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NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit
Electricity Update

April/May 2018

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

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Introduction

Welcome to an April/May 2018 double issue of the *NEEA Electricity Update*, with data updated from the end of February to the end of April 2018. *Electricity Update* is the companion publication to the quarterly *National Energy Emissions Audit Report*, the next issue which will be in June 2018. The *Electricity Update* presents data on electricity demand, electricity supply, and electricity generation emissions in the National Electricity Market (NEM).

Each issue of *Electricity Update* contains a more detailed discussion of one or two particular issues relating to the electricity system. In this issue we discuss recent changes in energy flows across the interconnectors between NEM regions. We also include some detail on the renewable shares of total electricity supply and generation in the NEM as a whole, and in each state.

Key points

+ ***Commissioning of a large number of grid-scale renewable generators, in particular solar, is the most important development of the past three months***

During March, April and early May twelve new grid-scale wind and solar generators were connected to the NEM, spanning all four mainland NEM states, with a total capacity of 1030 MW. The 12 new installations included eight new solar PV farms will almost triple grid-scale solar generation capacity in the NEM. These are the first of many more under construction, together with many new wind farms.

+ ***Electricity generation emissions in the NEM fell again, but only slightly***

Annual emissions from NEM electricity generation decreased again in March and April, though only by a very small amount in April.

+ ***Net electricity consumption from the grid has been almost constant, but total electricity demand including self-generated rooftop solar shows a gradual increase in consumption***

When electricity supplied by rooftop solar PV is added to net electricity delivered to consumers by the grid, the total electricity consumed is gradually increasing in both the NEM and Western Australia. However, the rates of increase are significantly less than the rates of growth of either population or GDP.

+ ***Since the closure of Hazelwood in March 2017, South Australia has become a net exporter of electricity, Queensland coal generation increased because it is cheaper than NSW***

March 2018 was the first month when South Australia became a net exporter of electricity, in net annualised terms. Coal power station closures continue to be driven by competition from cheaper generators, including other coal generators.

+ ***Clean Energy Regulator says that the 2020 Large Renewable Energy Target will be met***

In a formal statement issued on 8 May the Clean Energy Regulator says that there is now sufficient generation capacity under construction or already built to ensure that the 2020 target will be exceeded.

Generation, demand and emissions trends

Demand for electricity

In this update we provide new data on total electricity demand, which includes household solar PV. We will distinguish between the usual definition of demand, which is really *net* supply to customers from the grid, with *total* demand inclusive of solar generated by 'prosumers' and consumed by them, behind the meter. Net demand measures the economic supply of electricity in the market, while total demand is the true physical quantity consumed. It should be noted that residential solar is still relatively small but that despite the vagaries of policy incentives, it is the most steadily growing generation source in the NEM (Figure 6: red line).

Figures 1 and 2 show respectively the absolute and relative changes in annual net demand for electricity supplied through the NEM in each state. In most states there appears to have been a small dip in demand during March, followed by a small rise in April. The most probable cause of these changes is the earlier date of Easter in 2018, compared with 2017, meaning that there was an additional public holiday in March and one fewer in April. There is no clear evidence of any significant change in the general trend of roughly constant demand in both the NEM and in WA, observed over the past year.

