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National Energy Emissions Audit
Electricity Update

February 2019

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

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Key points

- ***Total renewable generation now supplies more than 20% of total generation in the NEM, a share which is certain to keep growing***

In the year to November last, for the first time, total renewable generation, including hydro, wind and both grid scale and rooftop solar, contributed more than 20% of total NEM supply. Continued steady growth since then, means that the renewable share is most unlikely to ever fall below 20% in future.

- ***Simultaneously, annual NEM emissions have now fallen to more than 20 per cent below the maximum level they reached in the year to September 2008***

While total annual generation, including rooftop solar, has fallen by less than 3 per cent since 2008, emissions have fallen by more than 20 per cent, driven by the combination of rising renewable generation and falling coal generation.

- ***Wind and grid scale solar now supply a larger share of annual grid generation than hydro***

Similarly, in the year to November last, for the first time, wind and solar supplied a larger share of grid generation than hydro. a relationship which is also most unlikely to be reversed.

- ***On Friday 25 January maximum 30 minute (trading interval) demand across the NEM as a whole reached one of the highest ever levels, and the highest since 2017.***

The unavailability, at the crucial time, of about 1,300 MW of brown coal generation meant that it became necessary to impose some load shedding in Victoria. On the other hand, had there been no solar generation, as was the case in 2009 when the highest ever demand was recorded, that record level would have been exceeded on 25 January.

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Introduction

Welcome to the February 2019 issue of the *NEEA Electricity Update*, with data updated to the end of January 2019. The *Electricity Update* presents data on electricity demand, electricity supply, and electricity generation emissions in the National Electricity Market (NEM), plus electricity demand in the South West Interconnected System (SWIS). From time to time it will also include information and commentary on other fossil fuel related emissions, including emissions from consumption of petroleum products and natural gas. This will replace the quarterly *National Energy Emissions Audit Report*, which will no longer be published on a regular quarterly basis. This change will facilitate the reporting of important new data about Australia's energy combustion emissions, as and when such data become available.

Demand for electricity

Notwithstanding record hot weather across much of Australia during January, total demand during the month was only slightly higher than in January 2018. Consequently, there was a very small increase in annual NEM demand. There were small increases in Queensland, New South Wales and South Australia, and small decreases in Victoria and Tasmania. By contrast, in the South West Interconnected System (SWIS) of Western Australia, the steady fall in demand continued.

