1500 megawatt generator drops 150 megawatts of their supply for five minutes, forcing a \$14,000 interval while the other intervals are \$100, they earn the half-hour settlement price of \$2417 per megawatt hour for five intervals. After the rule change, they will earn a slightly reduced \$2,220 per megawatt hour on average over the half hour (\$14,000 for one 1,350 megawatt 5-minute interval and \$100 for five 1,500 megawatt 5-minute intervals). This still provides a lot of incentive to play the 'game'.

82. Gaming could occur three times as often if a generator were able to create a price spike every second interval.

83. AEMC (2017a).

84. The 5-minute settlement rule will provide a broader incentive to invest in fast-response technology for periods of genuine, short-term scarcity – such as supporting intermittent wind and solar generation.

85. Motta (2004).

86. High volatility could induce new investment if large consumers or retailers choose to manage volatility risk through entering contracts which underpin new generation investment.

87. Figure A.4, Figure A.8, Figure A.12, and Figure A.16 in Appendix A show the change in price by change in demand by demand octile. In NSW and Victoria there is very little change in price in response to changes in demand except in the highest octile (that is, at high levels of demand). In comparison, Queensland and SA are much more likely to have very large fluctuations at moderate levels of demand (in the 4th to 7th octiles).

3.5 Summary

Gaming adds to wholesale electricity prices, and opportunities for gaming may increase as demand and supply tighten in future. The most effective way to tackle gaming is to change the market rules. Chapter 5 consider the options.

But even in the worst cases, gaming explains only about 10 per cent of the average annual wholesale price. And prices have risen in NSW and Victoria, which do not have a lot of gaming. So Chapter 4 discusses the harsh reality: high prices might be here to stay.

4 Consumers may have to get used to high prices

Current prices are unprecedented, but they may become the new normal. The long-run marginal cost of new, firm generation is at least \$80 a megawatt hour, so unless subsidised or forced into the market, it is hard to see how the addition of new supply will bring prices down to 2015 levels.⁸⁸

A key reason Australians have enjoyed low prices in the past is the market was oversupplied and input costs were lower. Legacy generation built under public ownership, together with more government-induced generation and falling demand, led to overcapacity and very low prices. The market has corrected with the retirement of Northern and Hazelwood, and prices rose. A significant reversal in prices is unlikely in the wholesale electricity market. Politicians and consumers may have to get used to higher wholesale market prices than they have historically enjoyed.

4.1 Historic oversupply and legacy assets

The big price increases since 2015 aren't just a function of the supply-side shocks outlined in Chapter 2. They also represent a correction: before the power station closures, the electricity market was over-supplied, which kept prices low. The jump in wholesale prices has looked extreme because prices increased from a low base.

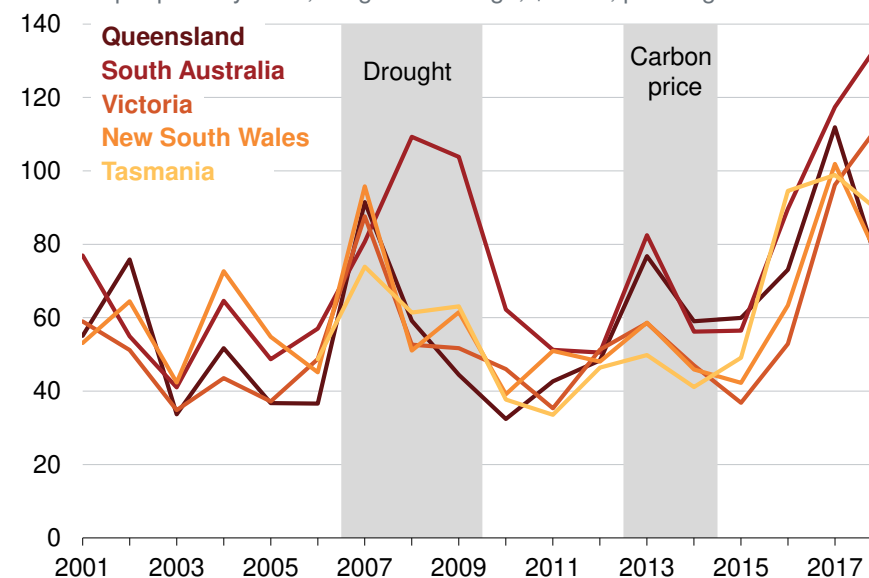
Historically, prices were low. With the exception of a few periods, notably 2007 to 2009 when the drought was at its worst, and 2012 to 2014 when a price on carbon was imposed on electricity generation, prices have remained generally around \$50 a megawatt hour since the NEM started 20 years ago, as shown in Figure 4.1.

Prices remained low for two reasons.

88. 'Firm generation' refers to capacity that can reliably generate during peak demand.

Figure 4.1: Wholesale prices are the highest on record since the NEM started

Annual spot price by state, weighted average, \$ 2017, per megawatt hour



Notes: 2018 is part year to end of April. Real prices in 2017 dollars.

Source: Grattan analysis of AEMO (2018a).

First, much of the generation used over the past 20 years came from legacy investments made before electricity markets were liberalised. Most of the generation that was in place when the NEM was formed in 1998 had been built under public ownership. Even today, more than 30 gigawatts out of 47 gigawatts of generation was built before the NEM was formed.⁸⁹

The original costs of building that generation were 'sunk' – sold or refinanced, lowering their cost base. Generators were able to be profitable at these lower levels; the market has not needed to reflect the higher long-run costs of operating a power station (the long-run marginal cost, or LRMC).

Second, extra capacity has been added, maintaining high levels of supply. While some of this capacity has come from private investment, more has been added from public sector involvement, government interventions and additional transmission connections between states. Governments' providing incentives for additional capacity – along with a downturn in demand for electricity – kept downward pressure on prices.

Much of the new generation built since the NEM was formed was funded with public money or through public subsidies via the Renewable Energy Target (RET).⁹⁰ There is now more than 5 gigawatts of wind and solar electricity in the grid; almost 2 gigawatts has been added since 2012.⁹¹

New interconnectors also suppressed prices. A further five interconnectors have been added since the NEM was formed.⁹² Two interconnectors between Queensland and NSW (Directlink and the Queensland/NSW interconnector), and Murraylink between Victoria and South Australia, were added between 2000 and 2002.⁹³ After Tasmania joined the NEM in 2005, Basslink (between Victoria and Tasmania) was added to the market. The NSW-Victoria interconnector came on line two years later. The NEM's first decade was characterised by increased connection between states, effectively increasing accessible capacity across the system.

Increasing supply was matching increasing demand until 2008. But in 2009, demand began to fall and then flatline (see Figure 4.2 on the following page). Maximum demand peaked in 2008–09 in Victoria and in 2010–11 in NSW and South Australia – and by 2016 maximum demand had fallen by 9 per cent in Victoria, 7 per cent in NSW and 13 per cent in South Australia.⁹⁴ Only Queensland has seen maximum demand increase, due to the start-up of the liquefied natural gas export industry.

Overcapacity in the market caused by high – and rising – supply, and falling demand resulted in lower prices. The price impact was compounded because much of the new generation – mostly renewable energy – was bid into the market at or below zero, because it has little or no running costs and receives revenue from the RET outside the NEM.⁹⁵

89. AER (2017b).

90. Between 1999 and 2016, 26 per cent of new capacity occurred with public investment and a further 26 per cent through the RET. Renewable generators receive an additional revenue stream through the sale of renewable energy certificates, so they are less reliant on revenues generated through the spot market, Wood et al. (2017a).

91. AER (2017b); and Warren (2018).

92. Before the NEM started only Victoria and South Australia were connected through transmission; they could get additional generation capacity from each other. NSW and Queensland were isolated, relying solely on local generation to both meet peak demand and provide sufficient reserves in case of generation outages.

93. AEMO (2017c).

94. AER (2017b).

95. Wood et al. (2016).

An increase in wholesale prices between 2012 and 2014, caused by the introduction of a price on carbon, hid the impact on prices of overcapacity and the increase in zero-marginal-cost generation. But the impact is clear to see either side of the carbon price in Figure 4.1 on page 36.

Overcapacity in the NEM peaked in 2015. At the time, there was concern the market was unsustainable and that a mechanism might be needed to force the exit of capacity, specifically coal-fired generation.⁹⁶ But market forces operated before governments needed to intervene.⁹⁷ Hazelwood power station required an additional \$400 million to be fit for continued operation.⁹⁸ Hazelwood's owners, Engie, decided there was not enough market revenue to make this investment worthwhile. Only higher wholesale market prices would make investment commercially viable.

4.2 Future costs

Over the long term – the lifetime of a generation asset – expected revenue must equal the LRMC of generating electricity or there will be no investment in new generation. In an energy-only market, revenues received from the spot market (and associated contract market) must enable a generator to cover its running costs and the capital costs needed to build the power station.

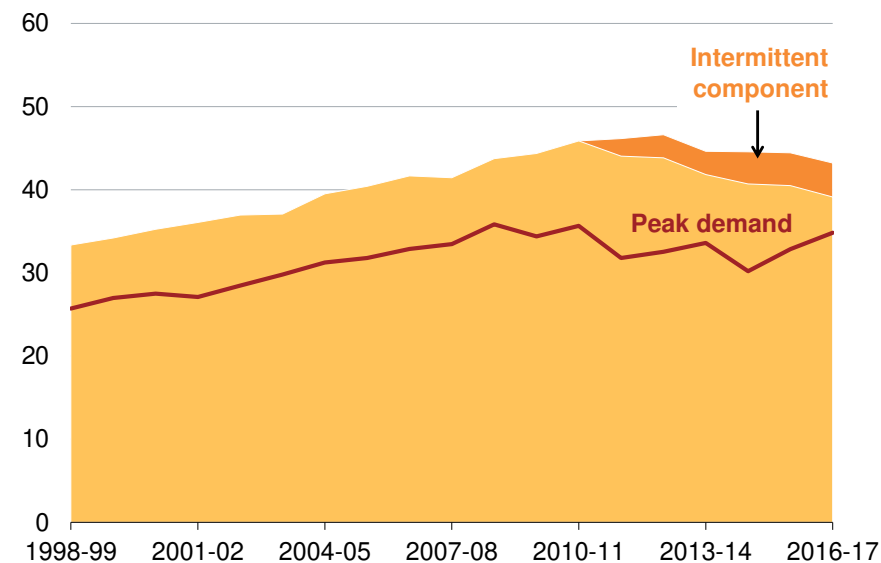
This does not mean that prices will remain constant. Prices are likely to oscillate between the SRMC and the LRMC of new generation. This is known as the capacity cycle: the market goes through periods of high prices that lead to new investment (See Box 5 on the following page).