Figure 1

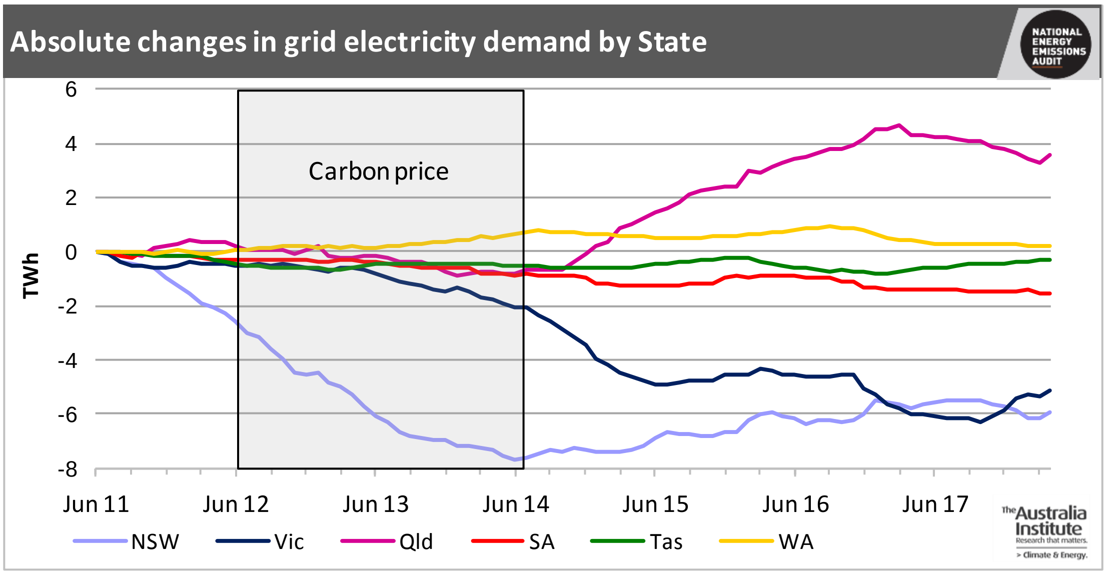


Figure 2

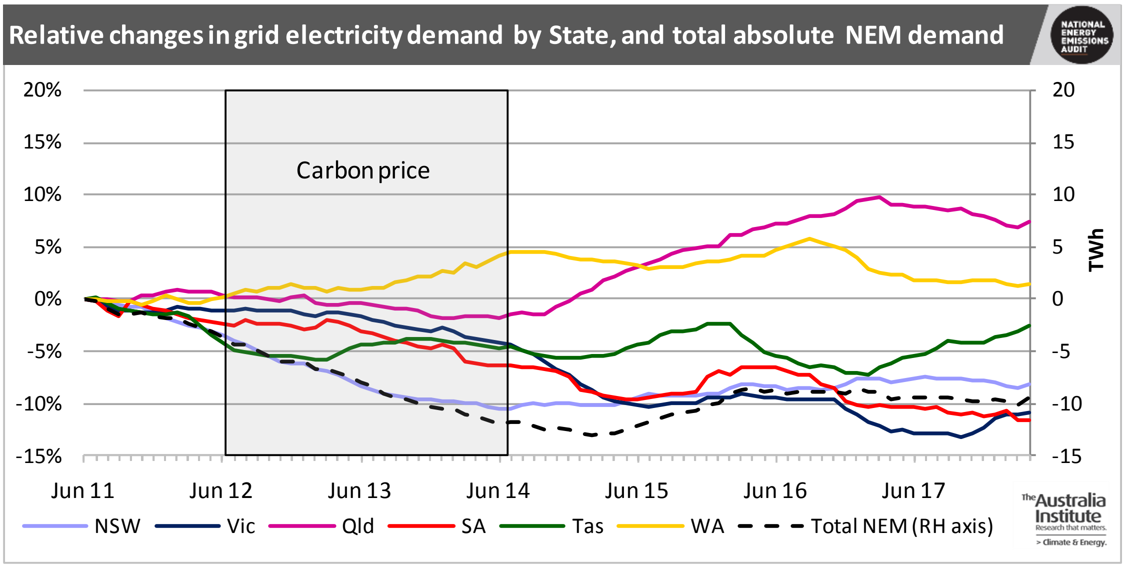
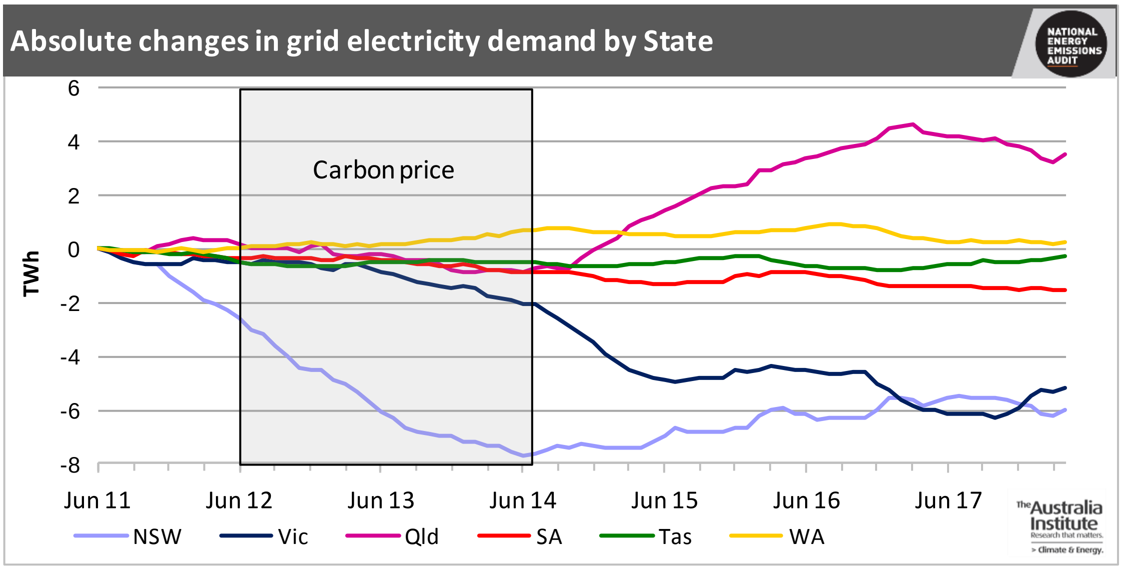