Figure 1

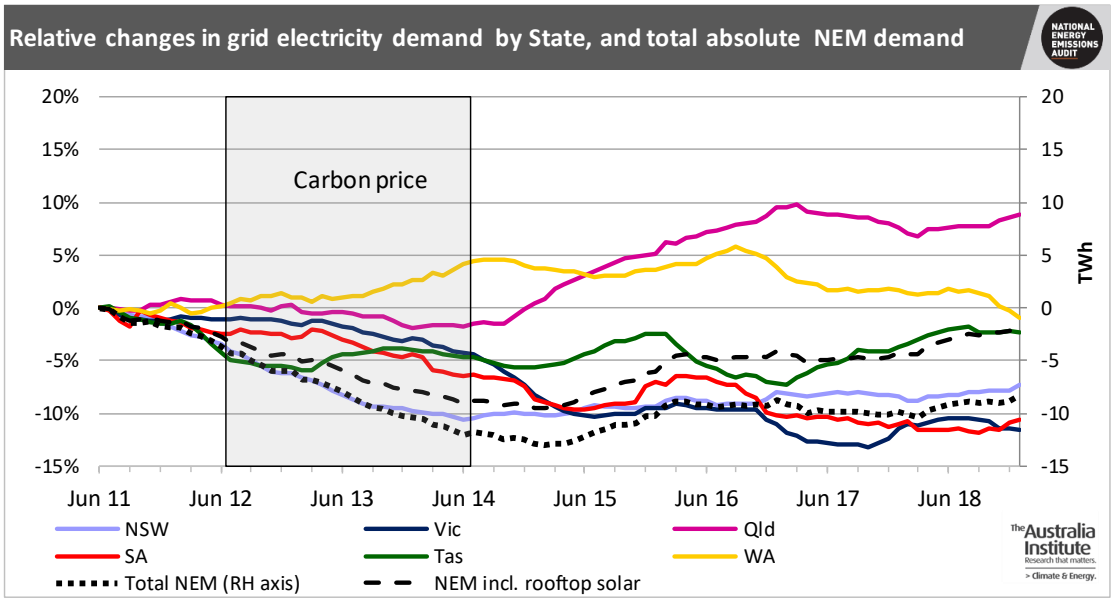
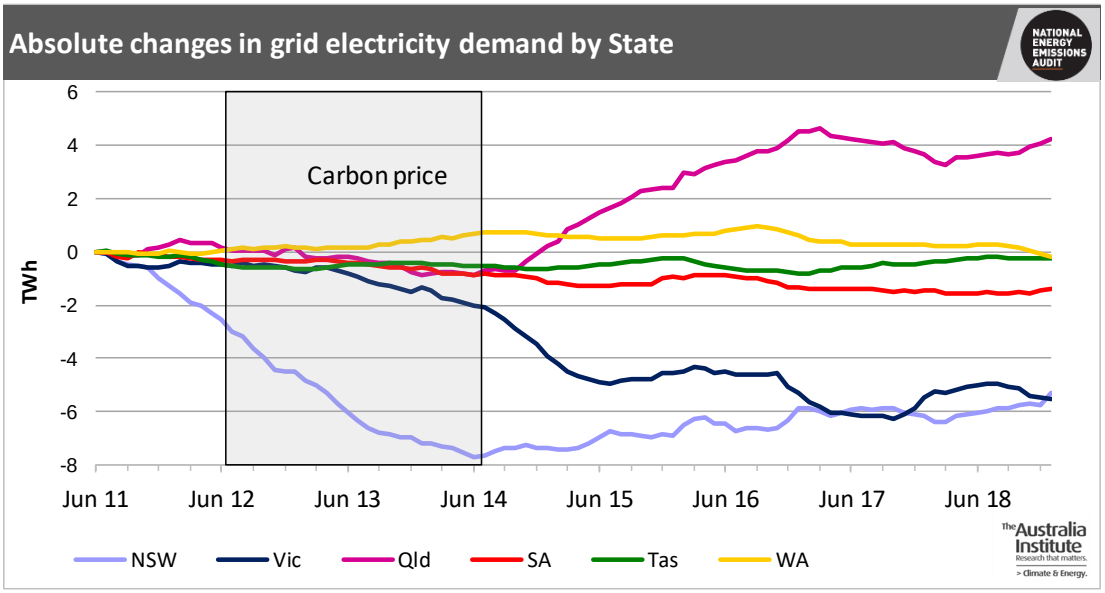


Figure 2



Record breaking hot weather in South Australia resulted on 24 January in the highest peak trading interval (30 minute) demand since 2014. In other states, however, peaks so far this year have been below record levels. The April issue of this report, after the end of summer,

will contain a full update of seasonal peak demand in each state. We examine electricity supply and demand in both South Australia and Victoria on 24-25 January in more detail later in this report.

Generation and emissions

As would be expected, with increased demand, total grid generation increased slightly in January. Black coal, gas, wind and grid scale solar all contributed to the increase, and consequently emissions also increased slightly, though emissions intensity continued to decrease.

