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National Energy Emissions Audit – Electricity Update

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Providing a comprehensive, up-to-date indication of key electricity trends in Australia

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Introduction

Welcome to the second issue of the *NEEA Electricity Update*, the companion publication to the *National Energy Emissions Audit Report*. The *Electricity Update* is published monthly and presents data on electricity demand, electricity supply, and electricity generation emissions in the National Electricity Market (NEM) up to the end of the immediately preceding month. Each issue of *Electricity Update* contains a more detailed discussion of one or two particular topics relating to the electricity system which have assumed particular importance in the period prior to publication. For this issue the topic is retail electricity prices.

All data are reported as annual moving averages. This approach removes the impact of seasonal changes on the reported data. Annualised data reported in *NEEA Electricity Update* will show a month on month increase if the most recent monthly quantity is greater than the quantity in the corresponding month one year previously. Most data are presented in the form of time series graphs, starting in June 2011, i.e. with the year ending June 2011. Some graphs start in June 2008. These starting dates have been chosen to highlight important trends, while enhancing presentational clarity.

Readers coming to *NEEA Electricity Update* for the first time may find it helpful to read the inaugural June 2017 issue, which contains more detailed background information about definitions of the various data categories displayed, such as “generation” and “demand”, and how that affects the interpretation of the graphs.

Key points

NEM electricity generation emissions down slightly

Total emissions from electricity generation in the NEM fell slightly in the year to June 2017, showing the emissions abatement benefit of the Hazelwood power station closure in March.

Brown coal generation down, black coal up and Victoria now a net importer from NSW

Annual brown coal generations decreased, as it will for the next nine months as the effect of the Hazelwood closure flows through to annualised totals. This was offset by increased black coal generation in both NSW and Queensland, increased electricity exports from Queensland to NSW, and a reversal of the flow between NSW and Victoria, from net imports into NSW to net exports from NSW to Victoria.

The additional emissions from these power stations were no large enough to offset the reductions from the Hazelwood closure, because black coal and gas generators are so much less intensive than the replaced generation from Hazelwood.

June a bad month for wind generation

June appears to have been probably the least windy month in south east Australia for at least a decade, leading to a large fall in wind generation, which was made up by additional output from both black coal and gas generators.

Total NEM demand down and WA demand also down

In the year to June 2017, total demand for electricity in Queensland, Victoria and WA decreased for the fourth successive month; demand stayed almost precisely constant in SA, and increased in NSW and Tasmania. For the NEM as a whole, the overall outcome was a small drop in total demand, after a small increase in May.

Higher NEM wholesale prices responsible for large increases in retail prices from 1 July

Large increases in retail electricity prices, starting from 1 July in NSW, Queensland, SA, Tasmania and the ACT are almost entirely the result of much higher wholesale prices in the National Electricity Market. These increases will make retail prices across the NEM the highest ever since the start of the NEM, in real 2017 $ terms, and probably the highest in real terms since the 1970s, if not the 1960s.

High electricity prices are caused by the high wholesale price of gas, in both SA and other states

A specific examination of retail prices in SA leads to three strong findings:

