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> Climate & Energy.

NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit
Electricity Update

January 2019

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

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Key points

+ ***Total emissions from NEM generation in 2018 were 20% below their peak level, reached exactly ten years ago, in 2008.***

This reduction in emissions was caused by a combination of lower average emissions intensity (about three quarters of the total reduction), as black and brown coal generation has been replaced by wind and solar, and by reduced consumption of grid electricity (about one quarter of the total), as buildings and equipment have become more energy efficiency and the supply from rooftop solar has grown dramatically.

+ ***The decline in emissions intensity seems likely to accelerate as growing renewable generation displaces coal as well as gas generation***

Over the past year and a half, growth in renewable supply has displaced mainly gas generation. From now on, it seems to be displacing the more emissions intensive black coal generation, meaning that emissions reduction should accelerate.

+ ***During 2018 NEM renewable generation grew much faster than in any previous year***

From December 2017 to December 2018, grid renewable generation grew by nearly a third, from 13.4% to 17.6% of total grid generation in the NEM. When rooftop solar is included in the calculation, the renewable share of total electricity supplied to consumers in the NEM reached 21.4%. This was by far the largest year on year growth in renewable generation ever seen in the NEM.

+ ***During December, the Crowlands wind farm came on line, supported by a long term supply contract to a consortium of Melbourne based consumers***

In what seems likely to become a new trend, the Melbourne Energy Project, a consortium of local government authorities, universities, cultural institutions and businesses, has helped to underwrite construction of the Crowlands wind farm by signing a long term agreement to buy well over a third of the expected annual output over the long term. While the Commonwealth government dithers, electricity consumers are acting to accelerate Australia's transition towards a low emission electricity supply system.

+ ***During the first really hot spell of the summer, rooftop solar had a big effect***

Prior to the extreme heat wave of mid-January, the hottest days of summer occurred on 3 and 4 January. If there had been no rooftop solar in either South Australia, on 3 January, or Victoria, on 4 January, demand on grid supply would in each case have been 9 per cent higher than the level actually reached. As a result, there was less need to run high cost gas and diesel fuelled peak generators in either state, and wholesale prices were almost certainly lower than they would have been without rooftop solar.

Introduction

Welcome to the January 2019 issue of the *NEEA Electricity Update*, with data updated to the end of December 2018. 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

Annual NEM grid demand continued virtually unchanged in December, as has been the case since July (Figures 1 and 2). Small decreases in demand were experienced in New South Wales and Victoria, while Queensland and South Australia saw small increases. Demand also decreased in Western Australia, where it was the continuation of a longer falling trend. During summer, small month to month changes are often caused by differences in the number of extremely hot days in the current month, compared with the same month twelve months previously. We look at an example of the effect on electricity demand of extremely hot days later in this *Update*.