Figure 3

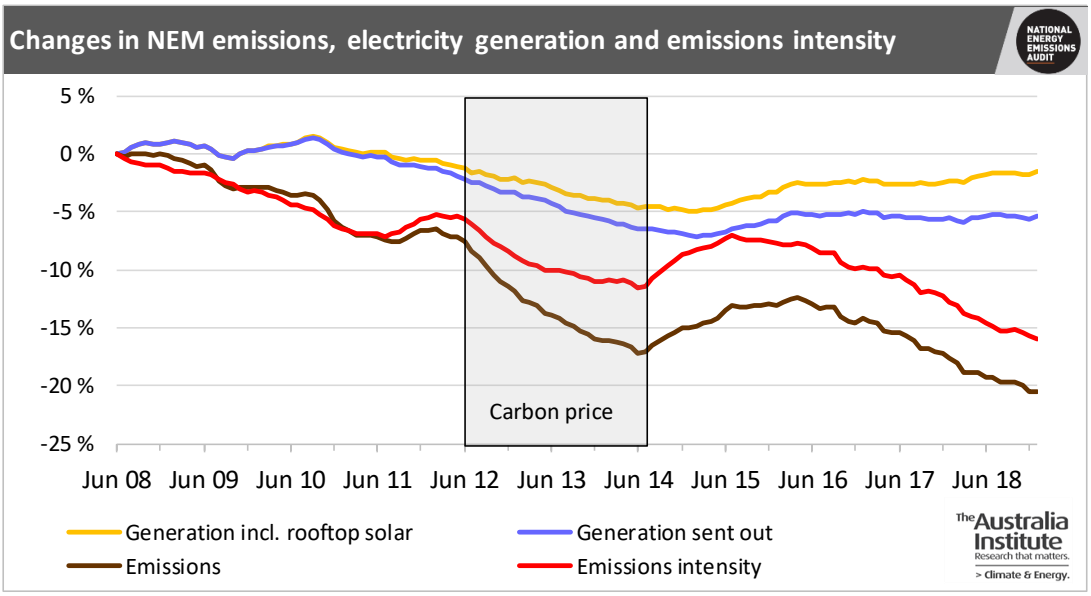
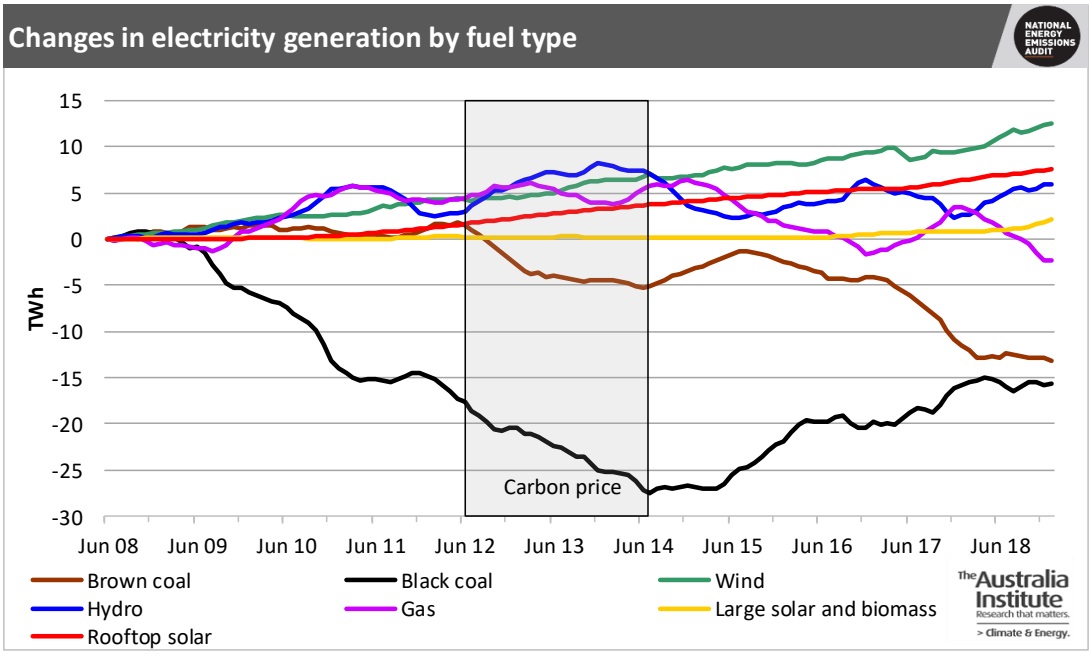


Figure 4



Monitoring growth in renewable generation

The growth in renewable generation in the NEM, expressed as a share of total generation, is shown in Figure 5, with each type of generation technology shown separately. It can be seen that the very strong growth experienced throughout 2018 continued in January. Grid connected renewables supplied 9.0% of total grid generation, on a sent-out basis, and hydro 8.7%, making a total of 17.7%. Annual wind and solar generation exceeded annual hydro generation for the first time in the year to last November, and, unless there is a dramatic and unexpected change in trend, combined wind and solar will be larger than hydro from now on. When estimated rooftop solar generation is included, the renewable generation share of generation, including rooftop solar, reached 21.0%, and all non-hydro renewables reached 12.6%. Both these shares seem set to keep growing from now on.