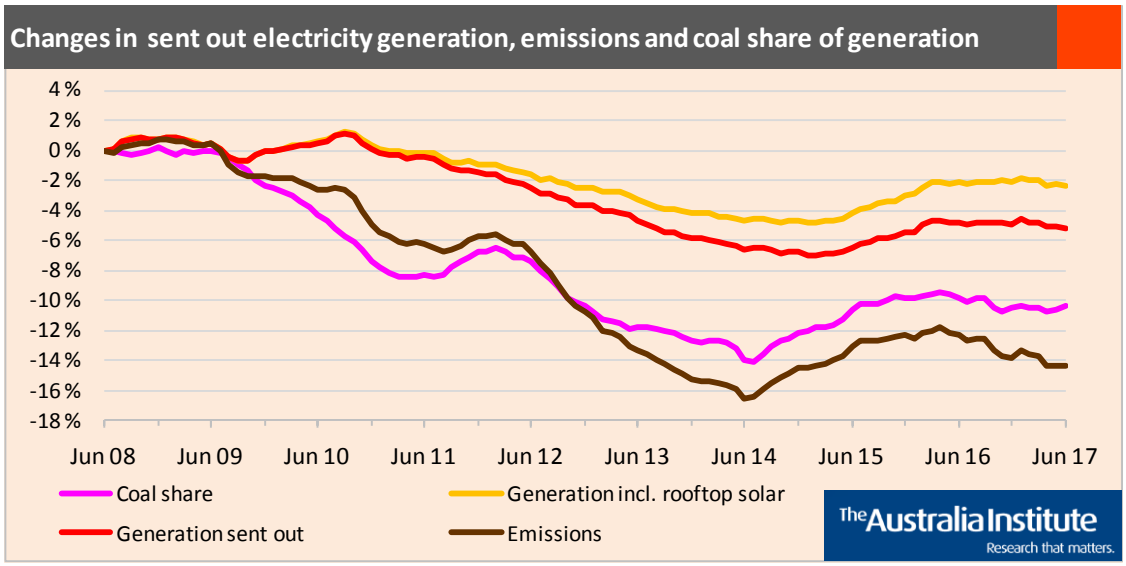
- electricity prices have historically always been higher in SA than in other states, because there are no low cost, high quality coal and hydro resources in the state;
- there is absolutely no positive relationship between the share of wind generation in supply and wholesale electricity prices in the state – in fact a negative correlation;
- there is a very strong positive correlation between wholesale gas prices and wholesale electricity prices.

It is therefore concluded that price increases in SA, and to a large extent in other states also, are almost entirely the consequence of high wholesale gas prices.

Generation and emissions

Figure 1 shows that total annual emissions from electricity generation in the NEM were virtually unchanged between May and June, while total generation, which is equal, of course, to NEM demand as shown in Figure 3, fell slightly. Figure 1 also shows the additional generation supplied by rooftop solar PV installed by both residential and commercial electricity consumers. The June 2017 issue of *NEEA Electricity Update* explains how the terms generation and demand are defined for the purposes of NEM operation, and hence how the graphs should be understood.