96. Simshauser et al. (2015).

97. When a market has oversupply, initially it is likely to lead to lower prices. But in the long run, firms with the highest costs (or lowest expected future returns) are likely to exit the market.

98. Potter (2017).

Figure 4.2: Supply kept rising while demand flatlined
NEM total built capacity and peak demand, gigawatts



Notes: This figure compares NEM capacity with peak demand since the NEM began. The intermittent component was calculated separately, with data for 2012-2017 only.

Source: Grattan analysis of AEMO (2017e) and AER (2017c).

Box 5: The capacity cycle

Figure 4.5 shows how prices in the market change over the long-term.

When prices are high, new generation enters the market. As more generation is added, the price starts to fall. Lower prices mean lower revenues, and hence less investment, in either the upkeep of existing generation or building new generation.

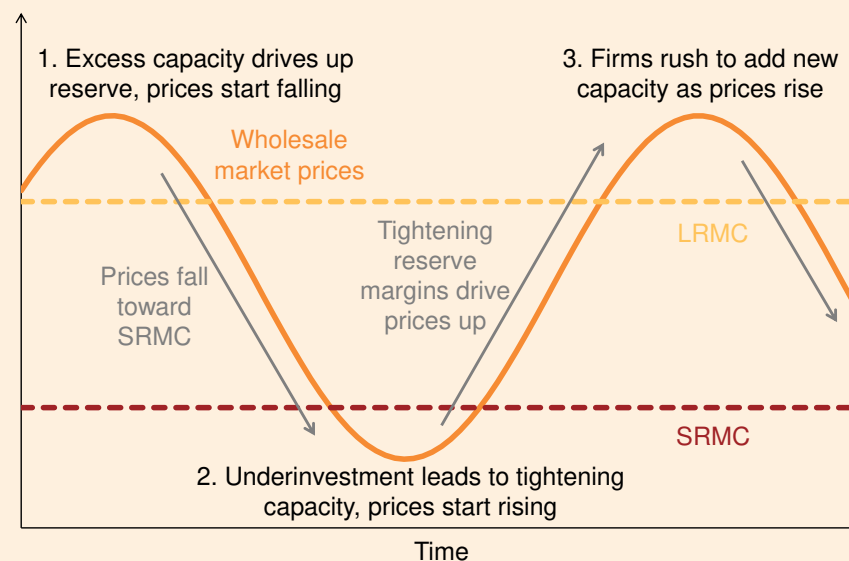
Prices eventually fall to the SRMC of existing generation. An energy-only market such as the NEM encourages all generation to bid into the market at their SRMC to ensure dispatch. When there is oversupply the market naturally reduces prices towards the SRMC of all existing generation. But – as Australia discovered in 2015 – this is unsustainable.

While some generators can manage lower revenues in the short term, in the longer term they struggle to keep operating. Eventually generation leaves the market. This constrains supply and enables other generators to take advantage of market power and push up prices. Arguably, this is where prices in the NEM are now.

If the market is allowed to work, the higher prices reflect the LRMC of new-build generation. When prices are this high, there should be new investment in generation. New investment increases supply and puts downward pressure on prices. The cycle begins again.

Figure 4.5: The generation capacity cycle

Average wholesale market price



Notes: LRMC = Long-run marginal cost; SRMC = Short-run marginal cost.

Source: Reproduced from Steed and Laybutt (2011) in McConnell and Sandiford (2016).

The current high prices in the market may signal that it is ripe for new investment. But even when new investment arrives, it does not automatically mean the market will revert to historical, sub-\$50 a megawatt hour prices. More supply does put downward pressure on prices, especially when demand doesn't increase. But long-run price outcomes in the market should enable investors to recover the long-run costs of generating electricity. And these costs appear to be far higher than \$50 a megawatt hour.

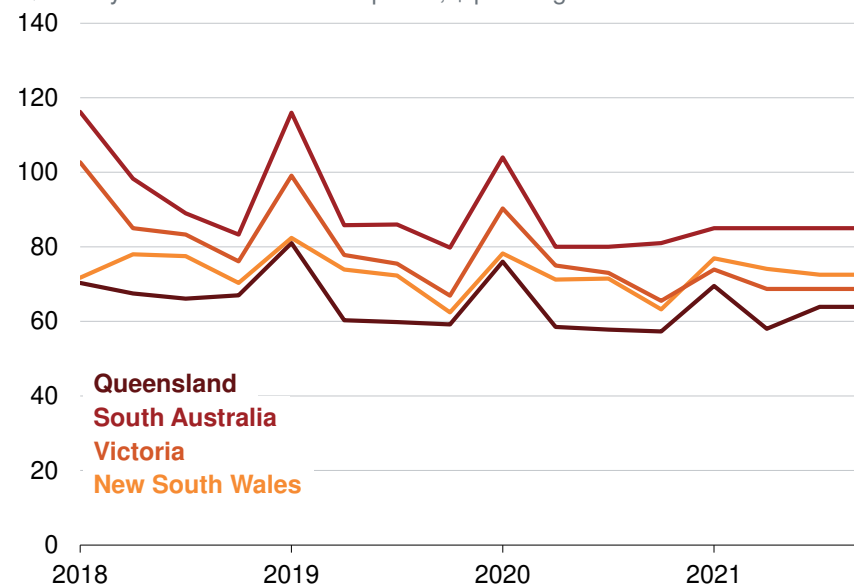
About 6000 megawatts of additional renewable capacity is due to be added to the NEM between 2018 and 2022, most of it incentivised by the RET and state-based renewable energy schemes in Queensland and Victoria. Some have forecast that this additional capacity is likely to lead to a significant reduction in wholesale electricity prices by the early 2020's.⁹⁹

Additional capacity will almost certainly reduce prices. If enough new capacity enters the system, prices may well fall to below \$50 a megawatt hour. But such low prices almost certainly won't be sustained. The experience of significant overcapacity between 2011 to 2015 showed that such low prices force generation to leave the market. This caused a correction, and prices shot up to over \$100 a megawatt hour. So even if increased renewable penetration provides short-term price relief, in the long-run prices will go back up again.

The market is reflecting this reality in futures contract prices. Figure 4.3 shows the prices for one form of financial contract – base futures – over the next four years. Base futures contract prices are an indication of future unweighted average wholesale prices in the NEM.¹⁰⁰ Base future prices are currently falling over time in all NEM states. But futures for

Figure 4.3: Futures contracts indicate high wholesale prices are here to stay

Quarterly base futures contract prices, \$ per megawatt hour



Note: Data for period ending 29 March 2018.

Source: AER (2018d).

99. COAG Energy Council (2017).

100. The purchaser of a base contract will lock-in a price per megawatt hour for electricity purchased over the period of the contract, Aoude et al. (2016).

2021 are currently selling from between \$60 to \$85 a megawatt hour. These price levels are still well above the wholesale prices in 2015.

Prices will need to stay high to encourage the investment Australia needs as it makes the transition away from its old, fossil-fuel generation fleet. New generation will be built only if prices are expected to remain above the LRMC of new-build generation (see Figure 4.4).

Those costs are far higher than \$50 a megawatt hour. New-build coal and gas plants are estimated to cost a minimum of \$76 and \$83 per megawatt hour respectively, although renewables costs are falling.¹⁰¹ The Purchase Power Agreement between Origin Energy and the Stockyard wind farm struck a price of below \$60 a megawatt hour.¹⁰² Origin has reported that Purchase Power Agreements for large solar farms are being signed at below \$80 a megawatt hour.¹⁰³

But even if the cost of solar and wind fell below \$50 a megawatt hour, those renewables will require firming capacity. The intermittent nature of wind and solar energy means that additional, dispatchable generation is needed to balance the market when wind or solar is unavailable. Firming capacity includes gas generation, batteries and pumped hydro. The best estimates are that firming costs will equate to between \$25 and \$30 per megawatt hour extra.¹⁰⁴

No one knows exactly how much it will cost to ensure there is sufficient firm capacity in the market to balance intermittent renewables. The new Snowy Hydro 2.0 project will help – providing an additional 2,000 megawatts of capacity in the form of pumped hydro storage. But it will come at a cost of up to \$4.5 billion; costs that will have to be recovered through prices in the wholesale spot and contract markets.¹⁰⁵

101. Commonwealth of Australia (2017); and Snowy Hydro Limited (2018).

102. Origin Energy Limited (2017).

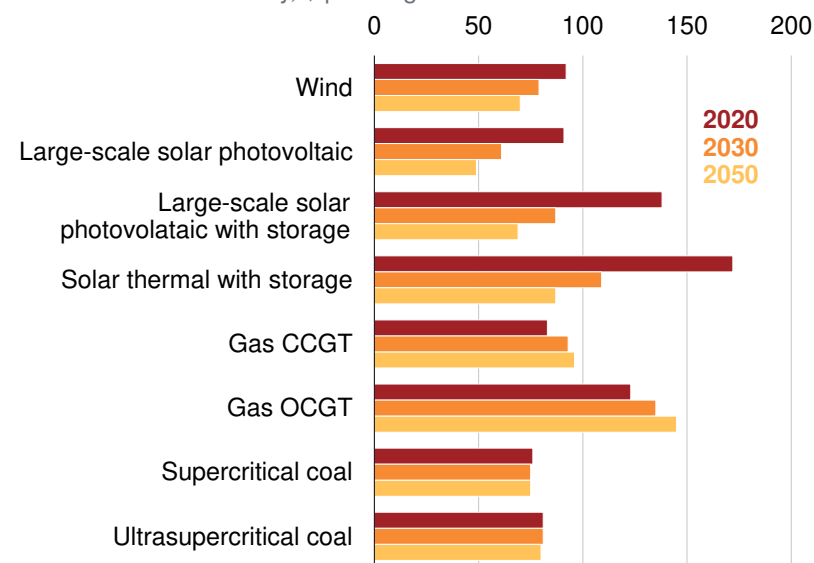
103. Parkinson (2018).