Figure 5

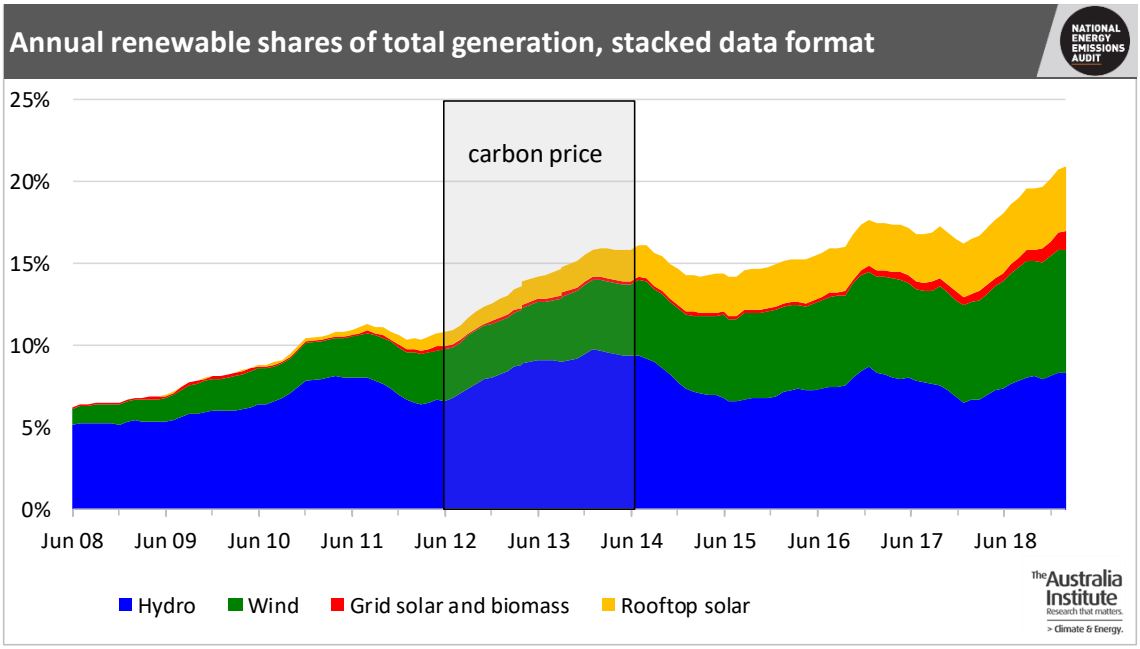


Figure 6 shows the total renewable share of total electricity supply in each state, except Tasmania, where supply is consistently almost 100 per cent renewable. All data are expressed as shares of total annual supply, where supply includes net interconnector flows. In South Australia, last August, total renewables, including rooftop solar, exceeded 50 per cent of total supply for the first time. In November the annual renewable share passed 20 per cent for the first time in Victoria. In New South Wales, notwithstanding the absence of a formal state government target for renewable generation, the renewable share of annual generation passed 10% last June, and has now reached 12%. In Queensland, the annual renewable share passed 8% in the year to January, up from 6% just seven months ago, and the rate of growth is accelerating.