Figure 1

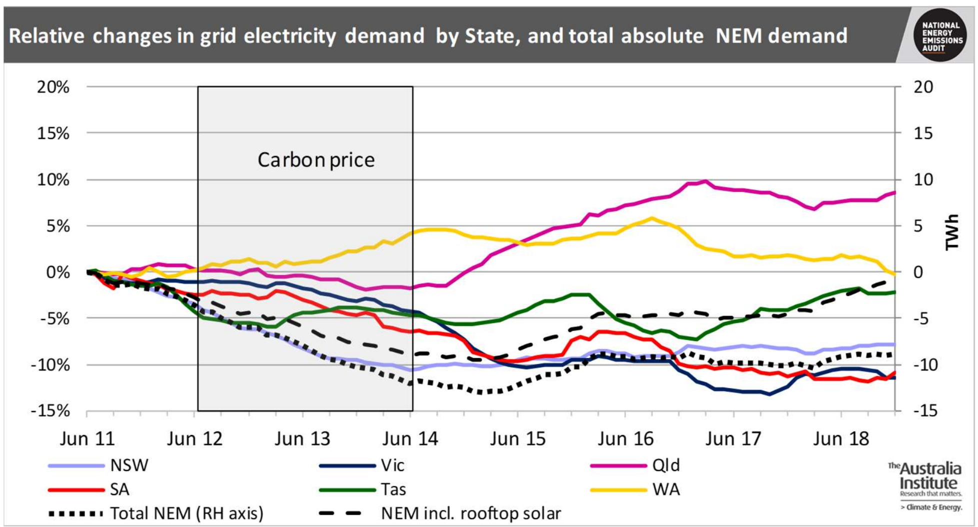
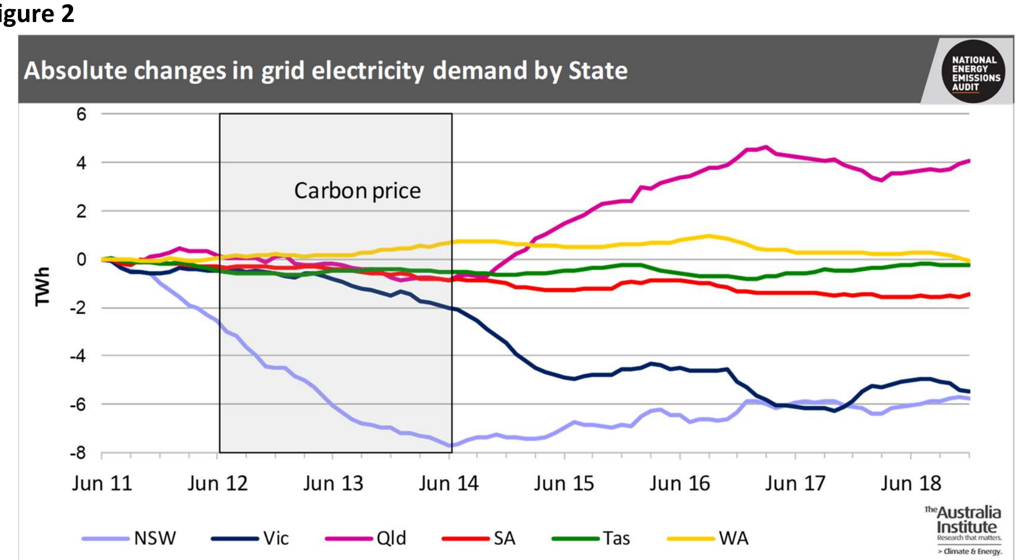


Figure 2



Generation and emissions

As would be expected, total grid generation continued almost unchanged in December, but annual emissions fell sharply, and are now more than 20% below their historic peak, in mid-2008. Emissions intensity is just over 15% below its 2008 level, which means that the total reduction in annual NEM emissions since then, equal to about 38 Mt CO_2-e, or 21 per cent, has been caused by a combination of reduced emissions intensity (about three quarters of the effect) and reduced consumption of grid electricity (the remaining quarter).