104. Blakers et al. (2017).

105. Snowy Hydro Limited (2017).

Figure 4.4: High prices are needed to encourage new investment

Levelised cost of electricity, \$ per megawatt hour



Notes: OCGT – Open cycle gas turbine; CCGT – Closed cycle gas turbine. Modelling assumptions from February 2017 which do not include recent reductions in technology costs.

Source: Grattan analysis of Commonwealth of Australia (2017).

AGL's plan to replace the Liddell power station, using a mixture of gas, renewables, batteries, demand-response and an extension of the coal-fired Bayswater power plant, is estimated to cost \$83 a megawatt hour.¹⁰⁶ For the project to make commercial sense, prices in the wholesale market will need to average \$83 a megawatt hour over the lifetime of the project.

There is an additional challenge for new investment in base-load generation, with either coal or gas. More intermittent, low marginal cost solar and wind will enter the market, and their long-run marginal cost is projected to continue to fall, as shown in Figure 4.4 on the preceding page. The likely impact on the wholesale spot market will be longer periods of very low prices, and short periods when coal and gas generators will be able to cover their costs. And if emissions targets are tightened, as they are likely to be over the next few decades, the risks to financiers become insurmountable. The challenge is reflected in the position taken by the industry on rejecting new coal as a viable investment.¹⁰⁷

The changing nature of generation – centralised to distributed – requires significant investment in the NEM's transmission networks. Good wind and solar resources are likely to be situated away from existing transmission lines, requiring new lines to be built. And if Snowy 2.0 is to work as the world's biggest battery, new connections between it and the rest of the grid will also be required.¹⁰⁸

4.3 Summary

As Australia closes its old power stations and moves to a low-carbon electricity system, it is going to need to build a lot of expensive infras-

tructure – both generation and transmission. And ultimately consumers will have to pay for it.

There is no silver bullet that will drastically reduce the cost – and price – of generating and delivering electricity.

106. In 2017 dollars, AGL (2017b).

107. Priftakis (2017).

108. Snowy Hydro Limited (2017).

5 What governments should, and should not, do

Wholesale prices have increased mainly because market conditions changed. Increasing input costs, together with previous and future withdrawal of legacy generation, mean that the days of sub-\$50 a megawatt hour electricity are over. Although low prices may reappear in the short-term, higher prices than in the past will be needed to get the long-term investment in new generation that Australia needs.

Policy makers can and should take some actions to put downward pressure on consumer prices. Dramatic government intervention in the market to break up private energy companies is not one of them. But stable energy and climate-change policy will encourage investment. Continued action in the gas market will help keep a lid on gas input costs. And changing market rules so it is harder for generation firms to 'game' the system will reduce inefficient price spikes in the market.

But the reality is that policy makers can do little to force wholesale prices down significantly. Politicians should be open and frank about this reality. If they want to reduce consumers' electricity costs, they will need to focus on other parts of the supply chain.

5.1 Addressing long-term prices

In the long term, keeping downward pressure on wholesale electricity prices means keeping downward pressure on the costs of building and running generation. And there are some levers governments can pull to do this.

5.1.1 Provide policy stability

The removal of the Northern and Hazelwood power stations has led to a tightening of supply in the NEM, increasing power prices (as shown in Chapter 4). The RET and various state-based renewable energy

schemes will provide additional capacity in coming years. But Australia won't achieve an efficient supply and demand balance in future unless governments create a strong investment environment.

As a previous Grattan Institute report, *Next Generation*, stated:

*"Policy stability is fundamental to long-term resource adequacy. Without policy stability no one will invest, regardless of whether energy-only markets can provide the right signals for investment."*¹⁰⁹

The National Energy Guarantee (the Guarantee) offers the opportunity for policy stability. If the final design of the Guarantee is endorsed by the states at the COAG Energy Council meeting scheduled for August 2018, then for the first time in almost a decade Australia will have a stable energy and climate-change policy. The Guarantee and the Finkel Blueprint provide a sound platform to underpin new investment in the NEM.

Yet the threat of government intervention remains, an example being the Federal Government becoming the sole shareholder in Snowy Hydro and pressing on with Snowy Hydro 2.0. Some politicians are calling for the compulsory acquisition of Liddell power station.¹¹⁰ Those calls should be rejected. Even with a settled, national energy and climate-change policy, such as the Guarantee, direct government intervention is likely to spook potential investors.

5.1.2 Keep downward pressure on input costs

The Australian prices for the two major fuel sources for conventional electricity generation – black coal and gas – are linked to international

109. Wood et al. (2017a).

110. Koziol (2018).

prices for those commodities. And there is little that domestic governments can do to alter the international supply and demand balance of either.

Governments should continue to implement the recommendations of the ACCC's *East Coast Gas Inquiry* that reported in 2016.¹¹¹ These include revising the restrictions several states have imposed on exploring for and developing unconventional gas resources, and increasing transparency around gas prices.

Gas prices have fallen to between \$8 and \$10 a gigajoule, from a high of \$20 a gigajoule.¹¹² But these prices are still way above the \$3 to \$4 a gigajoule paid before the domestic market was opened up for export.

International gas prices have historically been higher than domestic gas prices. Opening up the gas market for export means domestic customers must now compete with international customers. Through the ACCC monitoring role, export parity pricing should be the appropriate price benchmark.

5.1.3 Be honest with the public about prices

The east coast of Australia has benefited from legacy electricity generators built under government ownership. Together with periods of overcapacity created by further subsidised government intervention, it has led to prices closer to the SRMC of generation than the LRMC.

But the closure of two big coal-fired power stations has ended this period of overcapacity, and prices have responded accordingly. While renewables subsidised by the RET and state-based renewable energy schemes may well force prices down over the short term, in the long term, prices will need to rise above historical levels.

111. ACCC (2016).

112. ACCC (2018).

The NEM's legacy generation assets are coming to the end of their life and will need to be replaced. Prices in the market will need to be higher to encourage investment in new generation.¹¹³ And prices will need to remain high so generators can recover these capital costs.

It seems highly unlikely that the wholesale market will revert to sub-\$50 per megawatt hour prices for long periods. The best recommendation for politicians is to be honest with the electorate about that, or both politicians and the electorate are likely to be disappointed. If politicians want to put downward pressure on prices, they should focus on other parts of the electricity supply chain such as the retailers and the networks.¹¹⁴

5.2 Addressing gaming and market inefficiencies

Chapter 3 identified instances where generators in Queensland and South Australia have taken advantage of short-term constraints to increase half-hourly prices. This behaviour is neither illegal nor a major cause of the leap in wholesale electricity prices in the NEM since 2015. But extreme price fluctuations have increased wholesale spot-prices by around 10 per cent each year in Queensland and South Australia since 2013. And policy makers should address the problem by reforming market rules. The remainder of this section discusses rule changes that could prevent gaming.

Overseas markets have different structures and different rules. But they can suggest worthwhile ideas. Any rule change must be considered and developed in the context of the NEM.

113. The high cost of thermal coal and the flow-through of high gas costs add to the price pressure.

114. Wood et al. (2017c); and Wood et al. (2017b).

5.2.1 A gate-closure mechanism

Under current rules, rebidding can occur up to 67 seconds prior to the start of a 5-minute dispatch interval. This enables, even encourages, gaming. The fact that generators can submit very late rebids limits the ability of other generators to respond. Some generators are unable to ramp up quickly enough to respond to high prices that are projected in the very short-term.

An alternative would be a gate-closure mechanism, where the market is closed at a specified, longer, time before dispatch, and rebids at higher prices are then barred except in exceptional, specific circumstances. In Alberta, Canada, for example, the 'gate' is closed two hours before dispatch and rebids can be made only if power stations or units malfunction or break down.¹¹⁵

AEMC should reconsider a gate-closure mechanism for the NEM. The gate could be closed half an hour before dispatch.¹¹⁶ Late rebids at lower prices would be allowed, but any generator making a rebid at higher prices after closure would need to justify that decision to the market operator. If the justification was deemed inadequate, the generator would face a financial penalty.¹¹⁷ The mechanism could be designed so that generators bear the costs of the investigations into late bids.

Such a gate-closure mechanism would provide two core benefits:

- Generators would have time to respond to a rebid upwards just before closure by rebidding downwards their own generation, thereby lowering the price and ensuring dispatch.

115. Market Surveillance Administrator (2010).

116. The current prohibition against making false or misleading offers is a 'soft' gate-closure mechanism. The market rules should be strengthened to eliminate gaming.

117. Justifications should be more stringent than under the current market rules.

- AEMO would have time to synchronise and dispatch cheaper generation in the bid stack if a rebid just before closure forced the price up.

A day-ahead market would have a similar impact to a gate-closure mechanism, but it would involve a major change to the design of the NEM. And prices in a day-ahead market are typically higher than prices in a real-time market.¹¹⁸

5.2.2 Other potential market changes

Electricity wholesale markets around the world include a variety of other mechanisms to encourage competitive pricing and reliable supply. These include pivotal supplier rules, day-ahead markets, and/or demand-response mechanisms. All three should be considered for the NEM if smaller changes prove ineffective. But these more fundamental changes to the operation of the NEM cannot be considered in isolation.

Day-ahead market

A day-ahead market operates in the same way as the NEM spot market but 24 hours in advance of dispatch. Retailers and large businesses request a certain quantity of electricity for the following day, and generators respond by bidding their available output. Price and quantities are agreed for the following day.¹¹⁹ There is still a real-time wholesale market, where additional generation needed on the day is bought and sold.

The main difference between a day-ahead market and the NEM's current pre-dispatch process is that outcomes from the day-ahead market are financially binding. Because a large proportion of electricity is financially settled a day ahead, there is less incentive for generators

118. Wood et al. (2017a).

119. Schubert et al. (2002).

to game the system by resorting to late, strategic bidding in the real-time market. And any strategic bidding that does occur increases the wholesale price of only a proportion of all generation.