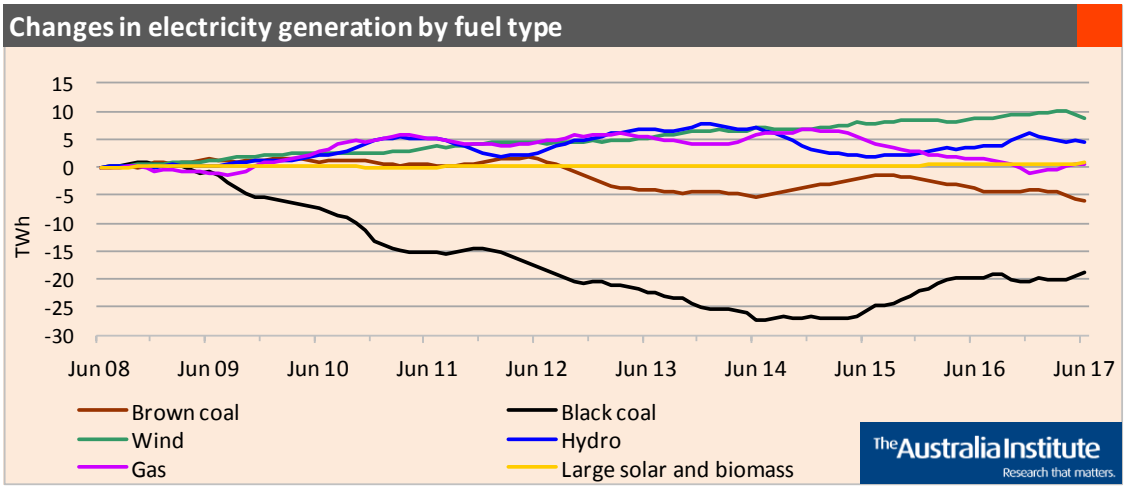
Figure 1



The interesting new aspect of Figure 1 is the divergence between coal share and total emissions in the past three months. This is a direct consequence of the closure of Hazelwood power station at the end of March, which led directly to a cessation of net exports of electricity from Victoria to NSW. NSW black coal power stations increased their output and, indeed, in May and June Victoria was a small net importer of electricity from NSW, for the first time in six years. NSW continued to import significant volumes from Queensland, meaning that coal generators in both states benefited from the absence of Hazelwood. In the NEM as a whole total coal generation went up (to the additional benefit of NSW and Queensland power stations), mainly because of the greatly reduced wind generation (see Figure 2), but emissions stayed roughly constant, because the NSW and Queensland power stations are much less emissions intensive than Hazelwood was.

The sharp reduction in both brown coal and wind generation during May and June can be clearly seen in Figure 2. Most people living in NSW, Victoria and SA during these months will have noted the large number of calm, sunny days (and almost complete absence of rain). This type of weather is of course very bad for wind generation and a quick inspection of the historic data suggests that June was probably the worst month since wind generation started to become important, about ten years ago. The average capacity factor for total NEM wind generation in June was 16%, compared with an average of 36% for calendar year 2016. Of the other generation types, brown coal was decisively down and black coal generation up, as already discussed. Gas generation also increased in Victoria and SA, while hydro decreased slightly.

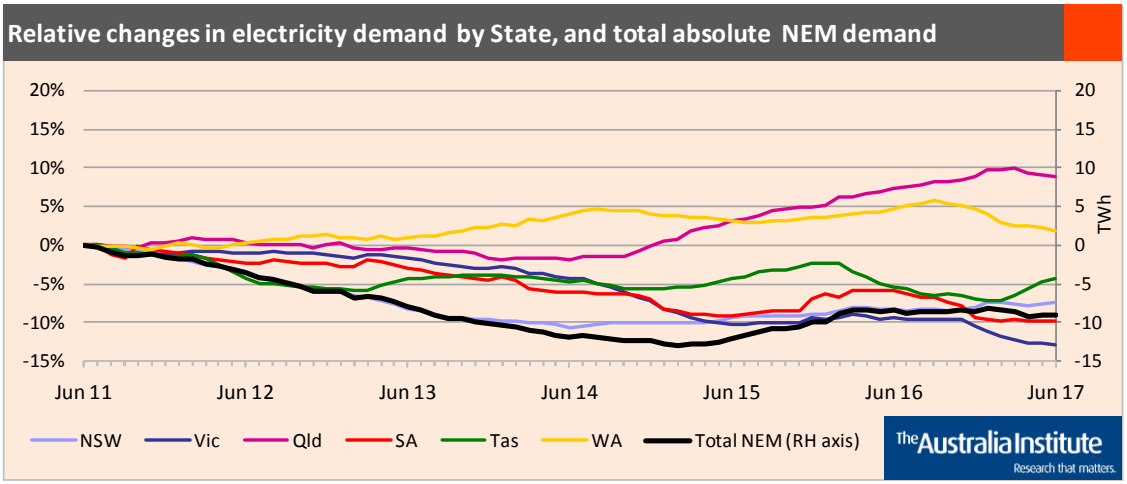
Figure 2



Demand

Figure 3 shows the relative changes, since the year ending June 2011, in total annual demand for electricity in each of the five regions of the NEM, and also in the SWIS. It also shows the absolute change in total demand in the NEM as a whole. Demand in both Queensland and WA continues to fall, suggesting that, behind the special factors driving growth in those states until recently, general trends in electricity consumption do not differ greatly across Australia.

Figure 3



A more detailed understanding of the trends in electricity consumption is provided by the performance benchmarking data for the Victorian distribution network businesses for calendar year 2016, published by the Australian Energy Regulator (AER) on 29 June last. The AER has been collecting performance data from all network businesses in the NEM since 2006, using a standard reporting template, thereby providing a data set which is consistent across businesses and over time. The Victorian businesses report on a calendar year basis and the corresponding businesses in all other NEM states report on a financial year basis. This means that the data for Victoria are the most up to date currently available.