Figure 3

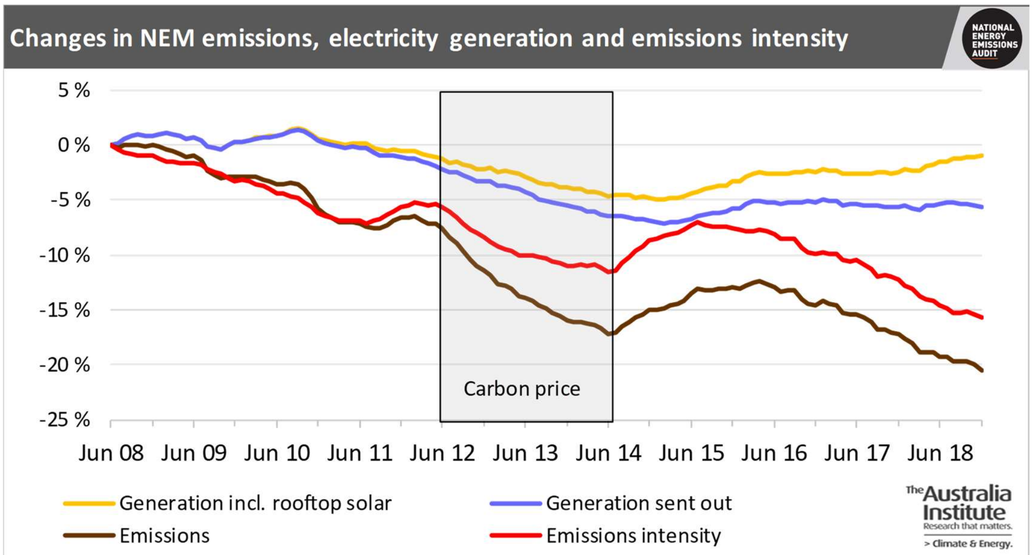


Figure 4

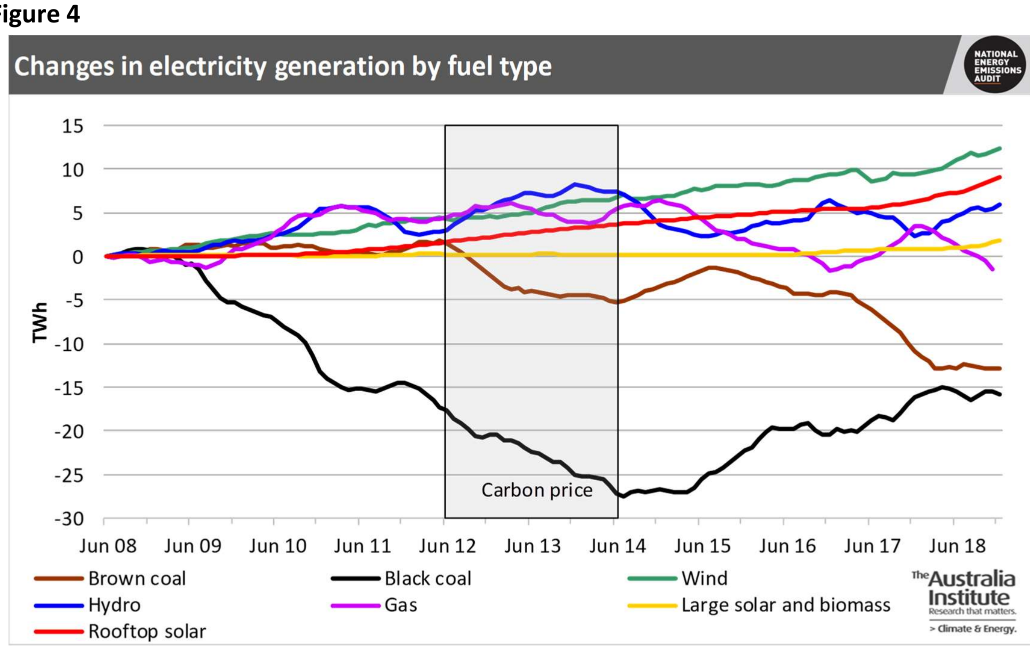


Figure 4 shows that the accelerating growth in renewable supply from new wind and solar generators is continuing to displace gas generation, but is also now starting to displace black coal generation. In Queensland, there was a small drop in coal generation and a somewhat larger drop in net exports to New South Wales, where these reduced imports from Queensland, together with the continuing fall in gas generation, were the offsets for increased wind and solar supply.

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, throughout 2018, the total renewable generation share grew consistently at a faster rate than ever before.