Figure 3 is a graph of the total demand, which has not been previously included in *NEEA Electricity Update*. It is the same as Figure 1, except that total demand in each state also includes the estimated electricity provided by rooftop solar installations. It can be seem that, with this inclusion, total electrical energy used by consumers in the NEM states appears to be gradually increasing, rather than remaining constant. The annual rate of increase, from April 2017 to April 2018, was about 0.8%. This is about half the most recent estimate by the ABS of Australia's rate of population growth, and about one third of the most recent estimate of GDP growth.

Figure 3



Generation and emissions

The March 2018 *NEEA Electricity Update* asked: What will happen to NEM emissions after the end of March? This question is pertinent because this marks the end of the 12 months of rolling average calculations that include the closedown of the high-emissions Hazelwood power station. Just one month of data past March is of course not enough to answer this question in any but the most tentative way. That said, Figures 4, 5 and 6 do provide the first such tentative answer. As expected, the fall in annual generation from brown coal has now ended. The decrease is largely offset by increased renewable generation, which means, with grid demand staying constant, coal fired generation in New South Wales and Queensland also stays roughly constant. Emissions also continue to decrease, though more slowly.

Figure 4

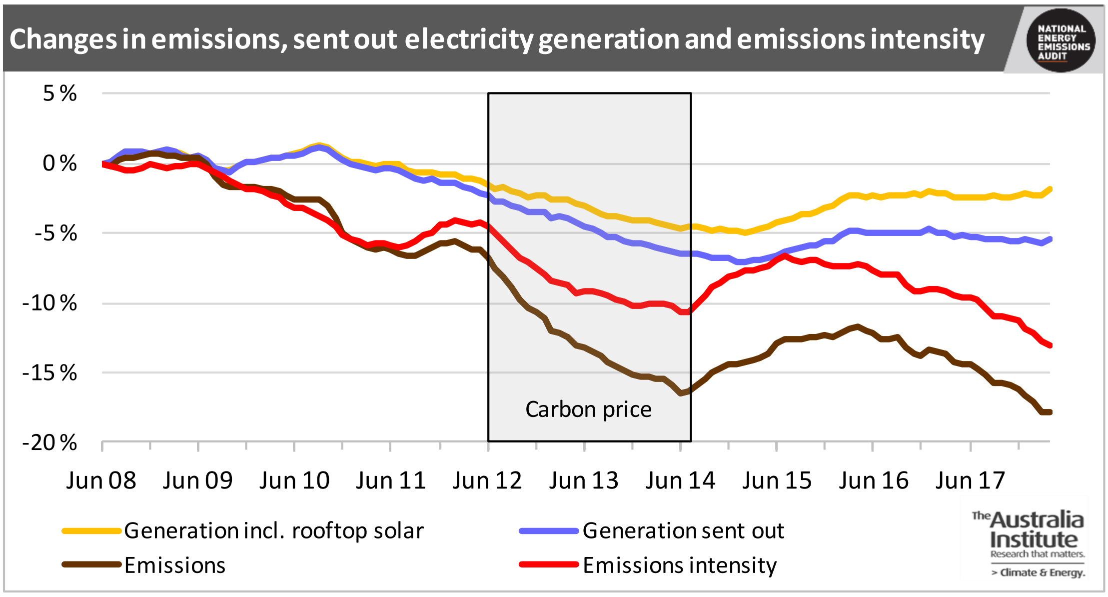


Figure 5

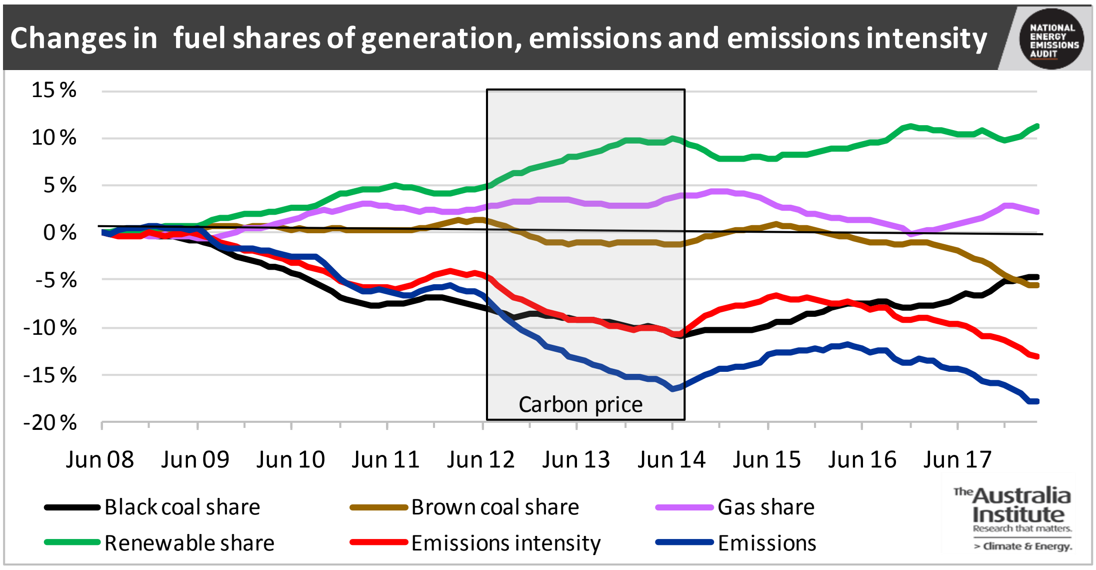
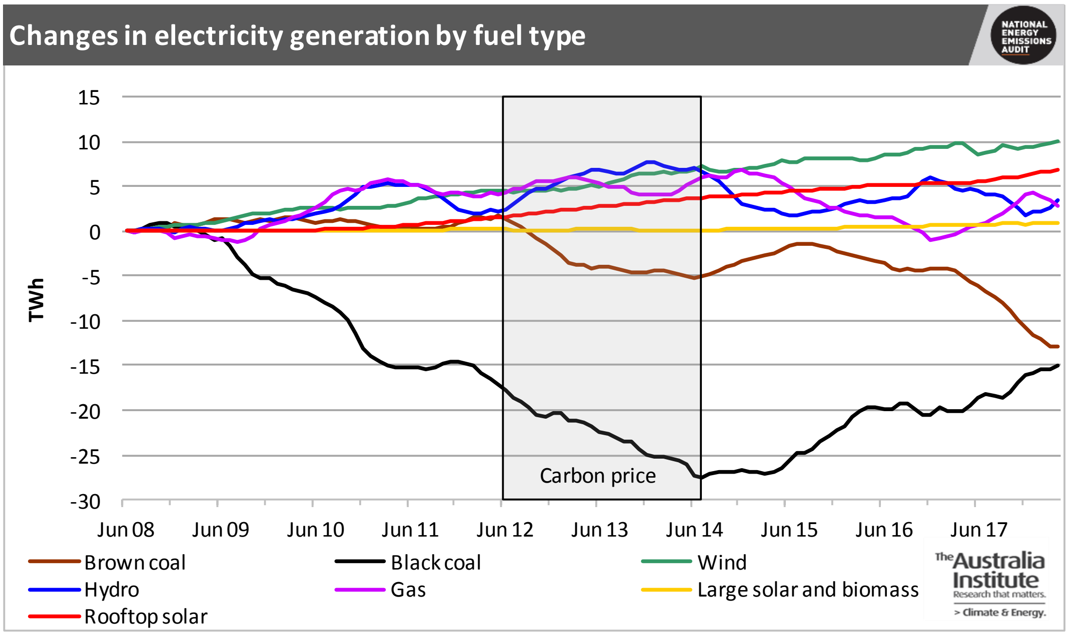
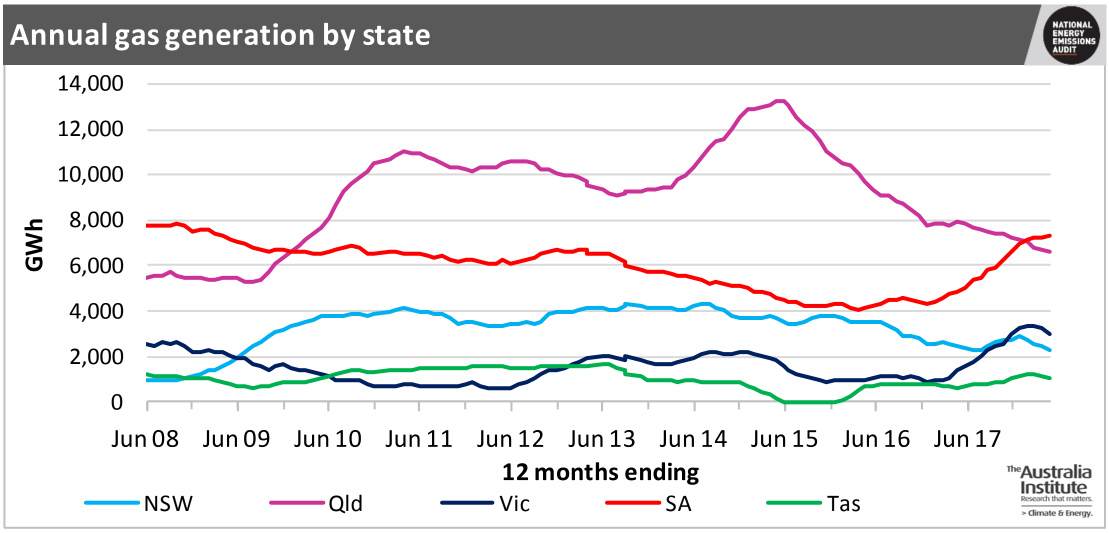


Figure 6



As shown in Figure 7, gas generation continues to decrease in every state except South Australia.