Each distribution business reports the total quantity of electricity it supplied during the reporting year to consumers, separated into four categories. The consumer categories are:

- residential,
- non-residential consumers not on a demand tariff, i.e. small business and other small non-residential consumers, of which there are currently over 300 thousand in Victoria,
- non-residential on a low voltage demand tariff, of which there are about 14 thousand, and
- non-residential on a high voltage demand tariff, which are large electricity consumers, of which there were 576 in 2016 (the Portland aluminium smelter is not included, because it is supplied directly from the transmission system).

Figure 4

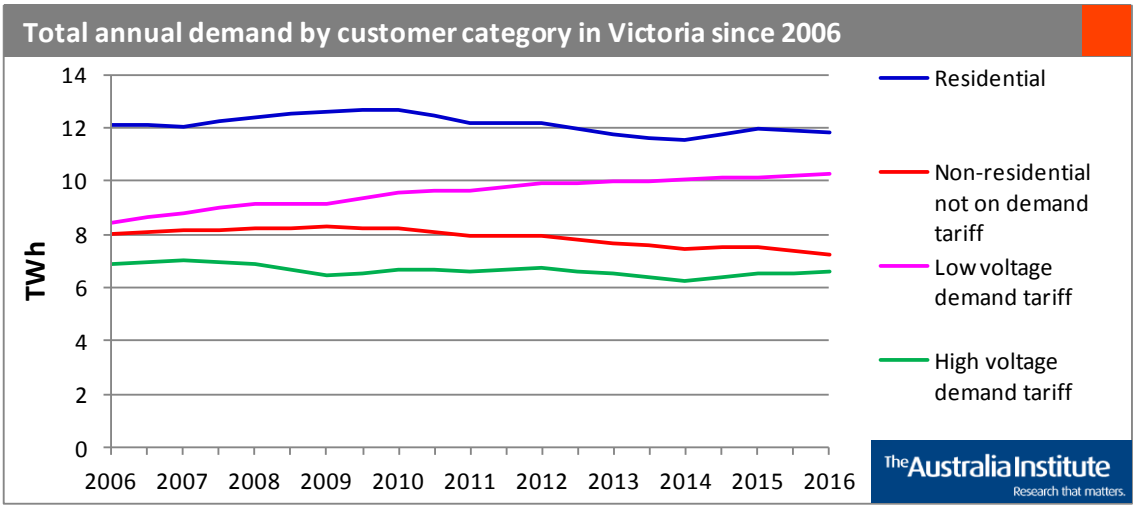


Figure 5

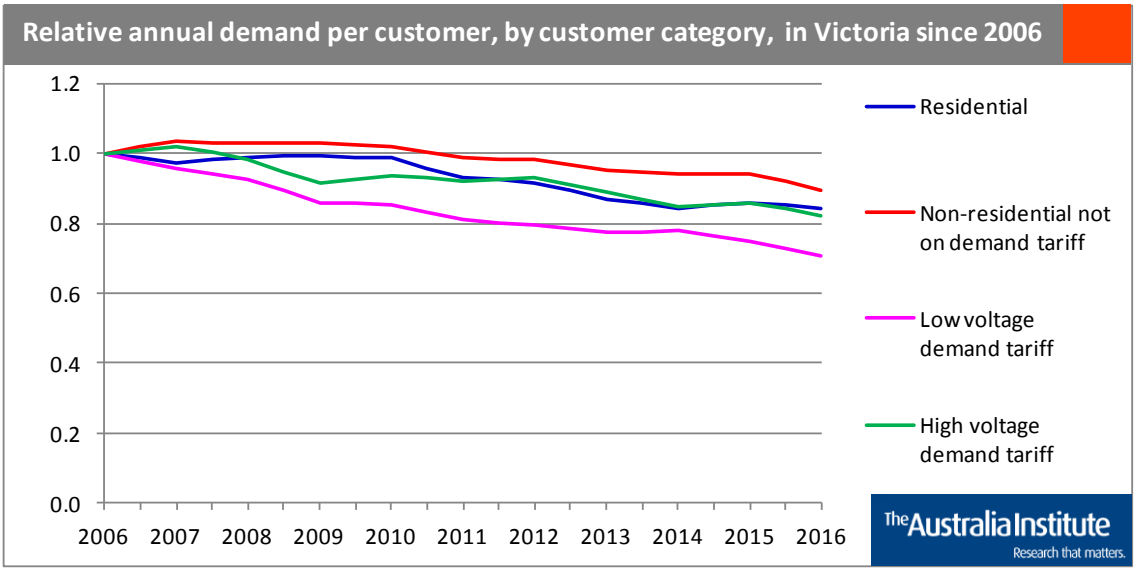


Figure 4 shows the absolute total annual electricity consumption by each of these customer categories since 2006. It can be seen that total consumption by three of the four categories has been roughly constant over the past ten years, but total consumption by customers on low voltage demand tariffs has increased appreciably. However, presenting the data in terms of