Many electricity systems in the US and Europe have day-ahead markets.¹²⁰

The 2017 Finkel Blueprint for the NEM recommended that the AEMC and AEMO investigate the suitability of a day-ahead market to help maintain system reliability.¹²¹ Prices are typically higher in a day-ahead market because the further out electricity is sold the greater the risk of non-delivery.

Pivotal supplier test

To limit big firms' ability to exert their market power to push prices to exorbitant levels, several North American jurisdictions use what is known as a pivotal supplier test.¹²²

AEMO should investigate whether such a test could help stop gaming in the NEM. The test would apply only when demand is very high or supply is severely constrained, such as when a transmission line is broken or a power station goes offline. If AEMO can meet demand during that period only by getting electricity from a pivotal supplier, AEMO could impose a price limit. The pivotal generator would then have to make its capacity available to the market for that period at the AEMO-imposed price.

Correctly designed, a pivotal supplier test could prevent big generators exerting their market power over short periods to rebid late into the market and force up prices.

120. For example, PJM, ERCOT, California, NYISO, ISO-NE, Northeast, Midwest, and Nord Pool.

121. Commonwealth of Australia (2017).

122. For example, ERCOT, California, and PJM. See Harvey and Pope (2017).

Demand response

Demand response gives consumers greater opportunity to manage their costs. And it can be cheaper and faster to introduce into the market than supply-side responses.¹²³ Demand response introduces greater flexibility into the market through financial incentives for consumers to reduce their energy use, and can reduce the impact of supply-side market concentration.

The five-minute settlement rule will improve very short-term incentives to manage demand. Sun Metals, and some other large industrials, are capable of providing five-minute demand response.¹²⁴ And other small-scale initiatives are encouraging households to manage their demand in peak periods.¹²⁵

The Finkel Blueprint recommended the AEMC investigate more substantial demand-response mechanisms for the wholesale electricity market. This could be a demand-response market, where larger commercial consumers bid their demand-response offers in a similar way to supply offers in the NEM. The current incentives for residential consumers to allow centralised management of their high-energy appliances during peak demand could also be extended.¹²⁶

5.3 Breaking up private generation companies is not warranted

Each of the state electricity markets in the NEM is at least moderately concentrated (see Chapter 3); there are levels of 'horizontal integration', whereby a firm owns multiple generators. The NEM also has high levels of 'vertical integration' – a single company owning both generation and retail businesses. Vertical integration can impact on both the generation and retail markets, as discussed in Box 2.

123. Commonwealth of Australia (2017).

124. Choi (2015).

125. Commonwealth of Australia (2017).

126. Wood et al. (2017a).

If the levels of concentration in state markets lead to firms exerting market power, then the most extreme option for dealing with it would be to break up the companies.

Queensland and South Australia would be primary targets for such market disaggregation, given most of the gaming appears to have occurred in those states. But NSW and Victoria are similarly concentrated, and, under the right scenarios, could experience the same behaviour.

The Queensland Government over time has reduced the number of publicly-owned generation companies from four to two – CS Energy and Stanwell.¹²⁷ The Labor Party went to the 2015 state election promising to merge the remaining generation businesses into a single entity. But the ACCC and major energy users expressed concern about the plan and, after winning election, Labor abandoned it.¹²⁸

To increase competition in the Queensland spot market, the government should split its generation businesses back into at least three.¹²⁹ This would enable the market to deliver more efficient prices, rather than relying on the government directing the behaviour of generators.

Disaggregating privately-owned businesses would be harder. The ACCC has no powers to divest a company of its assets – the ACCC cannot, for example, force an energy business to sell one of its generators.¹³⁰ The federal Government could introduce legislation that provided the ACCC with these powers, but it would be a long process

and would not necessarily guarantee that the businesses would be broken up.

Alternatively, the federal Government could compulsorily acquire parts of the generation companies – as has recently been suggested in the case of Liddell power station.¹³¹ Following acquisition, the government could then sell the business to a private enterprise.

But the compulsory acquisition route is fraught with difficulty. Section 51(xxxi) of the Constitution allows the federal Government to compulsorily acquire a company, but the process could be long and challenged in the courts.¹³²

There are also significant sovereign-risk issues associated with such blunt government intervention. At a time when there is a poor investment environment, compulsory acquisition would deter new investors in the generation market. And these risks would be likely to spread far beyond the electricity market.

Instead of trying to break up private energy companies, government should change market rules to prevent firms exerting market power. Government should be encouraging new investment by providing policy stability. Attempting to divest existing companies of their assets is likely to have exactly the opposite effect.

127. CS Energy (2011).

128. O'Brien (2015).

129. Labor has announced its intention to create a third generator, CleanCo, and the LNP has announced its intention to restructure the government-owned generation companies from two to three to drive down prices through increased competition, Moorhead (2017) and Frecklington (2018).

130. Potter (2018).

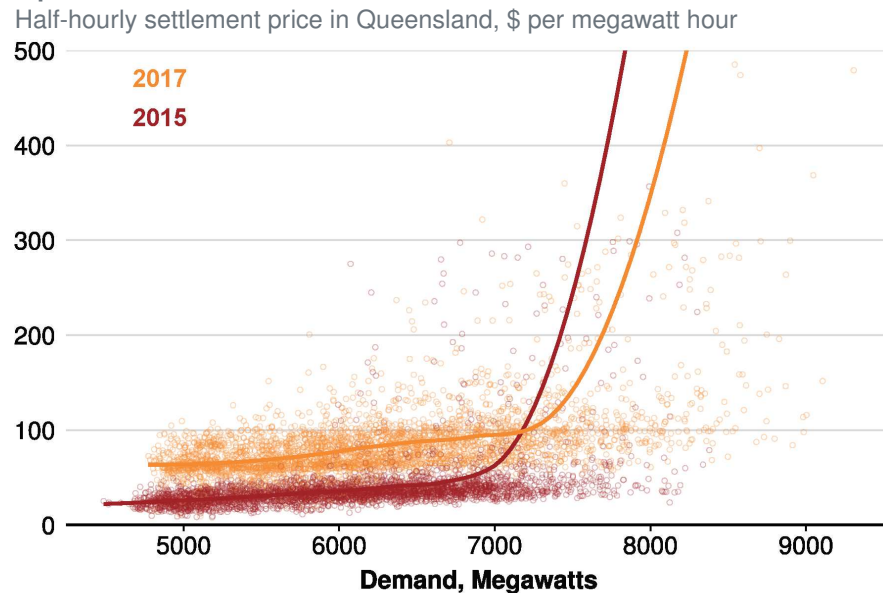
131. Murphy (2018).

132. ABC News (2018); and Wylie and Raper (2018).

Appendix A: Supplementary state charts

A.1 Queensland

Figure A.1: Supply curves have moved up and right in Queensland as input costs rise

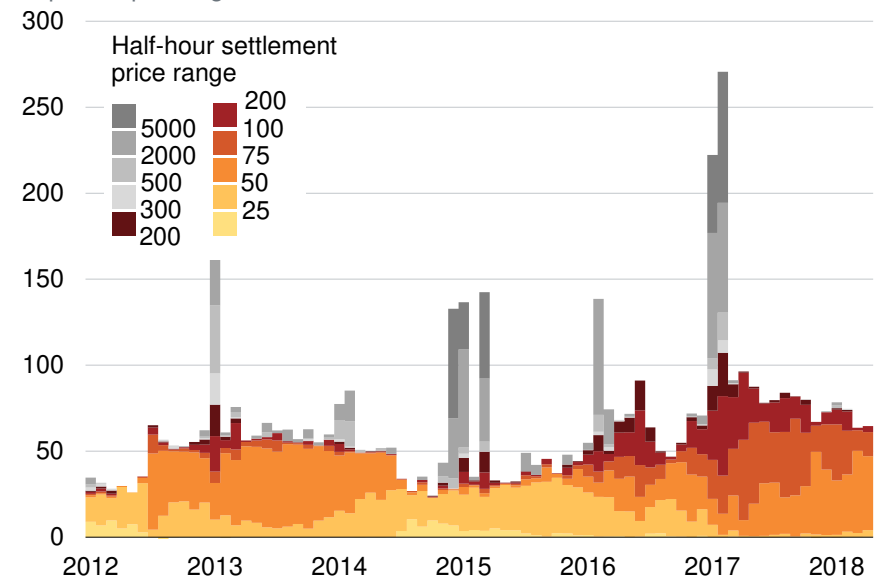


Notes: The faint circles represent the settlement price and demand for each half hour in that 12-month period. The lines are the average of all these half-hour settlement periods, or the 'supply curves'.

Source: Grattan analysis of AEMO (2018a).

Figure A.2: It's not only extreme prices pushing up the average price in Queensland

Monthly average wholesale price by proportional half-hour settlement price impact, \$ per megawatt hour

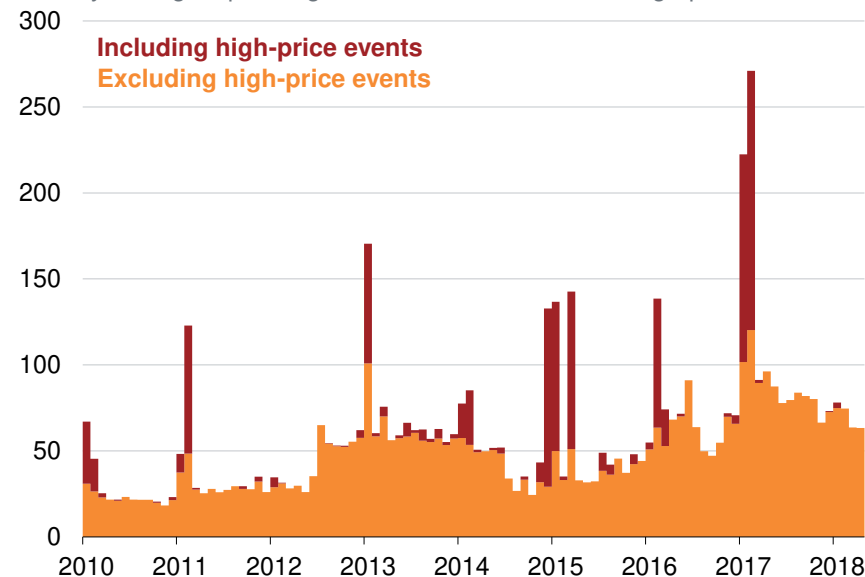


Notes: The height of each bar represents the cost-range contribution to the average monthly wholesale cost, not the frequency of the costs-range for half-hour settlement prices. So grey sections represent infrequent periods of high cost which have a large proportional impact on the monthly average.