Figure 6

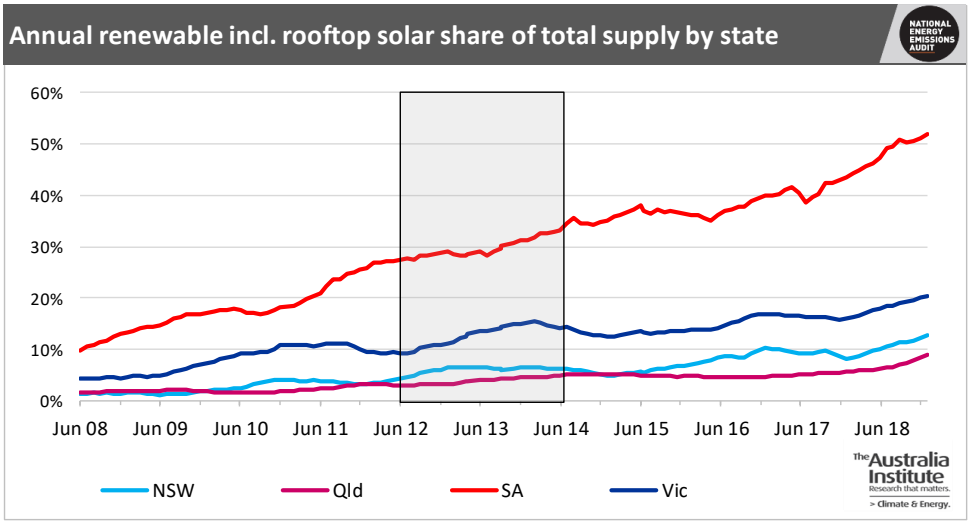
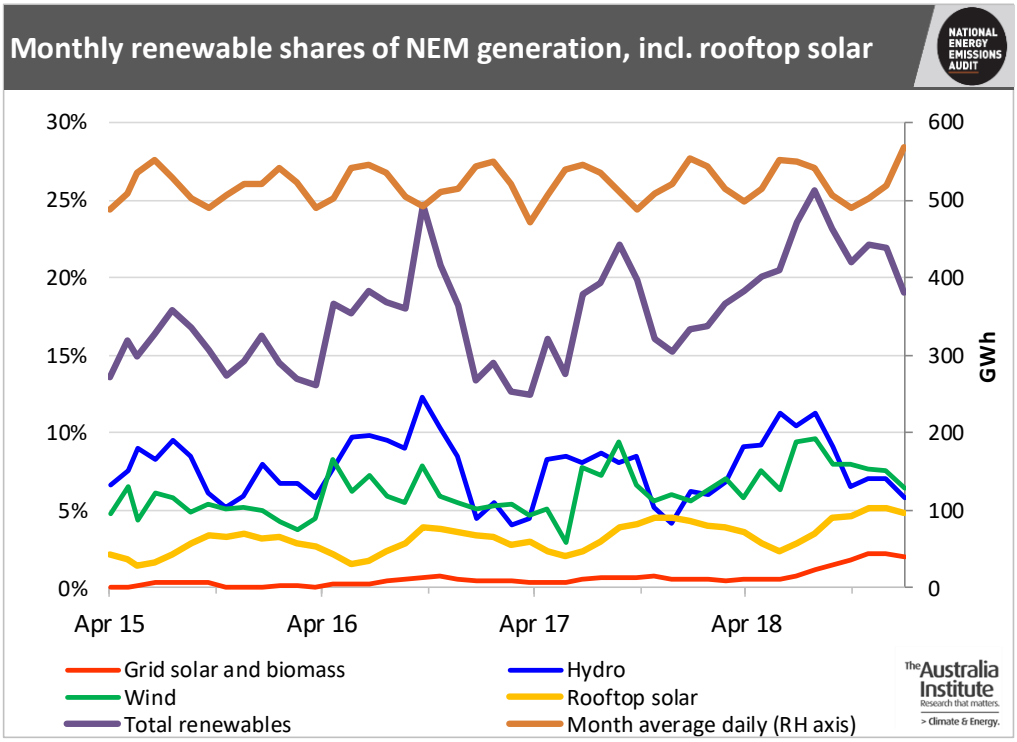


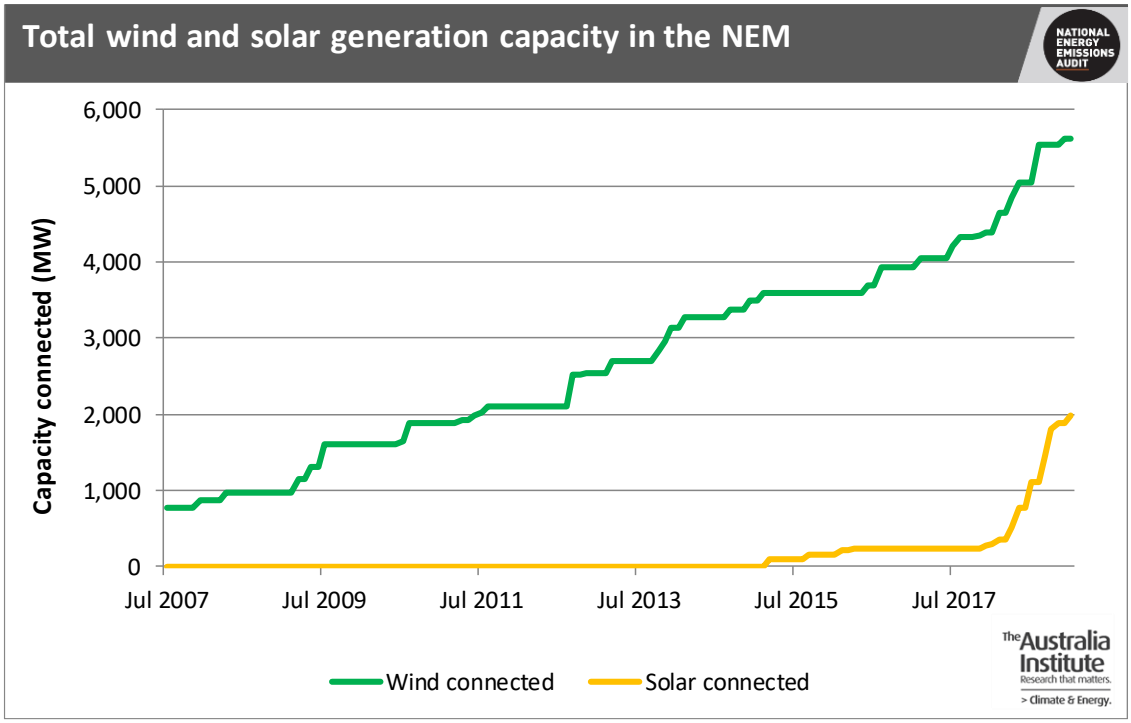
Figure 7, published for the first time last month, shows renewable generation shares in the NEM on a month to month basis. At present, most renewable generation is hydro and wind, which are lower, both in absolute terms and as shares of the total, in the summer months, than at other times of the year. As solar generation makes a progressively larger share of the total over the next few years, this difference between summer and winter in terms of total renewable generation can be expected to decrease. Interestingly, of the total increase in generation in January 2019, compared with January 2018, more than a half came from grid solar, and another quarter from rooftop solar, showing just how quickly solar generation is growing.