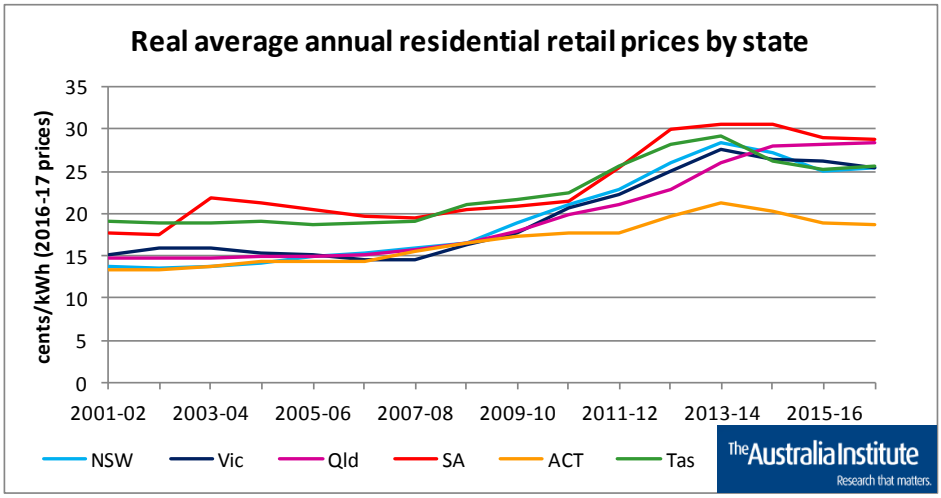
average consumption per customer in each category, as in Figure 5, reveals that this increase has been entirely caused by the growth in numbers of customers in this customer category; average consumption per customer has actually fallen faster than corresponding consumption per customer by the three other categories.

Electricity prices

On 1 July, retail electricity prices increased substantially – reports suggest between 10 and 20 percent, though that depends on how the calculations are done – in Queensland, NSW, SA, Tasmania and the ACT. Prices in Victoria will change, and almost certainly increase, on 1 January 2018. The announcement of the increases has provided ill-informed commentators with another opportunity to attack renewable generation, singling out South Australia for special criticism.

NEEA Electricity Update seeks to provide soundly based factual information about Australia's electricity system, in the hope of raising the quality of policy debate. To that end, Figure 6 presents a history of residential electricity prices in the NEM states since 2001, expressed in real 2016-17 dollars.