Source: Grattan analysis of AEMO (ibid.).

Figure A.3: Infrequent high-price events can have a big impact on average prices in Queensland

Monthly average \$ per megawatt hour with and without high-price events

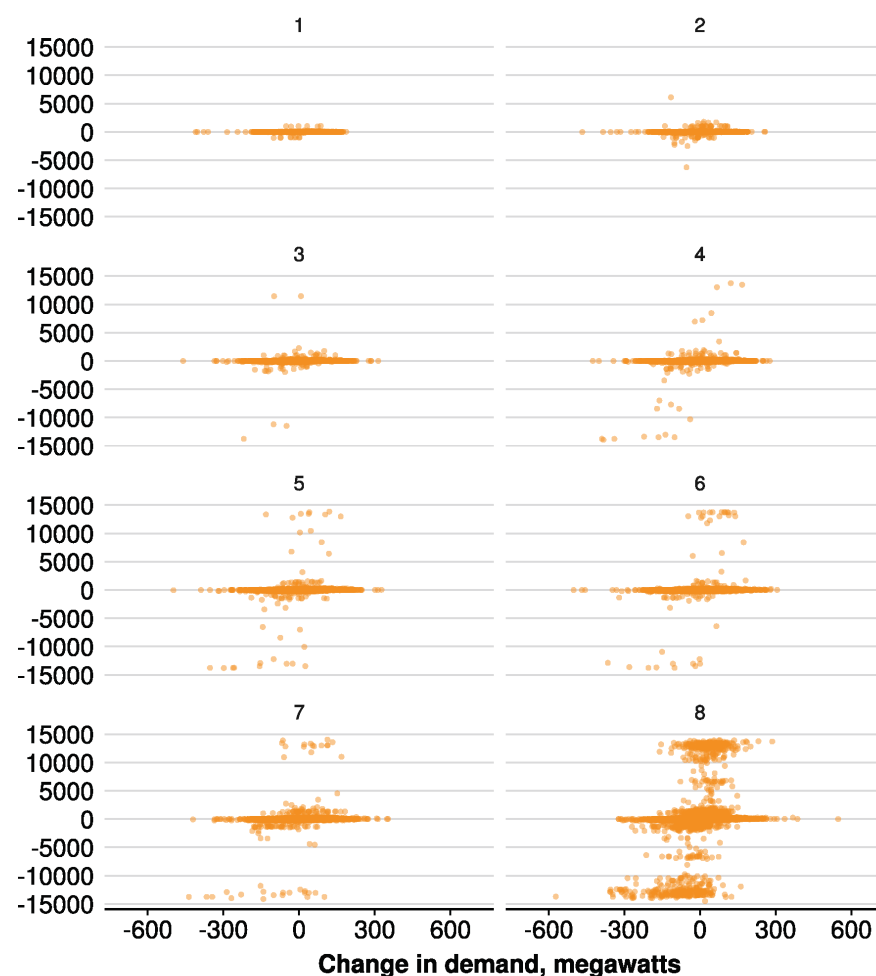


Notes: High-price events are those half-hour settlement periods where the settlement price was \$500 or more.

Source: Grattan analysis of AEMO (2018a).

Figure A.4: Queensland experiences big fluctuations in price at moderate demand

Change in price, \$ per megawatt, 2012 to 2018 by octile



Notes: X-axis is change in demand between 5-minute dispatch intervals, Y-axis is the corresponding change in price between 5-minute dispatch intervals.

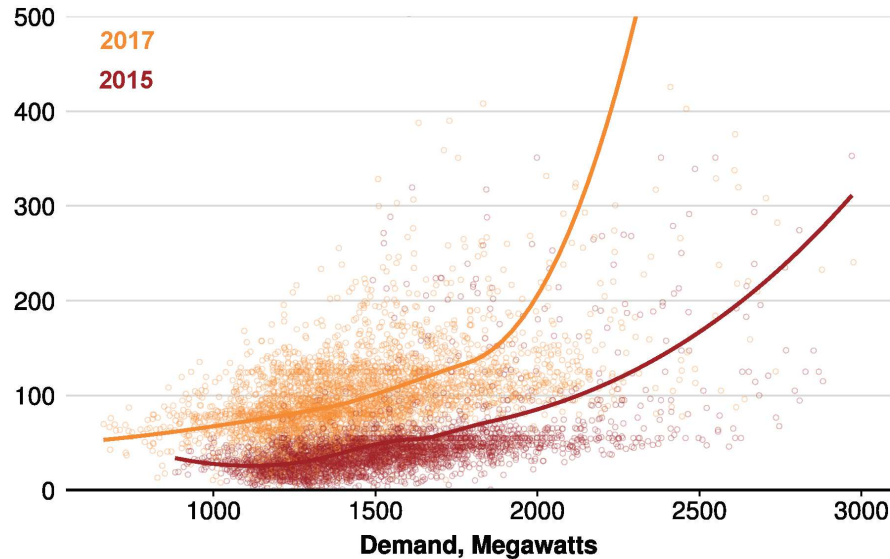
Octiles divide demand into 8 groups by year to assist comparisons between states.

Source: Grattan analysis of AEMO (ibid.).

A.2 South Australia

Figure A.5: Supply curves have moved up and left in South Australia as input costs rise and generators close

Half-hourly settlement price in South Australia, \$ per megawatt hour

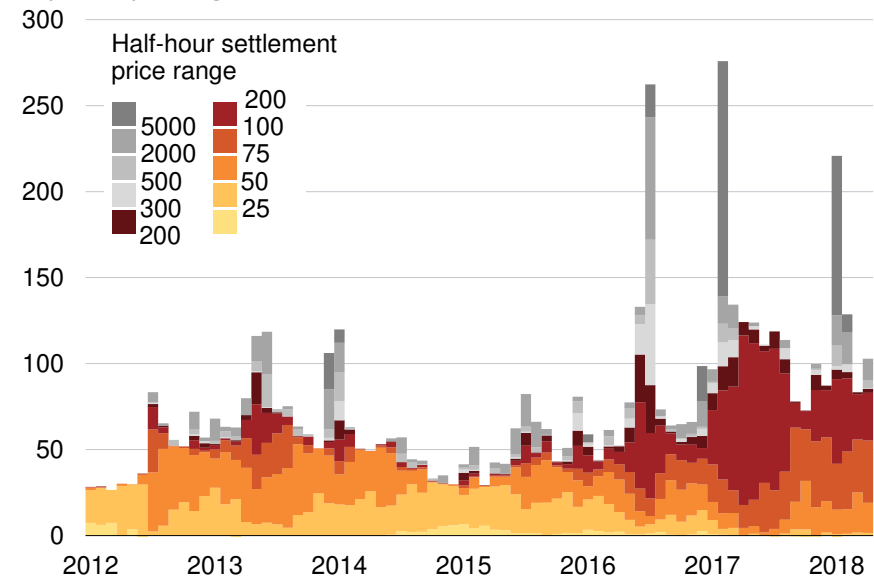


Notes: The faint circles represent the settlement price and demand for each half hour in that 12-month period. The lines are the average of all these half-hour settlement periods, or the 'supply curves'.

Source: Grattan analysis of AEMO (2018a).

Figure A.6: It's not only extreme prices pushing up the average price in South Australia

Monthly average wholesale price by proportional half-hour settlement price impact, \$ per megawatt hour

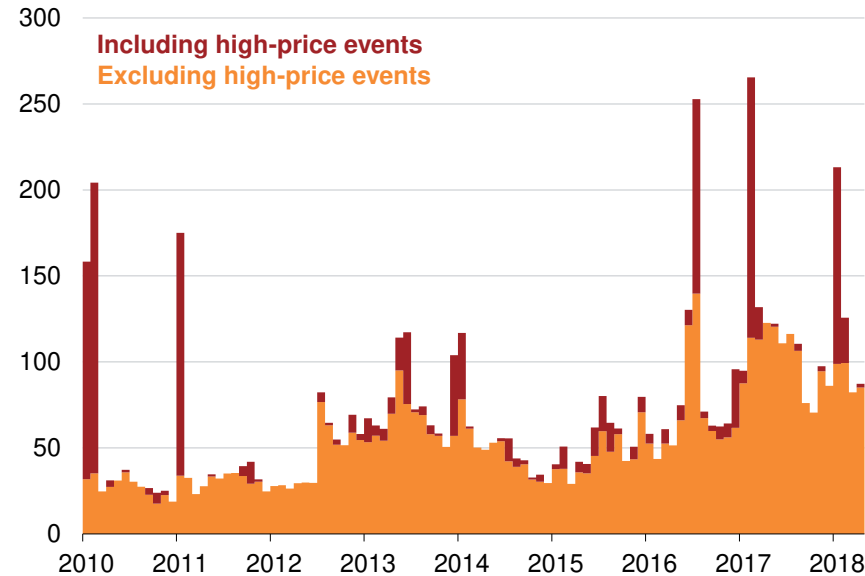


Notes: The height of each bar represents the cost-range contribution to the average monthly wholesale cost, not the frequency of the costs-range for half-hour settlement prices. So grey sections represent infrequent periods of high cost which have a large proportional impact on the monthly average.

Source: Grattan analysis of AEMO (ibid.).

