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NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit
Electricity Update

September 2018

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

Author: Hugh Saddler

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Introduction

Welcome to the September 2018 issue of the *NEEA Electricity Update*, with data updated to the end of August 2018. *Electricity Update* is the companion publication to the quarterly *National Energy Emissions Audit Report*, the next issue which is being published alongside the *Electricity Update*. 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).

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 focus on the record levels of renewable generation right across the NEM in August, together with the start of the boom in new wind and solar generators connecting to the NEM. We also comment on the apparent inability of the Business Council of Australia (BCA) to read relatively straightforward graphs and understand relatively straightforward text, as expressed in the criticism of recent NEEA reports in an article by the BCA's Chief Executive, Jennifer Westacott, published in the *Australian Financial Review* on August 29.

Key points

+ ***Renewable generation records broken again in August***

Average daily wind generation in the month of August exceeded the previous record set one month earlier. The wind share of total NEM generation in the year to August 2018 reached 7.5%, total grid renewable generation in the same period also reached a new record share of grid generation, at 16.6%. The renewable share with rooftop solar reached 19.7%. The corresponding share for Victoria alone went up to 18.9%, up from 12.3% just three years earlier. All these figures are records.

+ ***Wind provided 55% of grid power generation in South Australia during August***

During August, wind supplied 55% of grid generation and gas the remaining 45%. Wind and rooftop solar combined supplied 58% of the combined total generation. In net terms, 10% of all electricity generated in the state was exported to Victoria. Average wholesale prices in South Australia during August were 19% below the corresponding average of New South Wales, where renewables, including Snowy Hydro, supplied only 14% of generation (and 12% of supply including net imports from Queensland and Victoria). South Australian wholesale prices were also lower than wholesale prices in Queensland and Victoria.

+ ***New graphs in this issue show the start of a surge in new renewable generation coming on-line***

In the four months since the end of April, wind generation capacity connected to the NEM grid has increased by 14% and large solar generation connected has increased, from a low base, by 93%. The next two years will see continuing rapid growth in both wind and solar generation.

+ ***Official figures from the Energy Security Board suggest that by the end of 2020 total wind generation capacity connected to the NEM will be 41% higher than today and total solar connected will be almost three times current capacity***

We have calculated that the total additional electricity supplied by this new renewable generation will be equal to at least 9% of all NEM generation over the past year. It will equal the current total annual output from Eraring, the largest power station in Australia, and be double the current output from Liddell.

+ ***The reality of this imminent major increase in renewable generation has apparently been almost completely ignored by advocates for new generation investment within government***

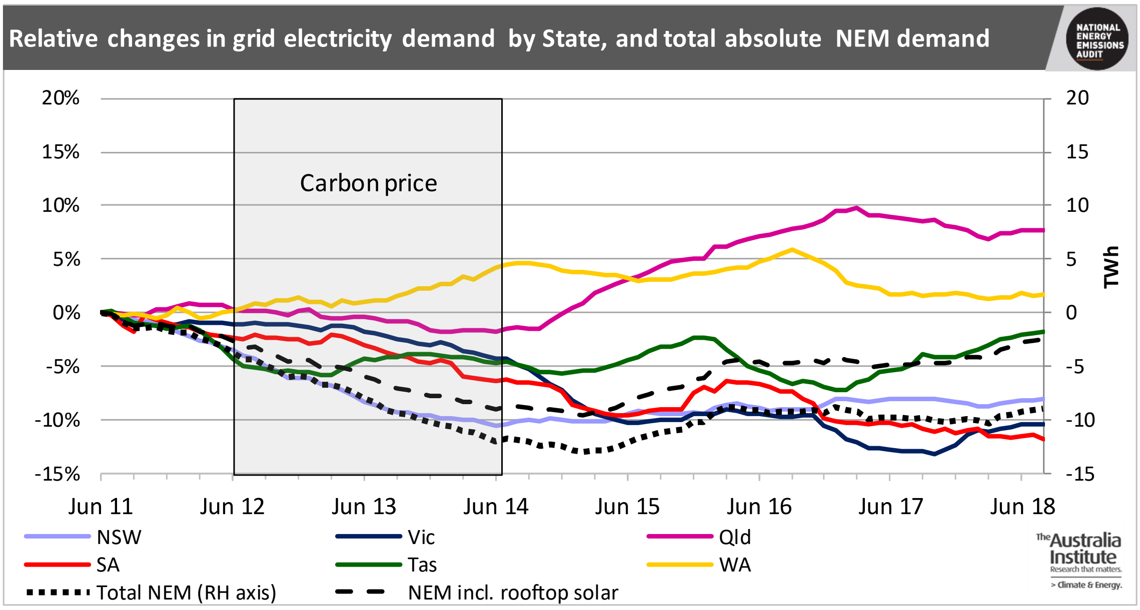
This volume of new generation is likely to significantly increase competition in the NEM wholesale electricity market, thereby putting downward pressure on prices, even without taking into account the so-called merit order effect, resulting from the almost zero variable cost of renewable generation. Why do government members talk so much about underwriting new coal fired generation?