Figure 6



Sources: ABS, *Consumer Price Index,* Table 9.
AEMC, 2013. *2013 Residential Electricity Price Trends final Report.*

The graph shows that:

- prices in the four mainland states have increased by between 60 and nearly 100 per cent since 2001, with smaller increases in Tasmania and the ACT;
- the relative increase has been less in South Australia than in the three mainland eastern states;
- most of the increase has occurred between2007 and 2013, and, although this cannot be concluded from the graph, was largely caused by higher transmission and distribution ("poles and wires") costs;

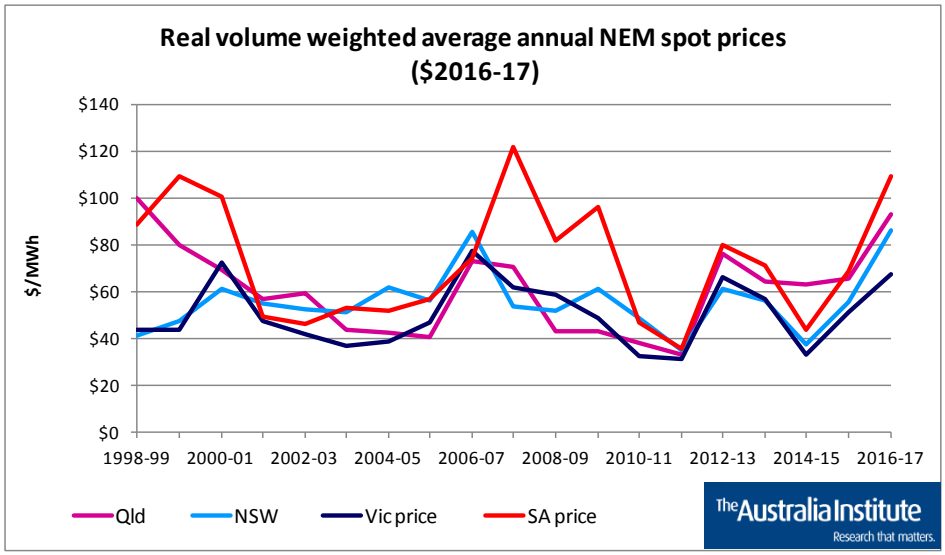
- prices in the ACT have always been lower than elsewhere, mainly because of the low cost, compact structure of its distribution network, but, importantly, will be little affected in coming years as its renewable generation share grows towards 100%, because most of the contract prices for renewable electricity are close to or below the expected NEM wholesale prices shown in Figure 7;
- prices in South Australia have, conversely, always been higher than in other states, but the difference is no more now than it was in 2001 and less than it was in many of the years in between.

It can also be deduced that, when the 1 July price rises flow through to CPI figures, the resultant retail prices in NSW, Queensland, SA, Tasmania and the ACT will be the highest ever, in real terms as well as nominal terms, and that will also be the case in Victoria from 1 January next.

The reason that prices are higher in South Australia than elsewhere is that the state does not have the large, low cost coal resources of other states, and is completely lacking in significant hydro resources. Together, these were the foundation of the rest of the Australian electricity supply system throughout the 20th century. Until the mid 1950s South Australia was completely dependent on coal imported from NSW, and imported petroleum products. It then developed the remotely located, poor quality coal resources at Leigh Creek, which fuelled a series of power stations built at Port Augusta, and then, when gas was discovered in the far north of the state in the 1960s, was able to add natural gas. Its generation costs have always been significantly higher than those in most other parts of Australia. However, in the 21st century, as the electricity system transitions to renewable generation, South Australia's abundant wind and solar resources will eliminate, and may even reverse its current generation cost disadvantage.