Figure 7



Figures 8 and 9 update the now regular graphs of growth in wind and grid solar generation capacity. Note that the graphs have been compiled by adding new wind and solar farms to the data in the first month in which they start generating. This has the effect, during the current rapid growth phase, of making growth in capacity appear to be faster than growth in generation. This effect will be reversed when growth in capacity eventually starts to slow down. One new solar farm, Susan River, near Maryborough, in Queensland, started supplying during January. There were no new windfarms.

Figure 8



For this issue, the expected total capacities in 2021, as shown in Figure 8, have been revised upward, by using a new definition of expected capacity by 2021. The new total capacities for wind and solar are calculated as:

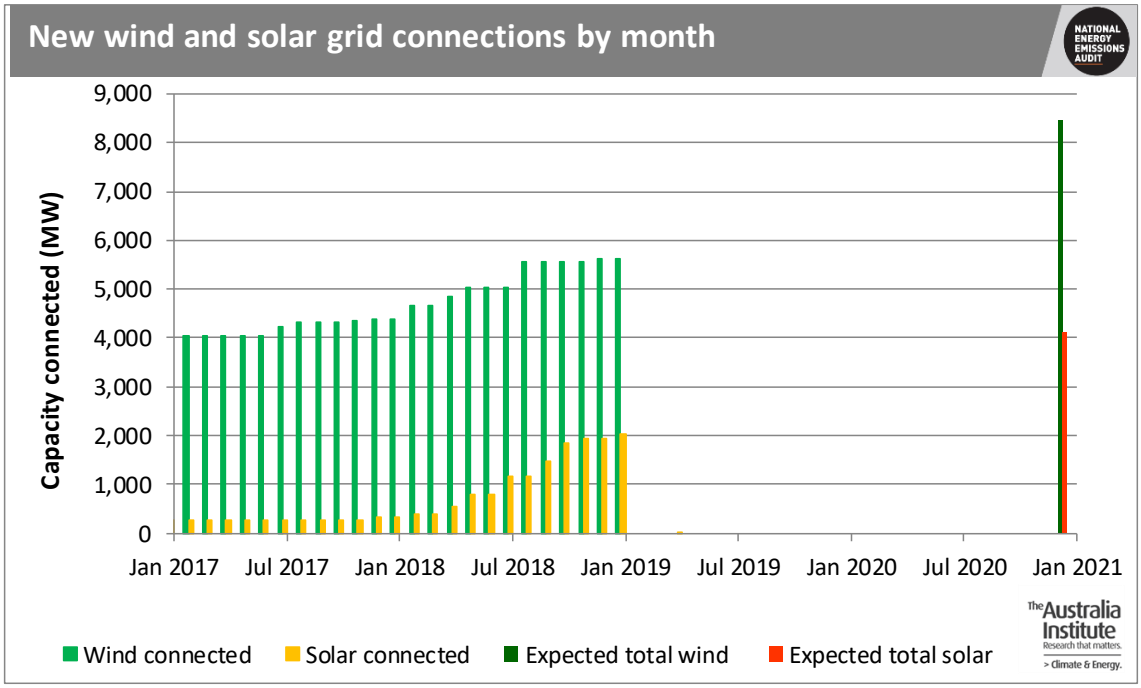
total capacity supplying in January 2019

\+ capacity of projects accredited by the Clean Energy Regulator since the start of 2018, but not yet supplying

\+ capacity of projects designated by the Clean Energy Regulator as committed, but still under construction and not yet accredited.