Figure 5

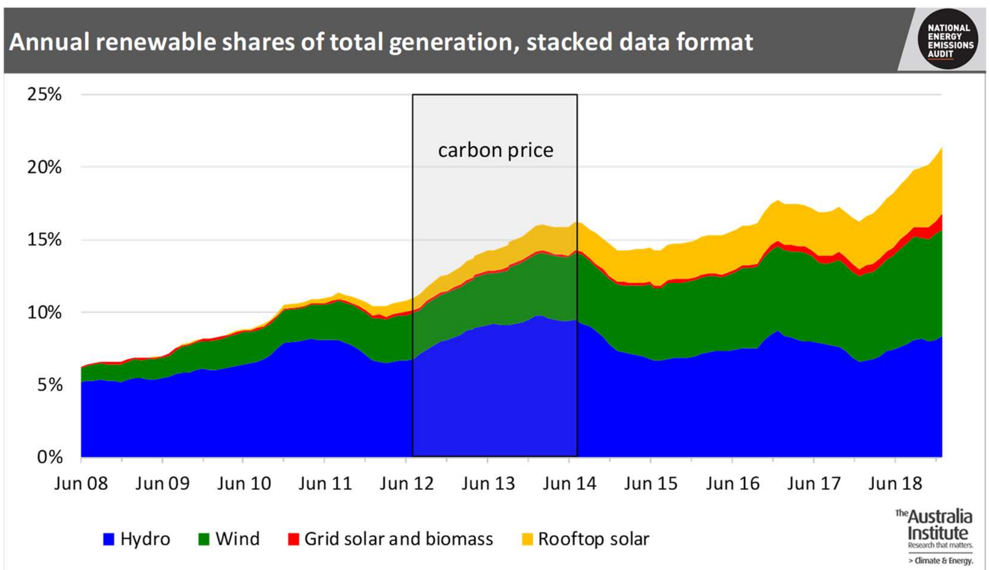


Figure 6 shows the total renewable share of total electricity supply in each state, except Tasmania, where supply is consistently almost 100 per cent renewable. All data are expressed as shares of total annual supply, where supply includes net interconnector flows. In South Australia, last August, total 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 