GENERATION, DEMAND AND EMISSIONS TRENDS

Demand for electricity

Changes in annual net demand for electricity supplied through the NEM in each state, up to the end of August 2018, are shown in relative terms in Figure 1. Also shown are the absolute changes in total NEM demand, both at the grid level, i.e. exclusive of rooftop solar, and including rooftop solar. The graph shows a very small increase in annual NEM grid demand since July, but overall a continuation of the general trend of the past two and a half years of no major change in annual grid level consumption of electrical energy. Consumption in the year to August 2018 was exactly the same as in the year to March 2016.

Figure 1



However, as *NEEA Electricity Update* has been reporting for several months, when electricity supplied by rooftop solar in added to grid level consumption, it is clear that total electricity used by consumers has been growing steadily, particularly over the past year and a half. Total consumption in the year to September 2018 was 1.1% higher than in the year to March 2016.

As explained in last month's *NEEA Electricity Update*, the absence of significant growth in consumption at the grid level in the NEM means that the primary requirement for new generation capacity will arise from the closure of existing generators. In its recently published *2018 Electricity Statement of Opportunities*, AEMO notes:

> "Modelling [undertaken as input to the Statement] includes over 5.6 gigawatts (GW) of committed new generation and storage capacity, and upgrades to existing generation. Most of this has become committed since the 2017 ESOO, with some 2.7 GW of utility-scale wind and solar generation added in the past quarter alone, mainly in Victoria." (p. 3)

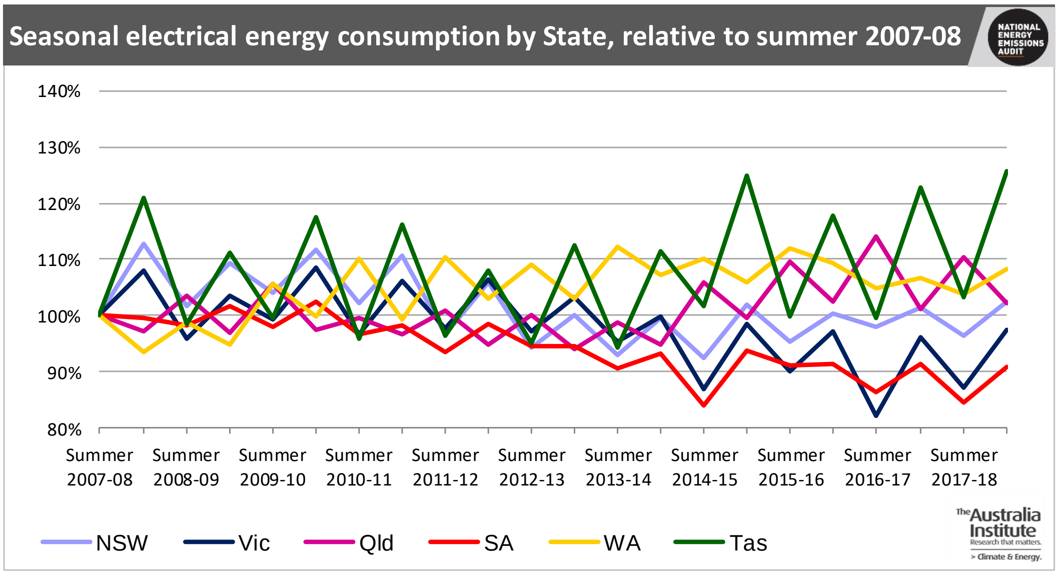
This leads to the conclusion that "After this summer, the level of risk [of supply interruptions] is forecast to reduce through to 2020-21, as more resources continue to be installed" (p. 3). Within a few years, however, the foreshadowed closure of Torrens Island A power station in South Australia and Liddell in New South Wales between 2019 and 2022, plus a downgrade of the assessed reliability of old thermal power stations, will mean that after 2022 continued system reliability will require that

> "new utility-scale renewable generation be complemented by storage, distributed energy resources (DER), flexible thermal capacity, and transmission, to ensure dispatchability in all hours." (p. 3)

Note that coal fired generation is explicitly excluded from this list by the qualifying adjective "flexible". There is a more extended discussion of new generation investment later in this *Electricity Update*.

Finally, regarding demand for electricity, every September (and every April) *NEEA Electricity Update* publishes the latest graph of seasonal electricity consumption, i.e. total electricity consumed during the summer months (December to March inclusive) and the winter months (May to August inclusive). It can be seen that winter electricity consumption appears to be trending slightly down in Victoria, South Australia and Western Australia, and slightly up in New South Wales and Tasmania.