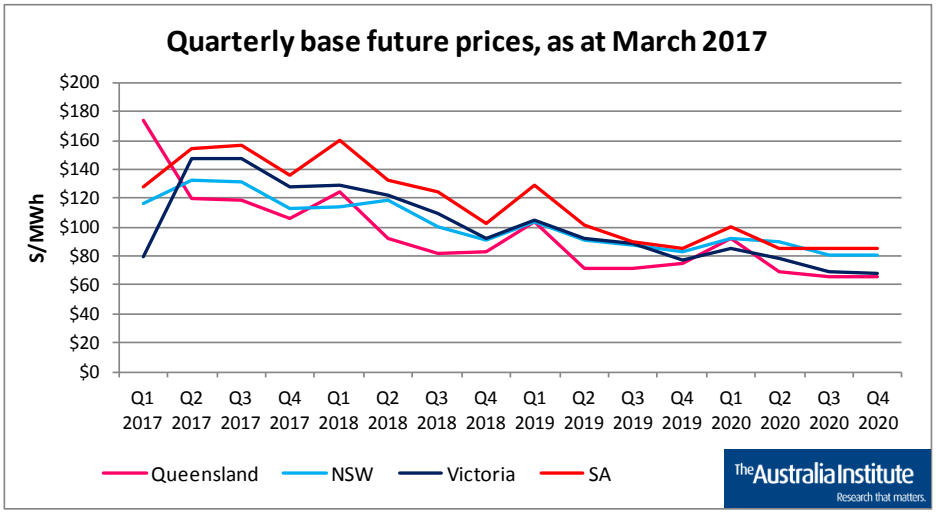
Why have retail prices gone up? The answer is easy to see in the combination of Figures 7 and 8. Figure 7 shows past real wholesale market prices in each NEM region (excluding Tasmania).

Figure 7



Source: AER

Figure 8



Source: AER

The large increase in the year just ended, most of which occurred during the six months from January, is easy to see. Figure 8 shows market expectation of how wholesale prices will move over the next four years, which serves as an indicator of the sorts of prices at which electricity retailers are contracting to buy the electricity they will be supplying to their customers over the coming months. Few anticipated the large wholesale prices increases of the past six months, which means that prices for 2016-17 were largely based on wholesale prices of around $40 to $50 per MWh (4 to 5 cents/kWh). A level of around $100 to $120 per MWh, as Figure 8 suggests, would equate to an increase in retail prices of about 6 cent/kWh. Most of the announced price increases have been a little below this level.

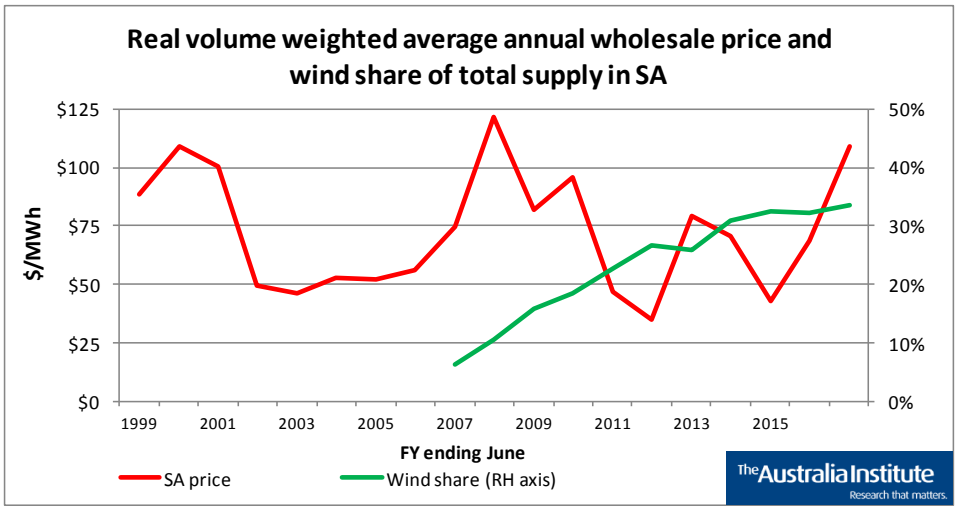
Turning again to South Australia, it is fairly clear from Figures 6 and 7 that higher prices in that state have nothing to do with the amount of wind generation there. That is confirmed by Figure 9, which shows wholesale prices from Figure 7 superimposed on the annual share of total electricity supplied in South Australia (including net imports from Victoria) supplied by wind generation. Clearly, there is absolutely no relationship between the two.

More detailed analysis shows that market wholesale prices are consistently lower when there is a high level of wind generation, than when there is little wind. Over the past four or five years in the South Australia wholesale market, volume weighted prices received by wind generators have been around 20 to 30 per cent lower than volume weighted average prices for the market as a whole, and even further below the volume weighted average prices received by gas generators.