South Australia the majority of renewable generation is from wind, whereas in Victoria and New South Wales hydro makes a major contribution. Wind generation varies from month to month much more than hydro generation, which explains why the trend line is more erratic for South Australia than for other states.

Figure 6

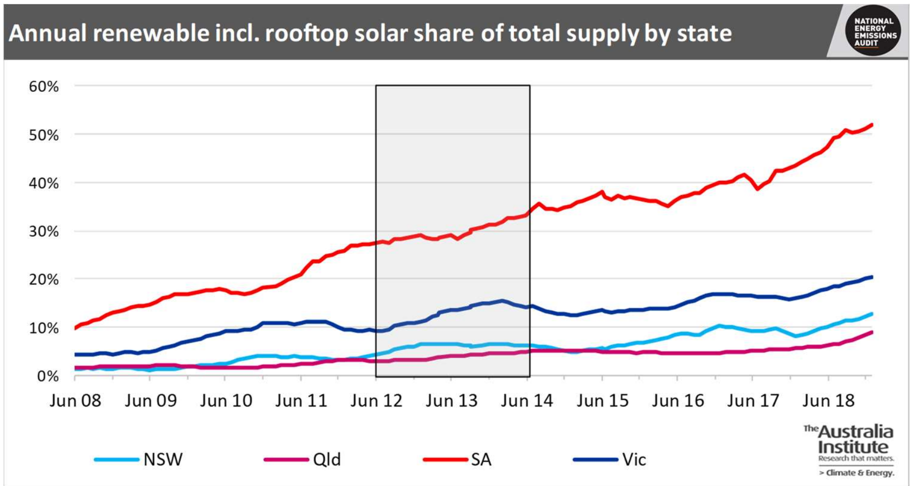
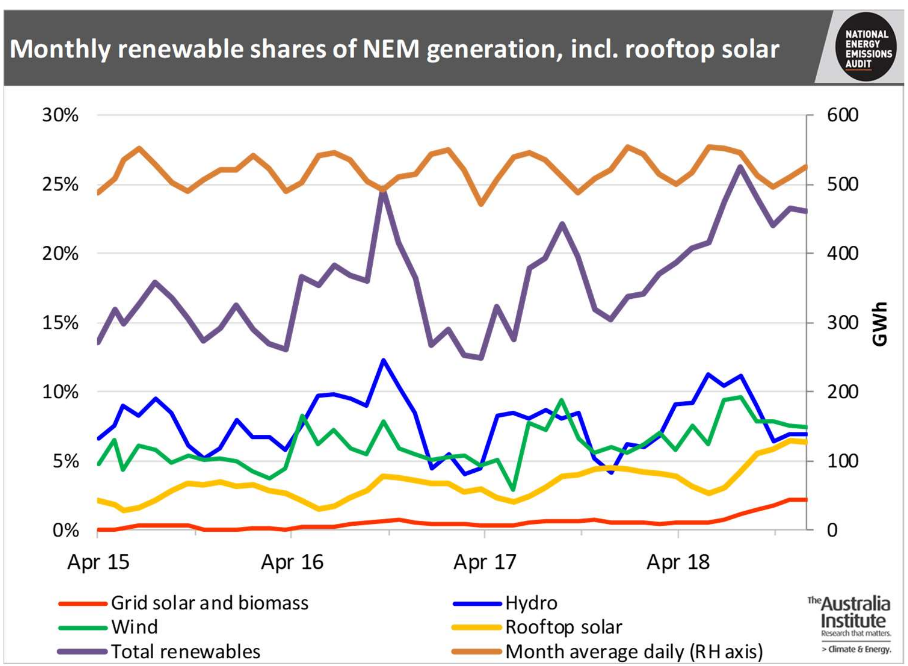