Figure A.7: Infrequent high-price events can have a big impact on average prices in South Australia

Monthly average \$ per megawatt hour with and without high-price events

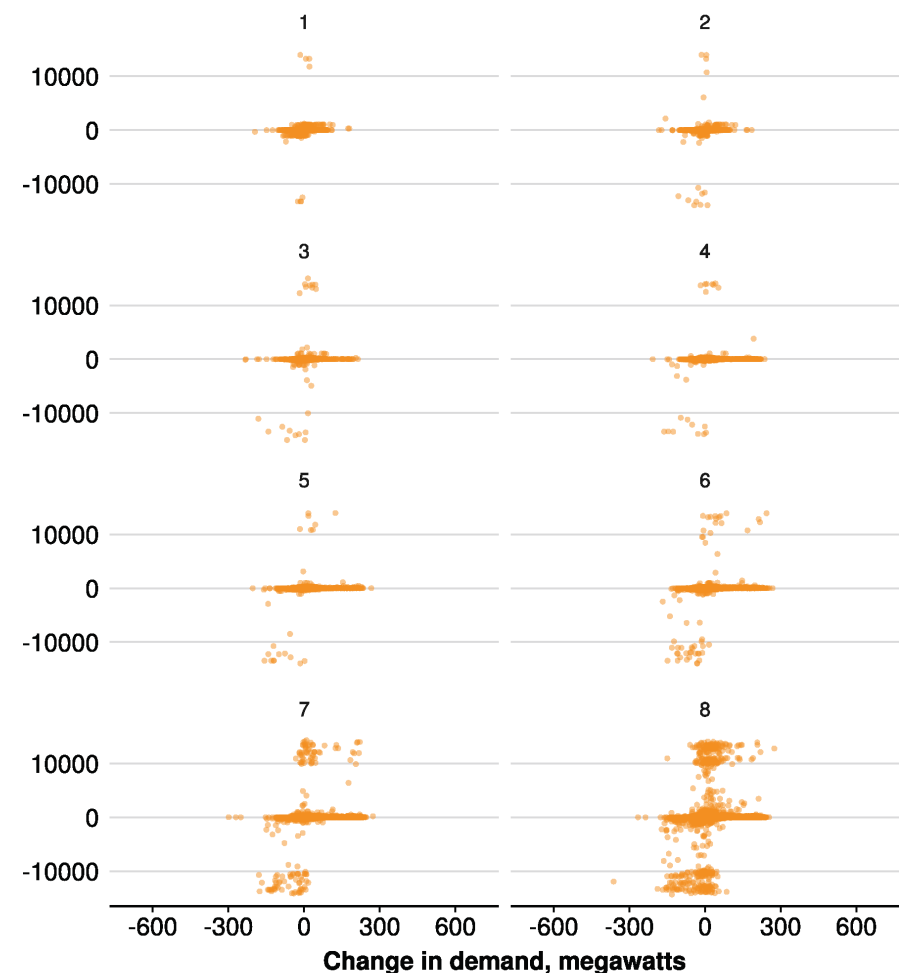


Notes: High-price events are those half-hour settlement periods where the settlement price was \$500 or more.

Source: Grattan analysis of AEMO (2018a).

Figure A.8: South Australia experiences big fluctuations in price at moderate demand

Change in price, \$ per megawatt, 2012 to 2018 by octile



Notes: X-axis is change in demand between 5-minute dispatch intervals, Y-axis is the corresponding change in price between 5-minute dispatch intervals.

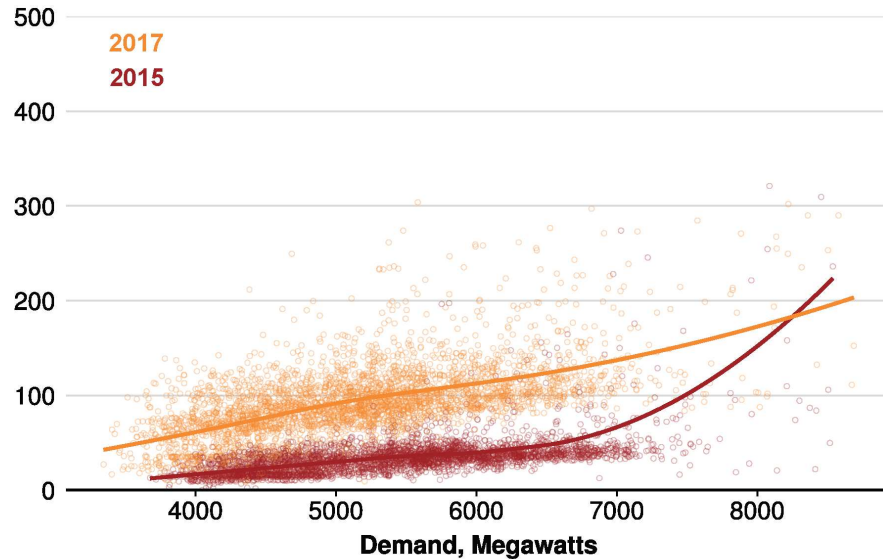
Octiles divide demand into 8 groups by year to assist comparisons between states.

Source: Grattan analysis of AEMO (ibid.).

A.3 Victoria

Figure A.9: Supply curves have moved up and left in Victoria as input costs rise and generators close

Half-hourly settlement price in Victoria, \$ per megawatt hour

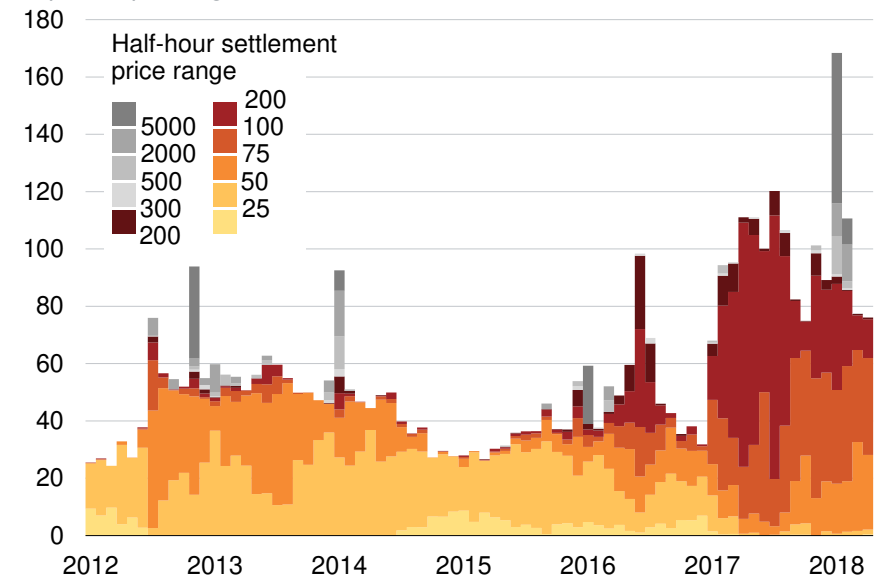


Notes: The faint circles represent the settlement price and demand for each half hour in that 12-month period. The lines are the average of all these half-hour settlement periods, or the 'supply curves'.

Source: Grattan analysis of AEMO (2018a).

Figure A.10: It's not just extreme prices pushing up the average price in Victoria

Monthly average wholesale price by proportional half-hour settlement price impact, \$ per megawatt hour

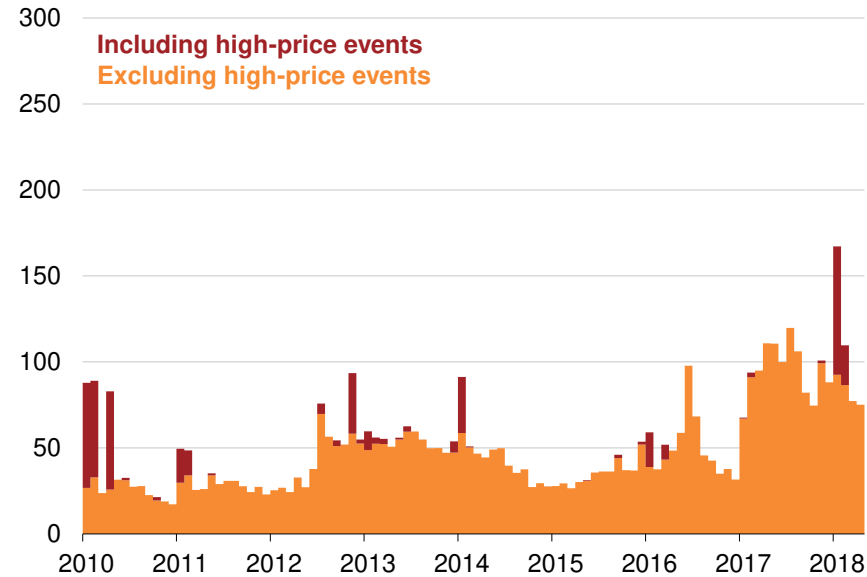


Notes: The height of each bar represents the cost-range contribution to the average monthly wholesale cost, not the frequency of the costs-range for half-hour settlement prices. So grey sections represent infrequent periods of high cost which have a large proportional impact on the monthly average.

Source: Grattan analysis of AEMO (ibid.).

Figure A.11: Infrequent high-price events can have a big impact on average prices in Victoria

Monthly average \$ per megawatt hour with and without high-price events

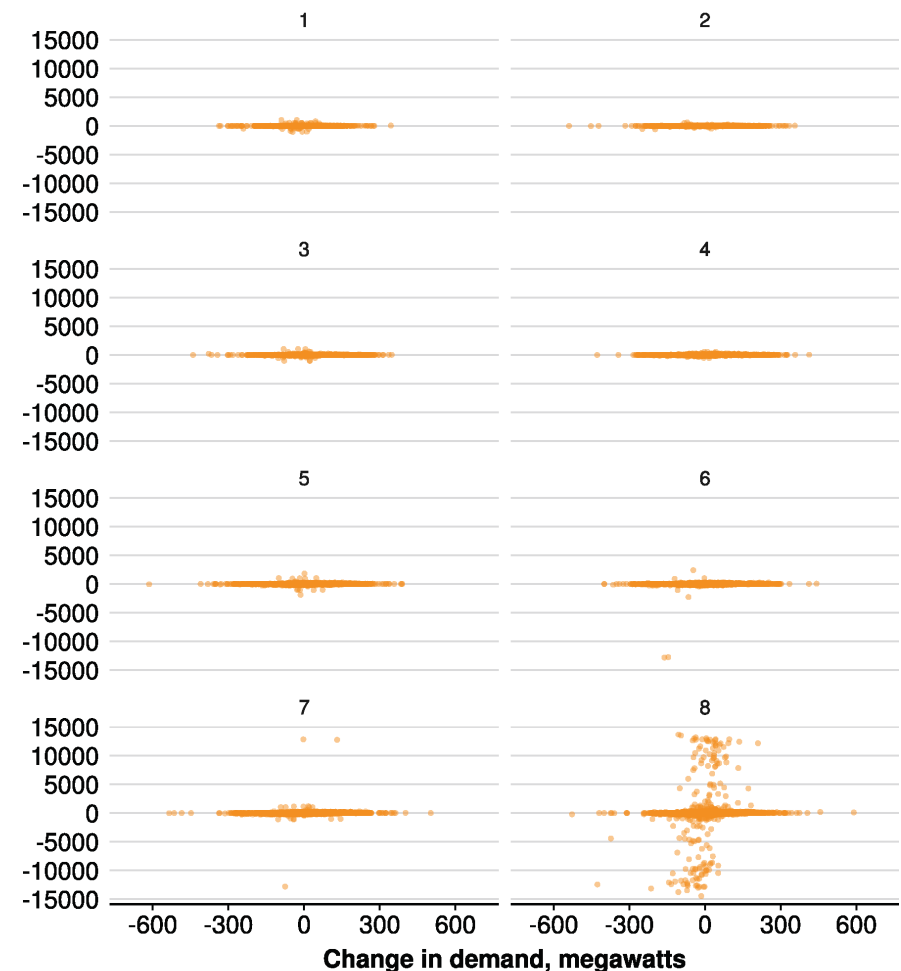


Notes: High-price events are those half-hour settlement periods where the settlement price was \$500 or more.