Figure 7

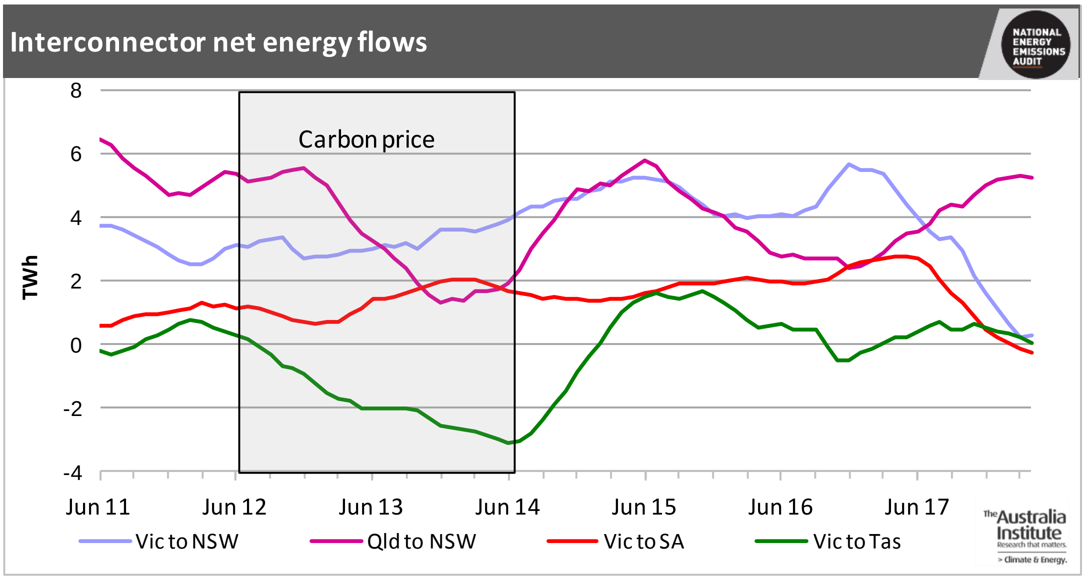


The higher gas generation in South Australia is a direct consequence of the reduced availability of brown coal generated electricity from Victoria. Local gas generation in the state has replaced imported electricity. Gas generation is of course expensive and it is this situation which explains the strong interest in grid scale energy storage projects in the state, including both off-river pumped hydro and batteries.

Interconnector flows

The dramatic change in the net balance of flows through the interconnectors between NEM regions, i.e. states, is shown in Figure 8, which is a graph presented for the first time in *NEEA Electricity Update*.

Figure 8



In the year to April 2018 Victoria was almost precisely in balance with all three states to which it is connected.

In the case of South Australia, March 2018 was the first month during which annualised electricity exports to Victoria exceeded annualised imports, i.e. South Australia became a net exporter of electricity. During the early years of the NEM, in 1999 and 2000, when local generation depended entirely on gas and local coal, net imports from Victoria supplied as much as 30% of electricity consumed in South Australia. Wholesale prices in South Australia were also higher than in any other state, as they have also been over the past few months. These observations are not consistent with the claim, so often made by opponents of wind and solar generation, that high wholesale prices in South Australia over recent years are the consequence of the high level of wind generation in the state. What the data are consistent with is the absence of low cost conventional primary fuel sources (coal and hydro) in South Australia, combined with an extraordinarily peaky demand profile, both of which factors applied in 1999 just as they do today. The difference today is that the state is now taking advantage of its abundant resources of wind and solar radiation, and the new technologies which have made them the lowest course sources of new generation, to supply much of its electricity requirements. That South Australia has very poor conventional energy resources but good wind resources has been known for a very long time, not least by the electricity supply industry. During the 1950s the Electricity Trust of South Australia undertook a study into the feasibility of wind generation, long before wind had been recognised anywhere in the world as a practical source of large scale electricity generation.