Figure 7 is a new graph which shows renewable generation shares in the NEM on a month to month basis, since April 2015, which is the first month for which estimates of monthly rooftop solar generation are available. It also shows, for comparison, average daily total NEM generation, including rooftop solar, in each month. The contrasting seasonal patterns of, on the one hand, hydro and wind generation, and, on the other hand, solar generation are clear to see. The "double seasonality" of total electricity consumption, driven mainly by space heating and cooling loads, is also clearly seen.

Figure 7



Finally, Figures 8 and 9 update the graphs of growth in wind and grid solar generation capacity, first introduced in last September's *Electricity Update*. No new solar farms started supplying during December, and just one new windfarm, Crowlands, located near Ararat, in Victoria.

Figure 8

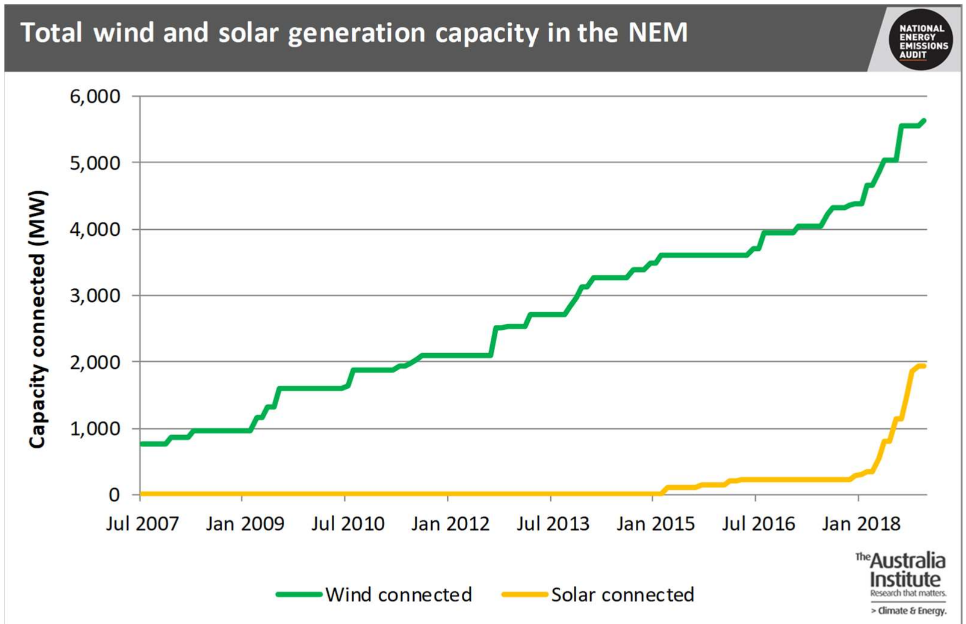
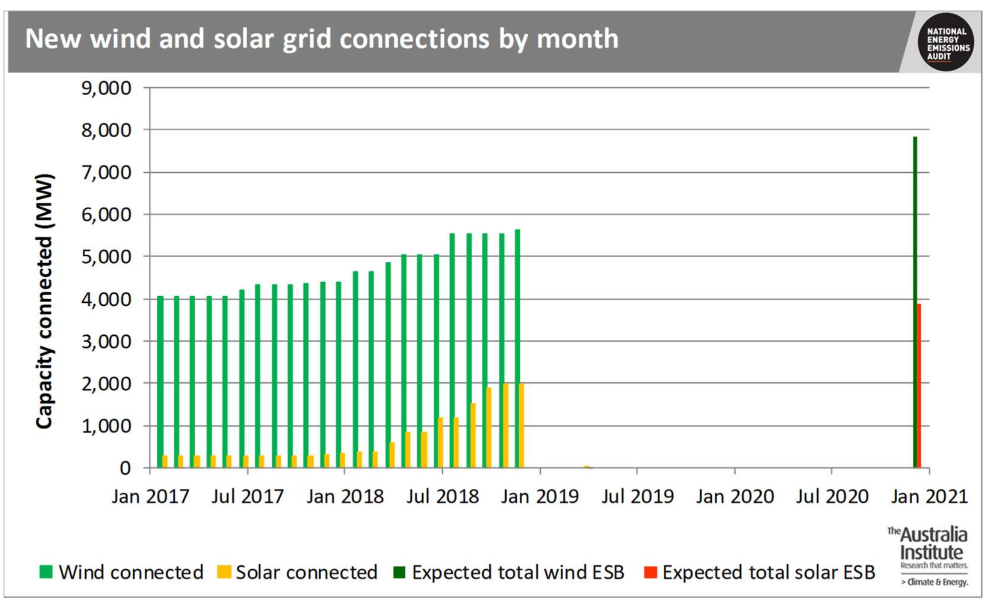


Figure 9



Crowlands is being developed by Pacific Hydro, one of Australia's longest established renewable generation developers, and has a capacity of 80 MW. Interestingly, in the words of Pacific Hydro's project website, Crowlands "has been underwritten by the Melbourne

Renewable Energy Project, a power purchasing agreement between fourteen leading universities, cultural institutions, corporations and Councils".