Source: Grattan analysis of AEMO (2018a).

Figure A.12: Victoria has few big changes in price with changing demand

Change in price, \$ per megawatt, 2012 to 2018 by octile



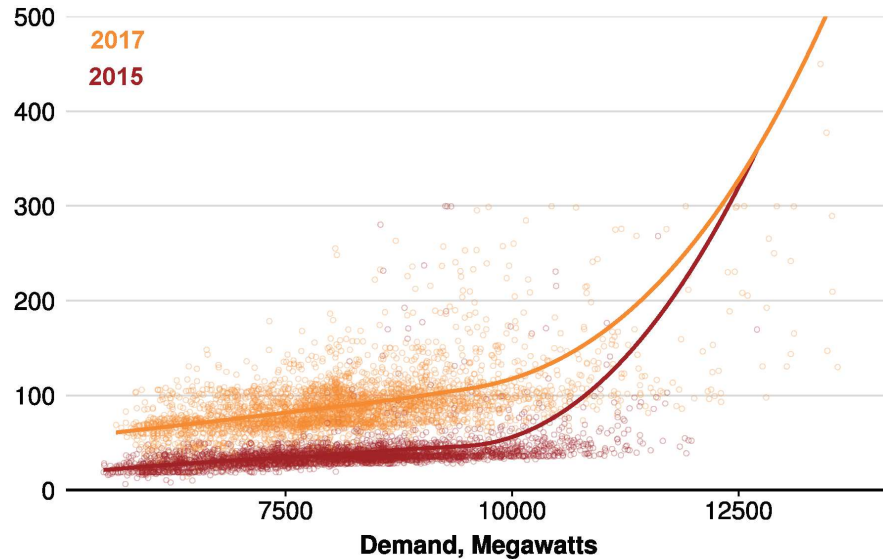
Notes: X-axis is change in demand between 5-minute dispatch intervals, Y-axis is the corresponding change in price between 5-minute dispatch intervals.

Octiles divide demand into 8 groups by year to assist comparisons between states.

Source: Grattan analysis of AEMO (ibid.).

A.4 New South Wales

Figure A.13: Supply curves have moved up and left in NSW as input costs rise and generators close
Half-hourly settlement price in New South Wales, \$ per megawatt hour

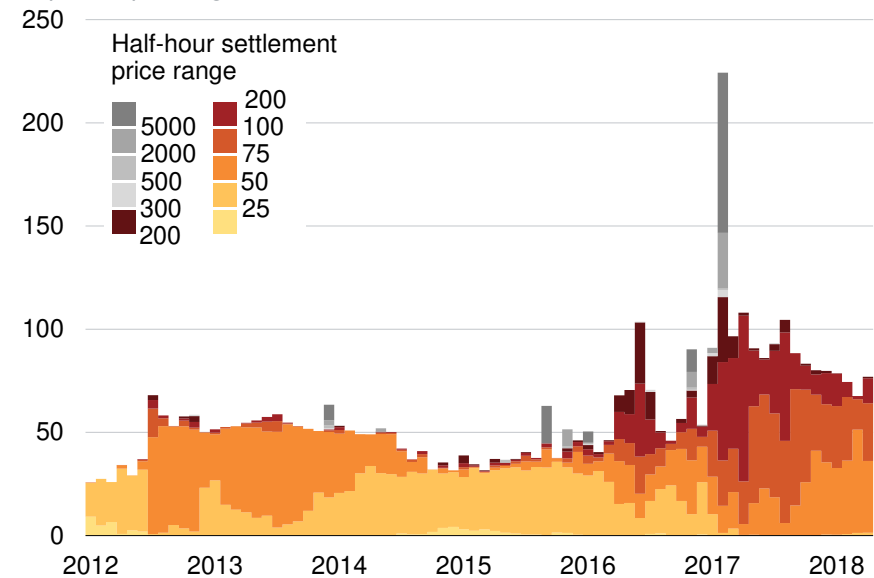


Notes: The faint circles represent the settlement price and demand for each half hour in that 12-month period. The lines are the average of all these half-hour settlement periods, or the 'supply curves'.

Source: Grattan analysis of AEMO (2018a).

Figure A.14: It's rarely extreme prices pushing up the average price in NSW

Monthly average wholesale price by proportional half-hour settlement price impact, \$ per megawatt hour

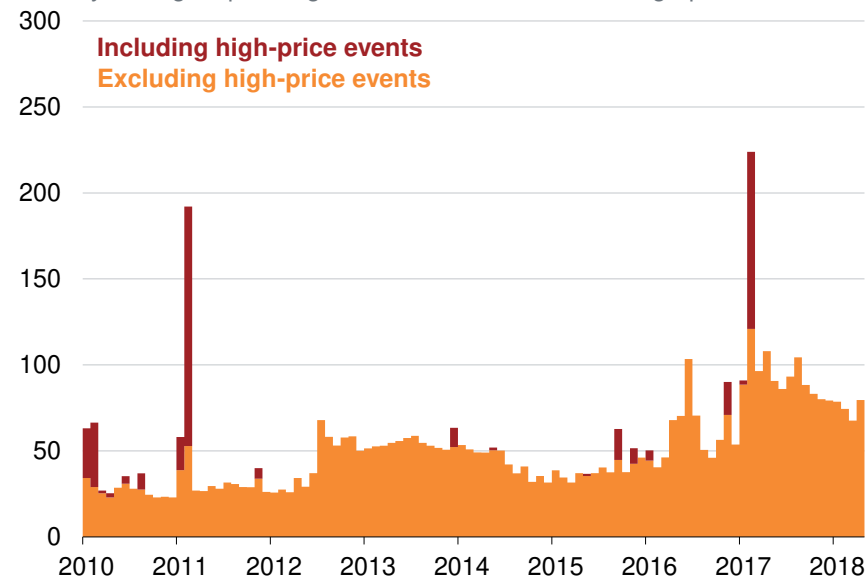


Notes: The height of each bar represents the cost-range contribution to the average monthly wholesale cost, not the frequency of the costs-range for half-hour settlement prices. So grey sections represent infrequent periods of high cost which have a large proportional impact on the monthly average.

Source: Grattan analysis of AEMO (ibid.).

Figure A.15: Infrequent high-price events can have a big impact on average prices in NSW

Monthly average \$ per megawatt hour with and without high-price events

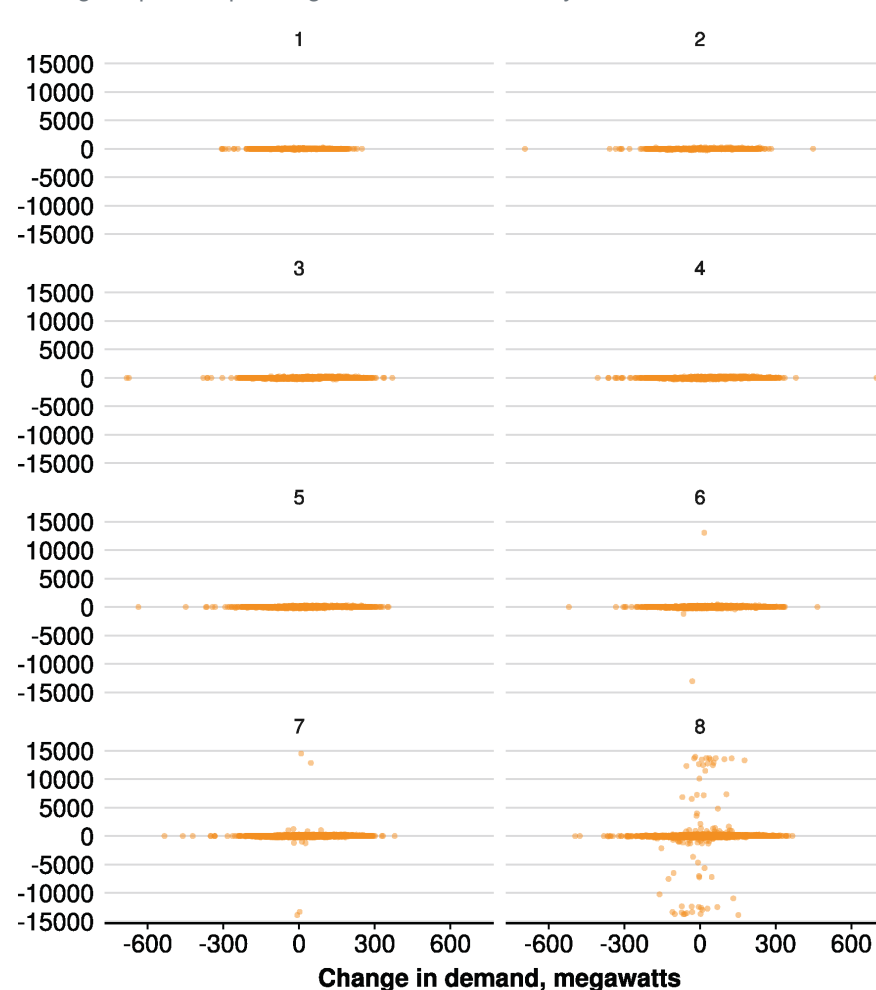


Notes: High-price events are those half-hour settlement periods where the settlement price was \$500 or more.