In addition to this capacity, shown in Figure 8, the Clean Energy Regulator has assessed as probable a further 661 MW of wind generation capacity and 744 MW of grid scale solar generation capacity. Even without this additional capacity, the 2021 totals shown in Figure 8 will result in total annual generation by wind and grid scale solar reaching more than twice current levels, and contributing about 20 per cent of the current total NEM generation. Including hydro and small solar is likely to see renewable generation supplying over one third of total electricity consumed in the NEM.

Figure 9



More on solar generation and peak demand on heatwave days

Last month's report looked closely at the contribution of rooftop solar generation to meeting peak demand in Victoria and South Australia during two very hot days during the first week of January. Three weeks later, on 24 and 25 January, there was another heatwave in south east Australia. Adelaide recorded its hottest ever day on Thursday 24 January, when the temperature reached 46.8 deg. C, and in Melbourne on Friday 25 January the temperature reached 43.7 deg. C, also very high, but somewhat below the historic maximum of 46.7 deg. C reached on 7 February 2009.

On 25 January the heat extended to New South Wales, and, as a result, total reported trading interval (30 minute) demand for electricity in the NEM reached 33,950 MW during the trading interval between 4.30 and 5.00 pm NEM time, which is 5.30 to 6.00 pm Australian Eastern summer time. This was one of the highest ever total NEM trading interval demand levels, exceeded on only three or four previous occasions, of which the highest was Thursday 29 January 2009, when demand reached 35,720 MW.

Reported demand on 25 January last would have been somewhat higher, were it not for the fact that AEMO intervened in the market in Victoria two ways. Firstly, it called on some of the Reliability and Emergency Reserve Trader (RERT) capacity, comprising an unknown and unreported quantity of standby generation and demand response. Details of composition, volume and price are confidential between AEMO and contracted providers. Secondly, AEMO requested some load shedding. These emergency interventions presumably account for the fluctuations in total demand visible in Figure 10. AEMO's interventions would almost certainly

not have been needed, had all of Victoria's brown coal generation capacity been available on the day. Unfortunately, however, three of the large Latrobe Valley brown coal units were out of action: one 560 MW unit at Loy Yang A and two 380 MW units at Yallourn W. We will know more about the complex series of events in the electricity market on 25 January when AEMO and AER publish their respective reports on the day's event, as they are required to do under the NEM Rules.

Demand in South Australia peaked the previous day, Thursday 24 January. On that day, all of the state's diesel fuelled peaking generators were called into action for a few hours. This was the first, and so far only occasion on which both of the so-called temporary generators operated together to supply demand, as opposed for testing. They supplied in total on the day 736 MWh, reaching a maximum capacity of just under 220 MW, at around 9 pm, local summer time.

These generators were initially leased, then purchased outright, by the previous Labor government, as a key part of its response to the system black event of September 2016. In a budget statement in December 2017 the then state Treasurer said that the total cost of leasing, then buying these generators was $339 million. This seems an extremely high price to pay for generation capacity which is so seldom needed.

Finally, as a follow-up to the examination of the contribution of solar generation to meeting peak summer demand in last month's NEEA Report, Figure 10 shows the contributions of both rooftop and grid solar generation on 25 January. Peak grid demand of 33,950 MW occurred during the trading interval ending at 6 pm. Australian Eastern Summer time. However peak total demand, including the contribution of rooftop solar, occurred an hour and a half earlier, and, at about 36,410 MW, was nearly 700 MW higher than the previously highest ever grid demand. As mentioned above, this occurred at the end of January 2009, when there was negligible rooftop solar capacity.