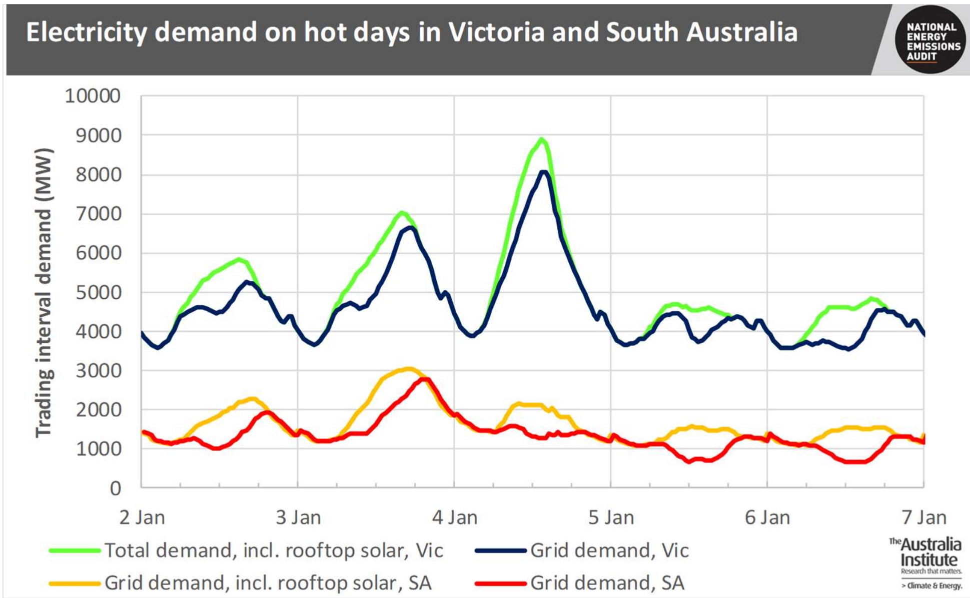
Figure 9 shows more clearly than Figure 8 that there has been a marked slowdown in new wind and solar farm connections over the past few months. This is consistent with quite widespread comments over recent months about delays in connecting new renewable generators, imposed by AEMO because of inadequate network transmission capacity in areas such as north Queensland, south west New South Wales and north west Victoria. Historically, each of these regions was relatively remote from major generation capacity and, with modest electricity consumption, had no requirements for large transmission capacity. AEMO has identified lack of transmission capacity in these regions as at present perhaps the biggest obstacle to the continuing transition of the NEM towards a low emission future.

The contribution of rooftop solar to meeting peak demand on heatwave days

Most people, even most politicians, know that annual peak demand in all mainland states of the NEM occurs on a very hot weekday in summer. Since the closure of Hazelwood power station, in Victoria, and before that, Northern, in South Australia, there has been concern about the ability of generators in the NEM to meet all demand on such days, exacerbated by concerns about the operational reliability of gas and coal generators in very hot weather. AEMO, together with some state governments, have taken various actions to reduce the risk of loss of supply, such as happened in both South Australia and New South Wales in February 2017.

To conclude this issue of *NEEA Electricity Update*, Figure 10 shows 30 minute demand in Victoria and South Australia during the five days Wednesday 2 January to Sunday 6 January. The graph also shows rooftop solar generation over that period.

Figure 10



The first point to note is the size of the effect of very hot weather on electricity demand. In South Australia on 3 January, peak trading interval (30 minute) demand, including demand supplied by rooftop solar, was 3,050 MW. Peak demand two days later, after a cool change in the weather, but also a weekday, was 1,579 MW, only just over half the peak on 3 January. In Victoria, peak trading interval demand for the week occurred on 4 January, and cannot be sensibly compared with the peak the following day, because that was a weekend. Two days earlier, however, on Wednesday 2 January, the peak was less than two thirds of the Friday peak.

The second important point is the large size of the reduction in peak demand on grid supply made by rooftop solar. In South Australia, total demand, including rooftop solar, peaked at 3,050 MW on 3 January, whereas peak grid demand was only 2,778 MW, a reduction of 272 MW, equivalent to 9%. On that day, four of the state's five open cycle gas turbine peaking plants generated for some of the time, but only two of the seven, very high cost oil fuelled open cycle plants, and that for less than two hours and at a small fraction of nameplate capacity. At least on paper, therefore, the state had plenty of spar capacity, which it did not have to draw on because of the contribution from rooftop solar.

In Victoria, rooftop solar reduced grid peak by over 9 per cent. Interestingly, both total peak and grid peak occurred during the trading interval between 4.00 and 4.30 in the afternoon, Eastern Summer Time. At that time, rooftop solar was still generating at about 80 per cent of its peak level for the day, meaning, if peaks continue to occur at that time, that further growth in rooftop solar would result in further large reductions in grid peak demand.

In South Australia, by contrast, the total peak on 3 January occurred during the period between 6.00 and 6.30, local Summer Time, and grid peak occurred an hour and a half later.

At that time, there was only a small contribution from rooftop solar, meaning that continuing growth in capacity will make only a modest further reduction in grid peak demand.

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.