Source: Grattan analysis of AEMO (2018a).

Figure A.16: New South Wales has few big changes in price with changing demand

Change in price, \$ per megawatt, 2012 to 2018 by octile



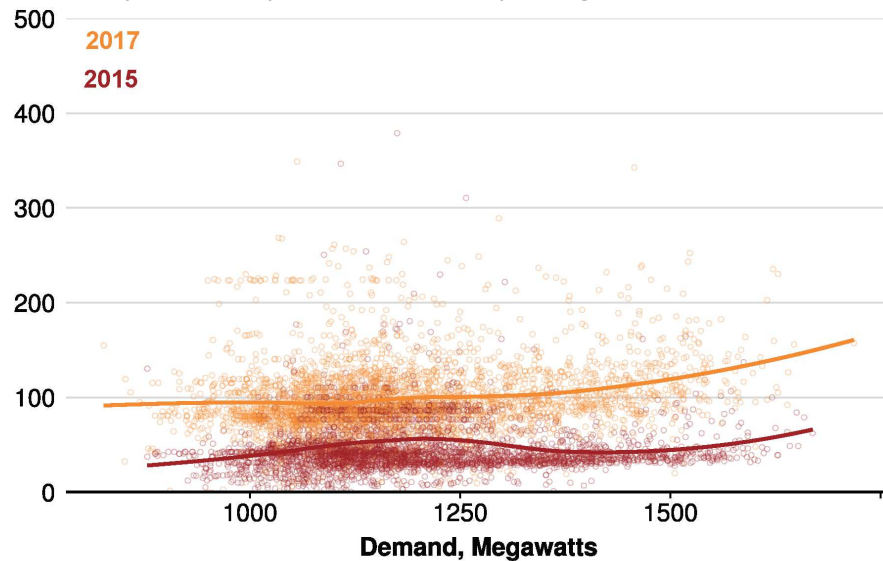
Notes: X-axis is change in demand between 5-minute dispatch intervals, Y-axis is the corresponding change in price between 5-minute dispatch intervals.

Octiles divide demand into 8 groups by year to assist comparisons between states.

Source: Grattan analysis of AEMO (ibid.).

A.5 Tasmania

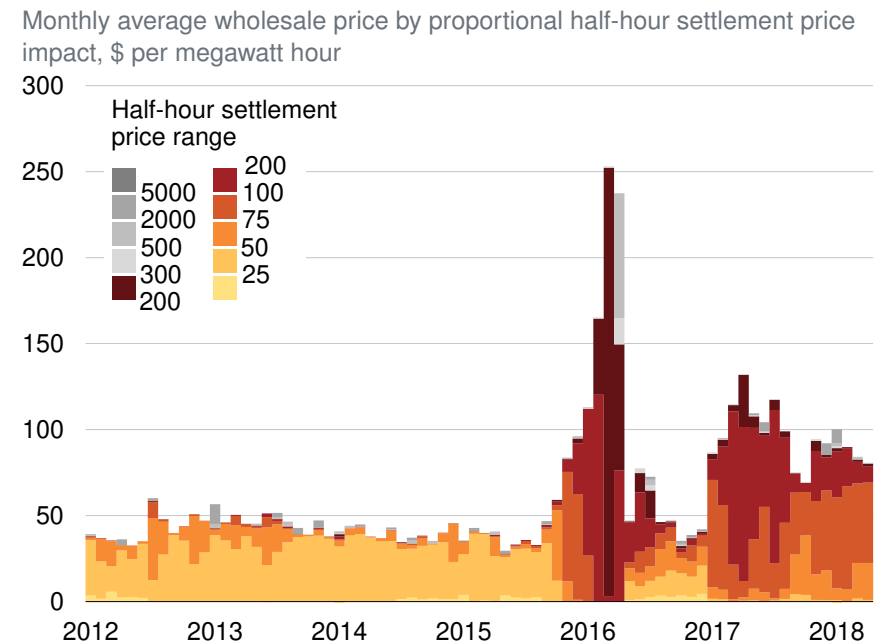
Figure A.17: The supply curve is very flat in Tasmania
Half-hourly settlement price in Tasmania, \$ per megawatt hour



Notes: The faint circles represent the settlement price and demand for each half hour in that 12-month period. The lines are the average of all these half-hour settlement periods, or the 'supply curves'.

Source: Grattan analysis of AEMO (2018a).

Figure A.18: It's not extreme prices pushing up the average price in Tasmania
Monthly average wholesale price by proportional half-hour settlement price impact, \$ per megawatt hour

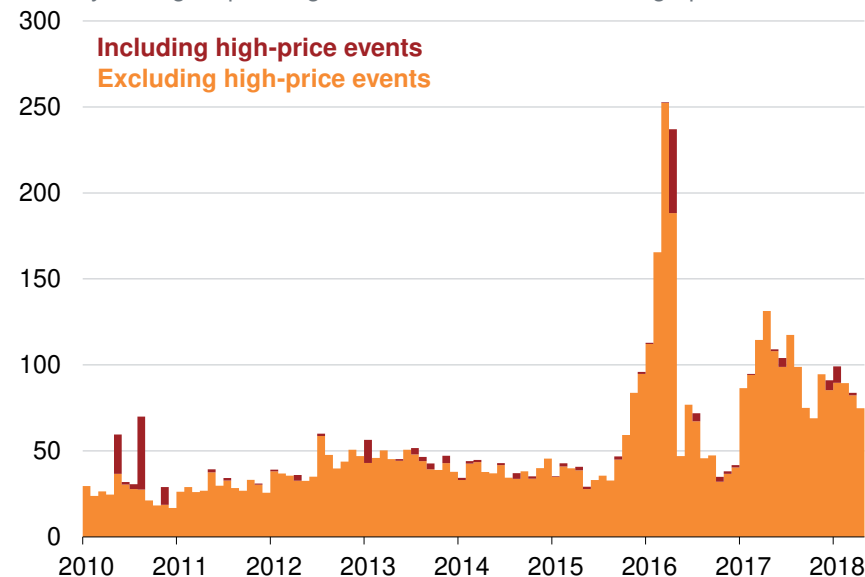


Notes: The height of each bar represents the cost-range contribution to the average monthly wholesale cost, not the frequency of the costs-range for half-hour settlement prices. So grey sections represent infrequent periods of high cost which have a large proportional impact on the monthly average.

Source: Grattan analysis of AEMO (ibid.).

Figure A.19: Infrequent high-price events can have a big impact on average prices in Tasmania

Monthly average \$ per megawatt hour with and without high-price events

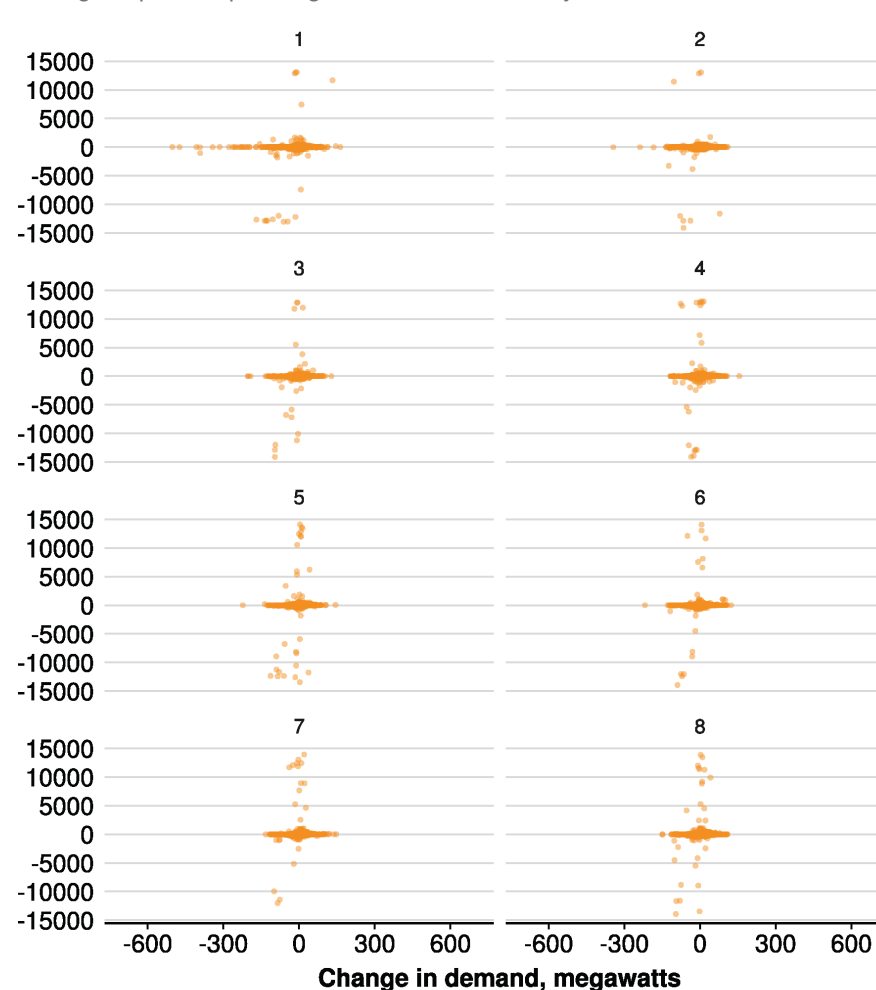


Notes: High-price events are those half-hour settlement periods where the settlement price was \$500 or more.

Source: Grattan analysis of AEMO (2018a).

Figure A.20: Tasmania has an unusual pattern of price change with respect to demand

Change in price, \$ per megawatt, 2012 to 2018 by octile



Notes: X-axis is change in demand between 5-minute dispatch intervals, Y-axis is the corresponding change in price between 5-minute dispatch intervals.

Octiles divide demand into 8 groups by year to assist comparisons between states.

Source: Grattan analysis of AEMO (ibid.).

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