Figure 10

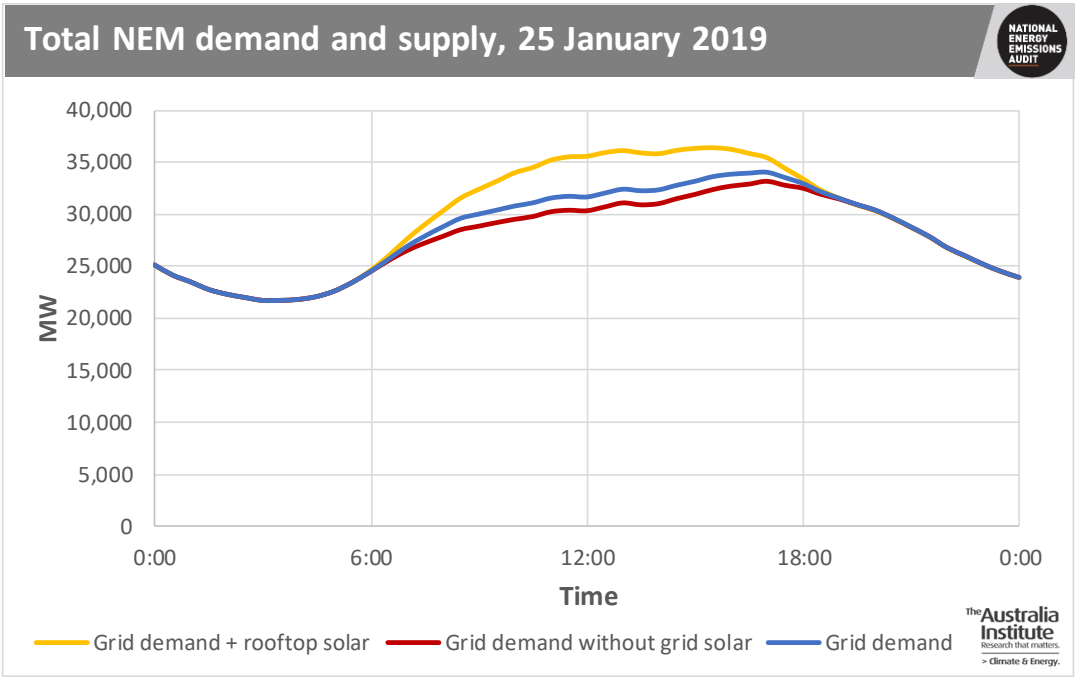


Figure 10 also shows grid connected solar farms, although still in their relative infancy, contributed almost 4 per cent of total supply at the time of peak consumption , i.e. between 4.00 and 4.30 pm Australian Eastern Summer time. Furthermore, at that time the solar farms were, in total, supplying no less than 93 per cent of their maximum output earlier in the day, demonstrating the particular value of solar generation on peak demand days. Any solar farm in Victoria or South Australia exposed to spot prices on the day would certainly have been rewarded, as pool prices in those two states were at or close to the cap level of $14,500 per MWh for no less than five hours, from 5.00 to 10.00 pm Australian Eastern Summer time.

APPENDIX: NOTES ON METHODOLOGY

Data on annual consumption of electricity, and seasonal peak demand, are for each of the six states. All other data are for the states constituting the National Electricity Market (NEM) only, i.e. they exclude Western Australia. 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.

Defining the particular meaning of the various terms used to describe the operation of the electricity supply system will help in understanding the data discussed.

Demand, as defined for the purpose of system operation, includes all the electricity required to be supplied through the grid level dispatch process, operated by AEMO. This includes all the electricity delivered through the transmission grid to distribution network businesses, for subsequent delivery to consumers. It also includes energy losses in the transmission system and auxiliary loads, which are the quantities of electricity consumed by the power stations themselves, mostly in electric motors which power such equipment as pumps, fans, compressors and fuel conveyors. Auxiliary loads are very large: in 2011 they amounted to 6.3% of total electricity generated and currently about 5.6%. Most of this load is at coal fired power stations, where it can be as high as 10% of electricity generated at an old brown coal power station and 7% at a black coal fired power station. Auxiliary loads are much lower at gas fired power stations, and close to zero at hydro, wind and solar power stations. Both demand and generation, as shown in the *Electricity Update* graphs, are adjusted by subtracting estimates of auxiliary loads. Thus demand, as shown, is equal to electricity supplied to distribution networks (and a handful of very large users that are connected directly to the transmission grid) plus transmission losses.

Generation is similarly defined to include only electricity supplied by large generators connected to the transmission grid. It does not include electricity generated by rooftop PV installed by electricity consumers, irrespective of whether that electricity is used on-site ("behind the meter") by the consumer, or exported into the local distribution network. From the perspective of the supply system as a whole, the effect of this generation, usually termed either "embedded" or "distributed" generation, is to reduce the demand for grid supplied electricity below the level it would reach without such distributed generation. That effect can be clearly seen in the regular total generation graph; the gap between the red line – electricity sent out to the grid from large grid connected power stations – and the yellow line – that electricity plus estimated electricity generated by distributed solar systems – is the electricity supplied by those systems.