Like South Australia, New South Wales has also been a net importer from Victoria since the start of the NEM. It has also been a large net importer from Queensland for most the period. As Figure 8 shows, net imports from Victoria have fallen almost to zero, but imports from Queensland remain at a high level, currently contributing over 8% of electricity delivered to consumers through the NEM. As explained previously in *NEEA Electricity Update*, the dependence of New South Wales on electricity generated in Queensland is not related to a lack of generating capacity within New South Wales. Since 2008, three coal fired power stations have closed in the state, but in the year to June 2008 both the level of net imports (about 8% of total supply) and the overall average capacity factor of operating coal fired power stations (about 65%) were almost the same as in the year to April 2018. Power station closures have been mainly driven by the 10% fall in grid electricity consumption over the same period, augmented by the growth of wind generation from zero to just over 3% of total supply. New South Wales has been a consistent net importer of coal fired electricity from Queensland and, until recently, Victoria, because its coal fired power stations cost more to operate than those in the other states, as a consequence of greater age and/or higher coal costs.

Finally, since the commissioning of Basslink in late 2005, flows of energy between Victoria and Tasmania have varied with circumstances. From the cable's inception until 2010 Tasmania was a net importer, in part because of the effect of prolonged drought on the state's hydro resource. During the carbon price period, Tasmania was a (relatively) large net exporter, for obvious commercial reasons. As soon as the carbon price was removed, Tasmania switched back to being a net importer, a necessity increased by drought during that time. This period ended with the cable breakage, which lasted from December 2015 to June 2016, which has been followed by another period of net imports to allow dam storage levels to recover from the very low levels they reached in June 2016. It is noteworthy that this cable failure coincided with announcements that construction will soon be starting on two new wind farms in Tasmania – Granville Harbour and Wild Cattle Hill. These are the first to be built in the state since 2013, i.e. since before the election of the Abbott Government, and will significantly reduce the possibility of supply security being compromised by any future cable failures.

Tasmania has received good rainfall over the past year and by March 2018 the total energy storage level had reached a level of 37%, which is comfortably above what Hydro Tasmania terms the Prudent Storage Level. However, during the last week of March the Basslink cable suffered another outage, which, as at the start of the fourth week in May, had not been repaired. In a media report date 10 April, Hydro Tasmania said that that "Tasmania is well-placed to manage a Basslink outage lasting up to 31 May". Hydro generation was increased to offset the relatively modest levels of net imports from Victoria, without needing to increase gas generation. As at 21 May, storage levels were at the same level of about 37% as they were when the outage occurred, as a result of good autumn rains. Thus the security of supply is far more assured than it was during the previous extended cable outage. According to ABC News reports, the current outage occurred onshore "when a contractor in Victoria damaged a piece of equipment during routine maintenance".[1] The damage should therefore be more amenable to repair than the previous outage which occurred on the seabed and was difficult to locate because it was caused by a small tear in the insulation cladding of the cable. It is likely that an approximate balance of imports and exports will be restored at that time.

[1] ABC (2018) *Basslink out until mid-April after contractor damages equipment in Victorian station*, http://www.abc.net.au/news/2018-03-28/basslink-cable-offline-after-contractor-damage/9598996

New renewable generation

Perhaps the most important development during the past couple of months has been the commissioning of a large number of new grid scale wind and, particularly, solar farms.

Table 1: New grid-scale renewable energy generators in Australia, (March-May 2018)

Name	Technology	State	Capacity (MW)
Silverton	Wind	NSW	200
Sapphire	Wind	NSW	270
Yaloak South	Wind	Victoria	29
Kiata	Wind	Victoria	31
Gannawarra	Solar	Victoria	55
Griffith	Solar	NSW	27
Parkes	Solar	NSW	66
Manildra	Solar	NSW	50
Clare	Solar	Queensland	100
Kidston	Solar	Queensland	50
Longreach	Solar	Queensland	17
Bungala	Solar	South Australia	135

The newest wind farm is Silverton (200 MW) in New South Wales, which came on line in mid-May. New wind farms during the preceding three months include Sapphire (270 MW), also in New South Wales, together with the smaller Kiata (31 MW) and Yaloak South (29 MW), both in Victoria. The number of new solar farms is much greater. In New South Wales, Griffith (27 MW) and Parkes (66 MW) came on line, followed by Manildra (50 MW) in early May. In Queensland, Clare (100 MW) and Kidston (50 MW) came on line during April. These have been followed in early May by Longreach (17 MW). In Victoria, the state's first grid scale solar farm, Gannawarra (55 MW) came on line in April. Later this year a 25 MW/50 MWh) Tesla battery will be added at the site. Finally, in South Australia, Bungala (135 MW) came on line in early May.