Most of the time, gas generators are the marginal source of supply in the SA market, and thus set the market price. Figure 10 shows the relationship between wholesale gas and electricity prices in the SA market. The gas price is what is called the Short Term Trading Market (STTM) price at the Adelaide gas trading hub. This is the price needed to balance supply and demand

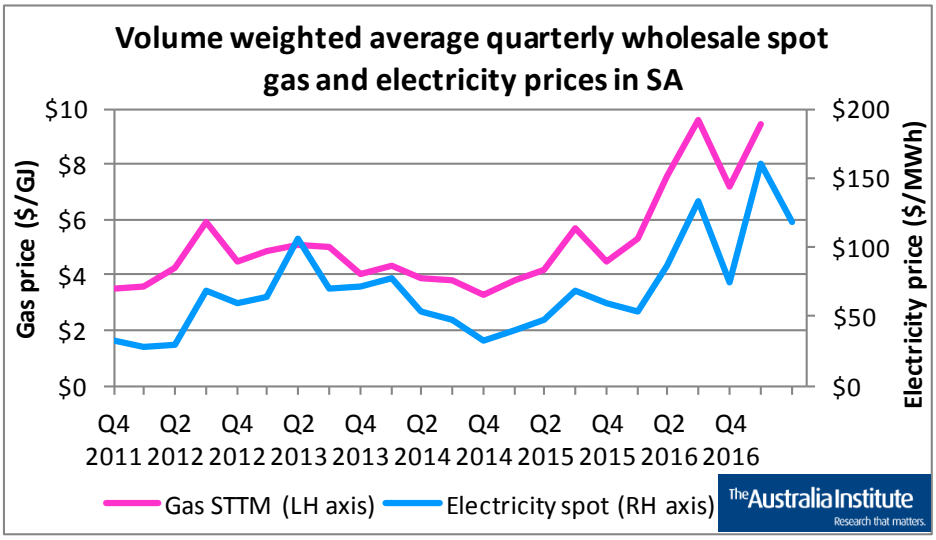
each day in the SA gas market. Most gas is traded under term contracts, not through the STTM, but the STTM is a good indicator of the marginal price of gas. Similarly, the NEM spot price is not the actual price at which most electricity is traded, but is the marginal price.

Figure 9



Sources: AER
AEMO data, extracted through NEM-Review

Figure 10



Source: AER

The correlation between the two data series is striking, confirming that higher wholesale electricity prices, and hence higher retail prices in SA are almost entirely caused by higher gas prices. Technical data on power station performance makes it possible to calculate the quantitative relationship between the two sets of prices. The two largest gas fired power stations in SA are Torrens Island B and, when it is operating, Pelican Point. According to AEMO data, Torrens Island B has a sent out efficiency of 28.5%, meaning that 12.6 GJ of gas are burned for each MWh of electricity sent out. This means that an increase in the price of gas,

from $5 per GJ in Q1 2016 to $9.5 per GJ in Q1 2017, will increase the fuel cost of Torrens Island B by $57 per MWh, or just under 6 cents/kWh. The corresponding increase at Pelican Point, which is much more efficient, but much smaller, would be $35 per MWh. No wonder retail electricity prices have gone up in South Australia.

A similar, though less stark effect is seen in the other mainland NEM states. This is not a malfunction of the National Electricity Market, but precisely how it was expected to operate, when set up. The launch of the NEM in 1998 was followed by a rush of construction of gas turbine power stations in Queensland, NSW and Victoria, and even in Tasmania, accelerated in Queensland by a gas generation mandate policy introduced by the state Labor government. It was envisaged that both the much lower greenhouse gas emissions and the superior operational flexibility of these power stations, compared with coal, would make them ideally suited to supplying hour to hour and day to day variations in demand for electricity, while also reducing emissions, by using a (then) relatively low cost source of fuel. How circumstance have changed!