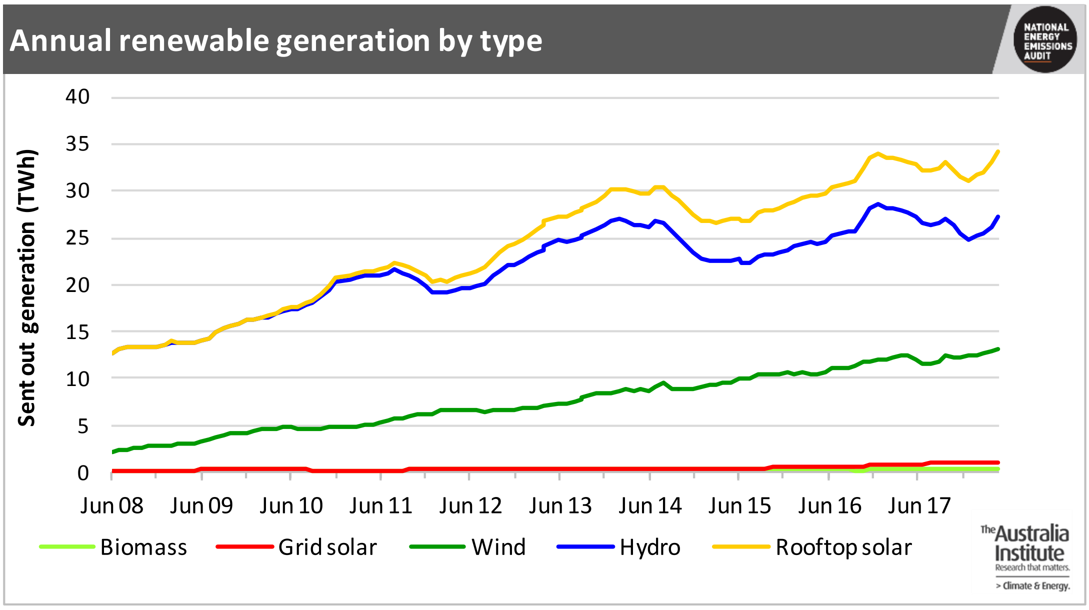
The capacity figures quoted here are the capacity registered with AEMO. When all of the solar farms listed here are fully operational, the capacity of grid scale solar in the NEM will be almost tripled, from around 280 MW to about 780 MW. These developments are for two reasons a significant milestone in Australia's transition towards clean electricity generation.

Firstly, they are a concrete demonstration that the construction cost advantage, which wind enjoyed over solar until a year or two ago, is gone. From now on we can expect new capacity to be a mix of both technologies. Indeed, the Clean Energy Regulator states that it expects solar to account for half of all capacity by 2020.[2]

Secondly, these new projects are the start of a flow of new renewable generation capacity, commissioned following the passage into law of the amended (reduced) Renewable Energy Target program, removing the grave uncertainties caused by the Abbott Government's attempts to destroy the whole program. The Clean Energy Regulator stated on 8 May that there is now sufficient generation capacity under construction or already built to ensure that the 2020 target will be exceeded.[3]

Finally, Figures 9, 10, and 11 show the growth in renewable generation in the NEM over the past eight years. Figure 9 shows the absolute quantities of each type of renewable generation. If rooftop solar is included, total annual renewable generation reached its highest ever level in the year to April 2018. Grid scale "new" renewable generation, i.e. wind and grid solar, also reached a record level in April. However, total grid renewable generation, i.e. excluding rooftop solar, was somewhat higher during the early months of 2017, because of higher hydro generation.

Figure 9



[2] http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target/Large-scale-Renewable-Energy-Target-market-data/large-scale-generation-certificate-market-update/large-scale-generation-certificate-market-update-may-2018

[3] *Ibid.*

Figures 10 and 11 show the same data, but expressed as shares of total generation; Figure 10 is grid scale renewable generation as a share of total grid generation, while Figure 11 is both grid scale and rooftop solar generation as a share of total generation, inclusive of rooftop solar.

Figure 10

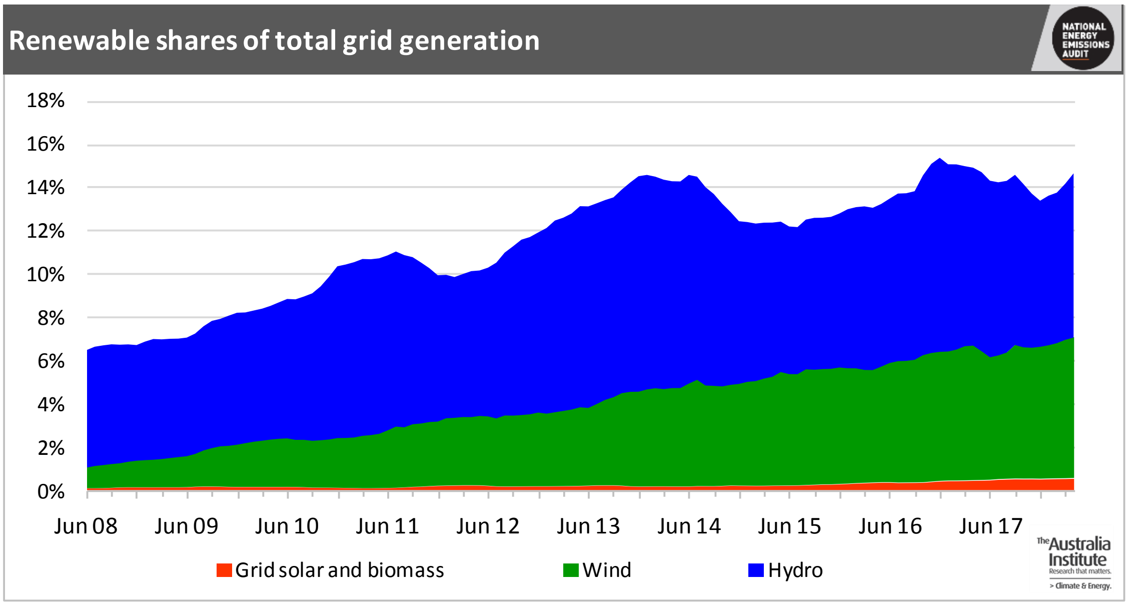


Figure 11

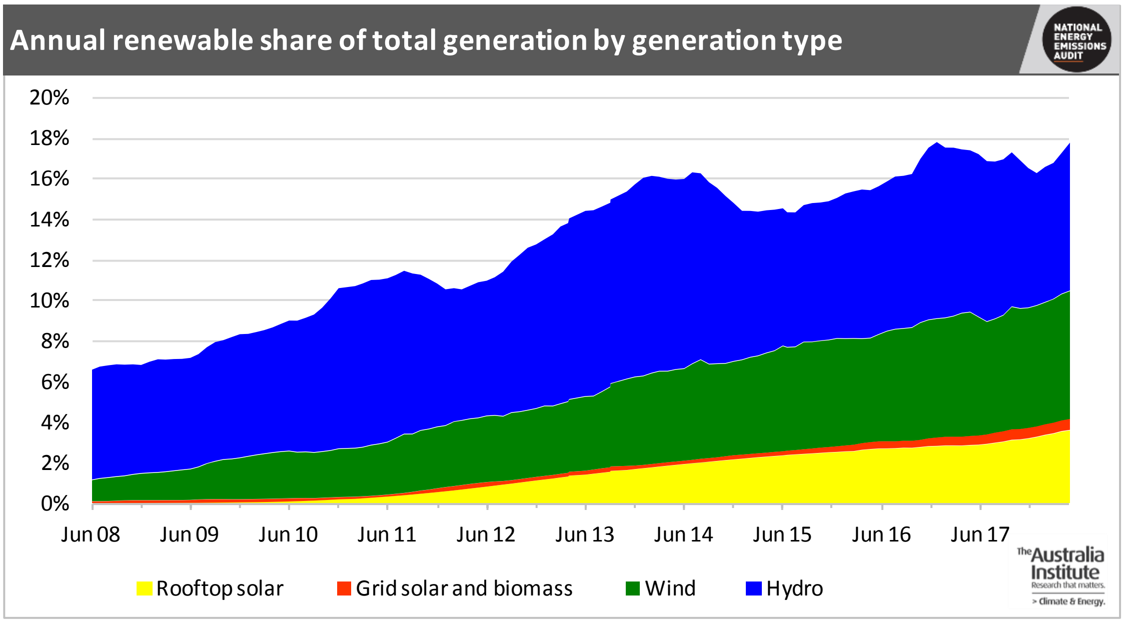


Figure 10 and 11 show that grid scale new renewable generation reached 6.9% of total grid generation in the NEM in the year to April 2018, while the inclusion of rooftop solar increases the new renewable share to 10.5%. As Table 2 below shows, both these shares are higher than the NEM average in Victoria, South Australia and Tasmania, and lower than the NEM average in New South Wales and Queensland. The New South Wales shares are expressed relative to total electricity supplied, including net imports, while for the other states the shares are of total generation in the state, inclusive of net exports. We consider that defining the shares in this way provides the most appropriate indication of the contributions of variable generation sources to total electricity supply in each state.

Table 2: Shares of total generation provided by new renewable generation in mainland states, year to April 2018

	Share of grid generation/supply	Share of generation/supply including rooftop solar
NEM	6.9%	10.5%
South Australia	41.5%	45.6%
Victoria	8.8%	11.6%
New South Wales (shares of supply incl. net imports)	4.1%	6.7%
Queensland	0.2%	4.5%

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, which for the year ending September 2017 was about 5.9 TWh p.a., equivalent to 3.1% of the combined total.