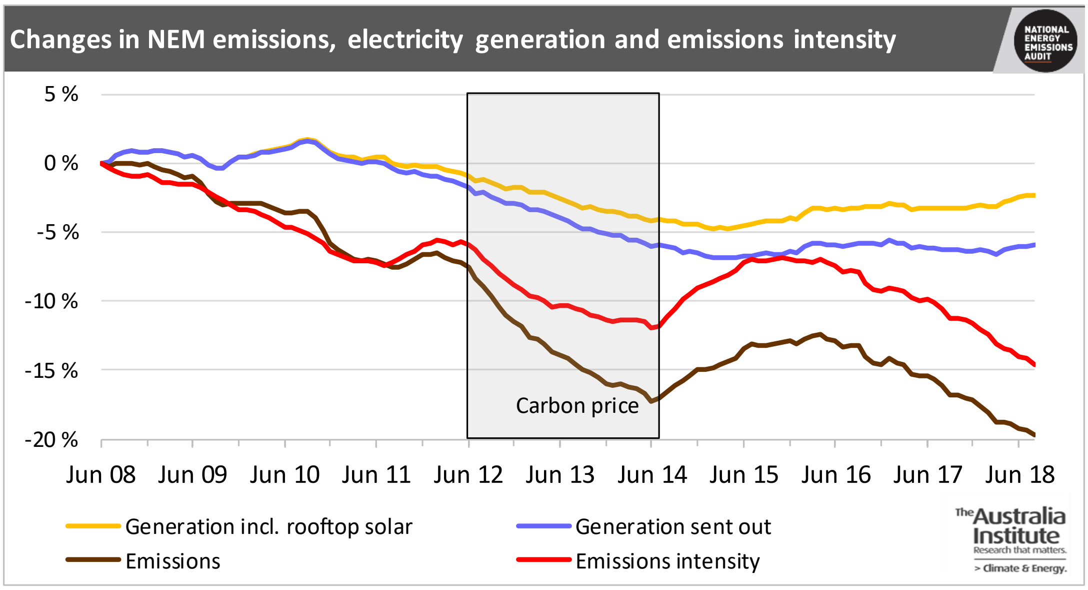
Figure 2



Generation and emissions

The key features of Figures 3, 4 and 5, first seen clearly in the July 2018 *NEEA Electricity Update*, are that, firstly, electricity generation emissions continue to decrease, and, secondly, the driver for this decrease is the displacement of black coal and gas generation by rapidly growing wind and grid scale solar generation. By contrast, as also previously noted, brown coal generation continues to maintain its share of NEM generation.

Figure 3



These changes are precisely the outcomes which a well functioning, competitive wholesale electricity market would be expected to deliver. Available generators are dispatched in a sequence based on their variable operating cost, generators with the lowest variable costs being top of the merit order, i.e. dispatched first, and generators with the highest variable costs at the bottom of the merit order. When available, the operating costs of wind, solar and hydro generators are close to zero, so they take priority, though hydro generators, especially outside Tasmania, are often constrained by lack of water. Brown coal generators are next because of the very low cost of their brown coal fuel, as explained in the recent ACCC report on electricity costs and prices. Black coal generators are next, followed by combined cycle gas, with open cycle gas turbine generators, run only occasionally to meet peak loads, the most costly. Consequently, wind and solar generators mostly displace black coal and combined cycle gas generators.

Figure 4

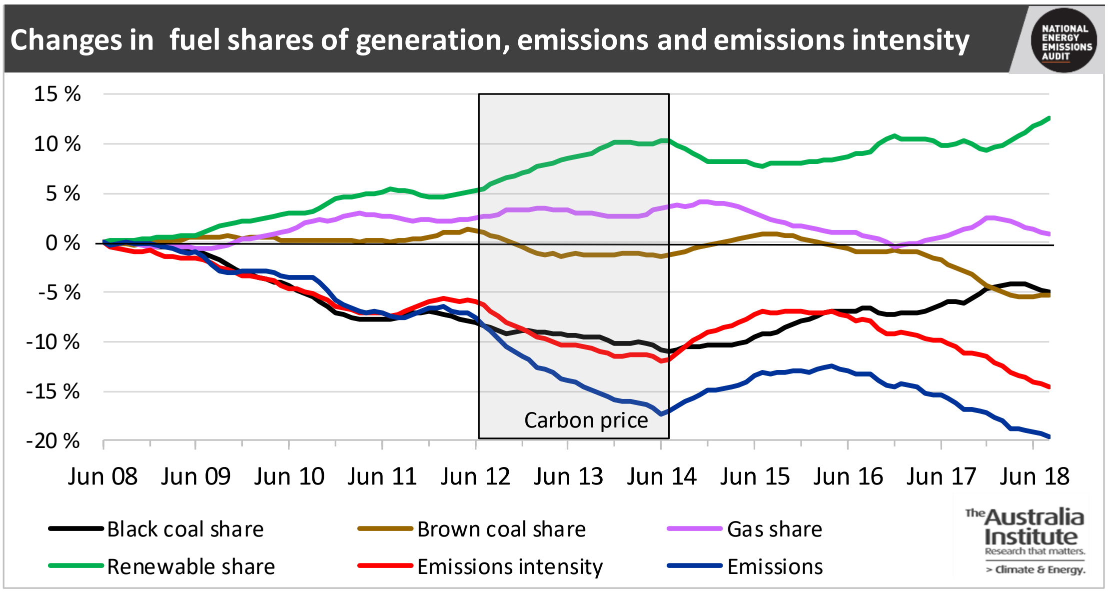


Figure 5

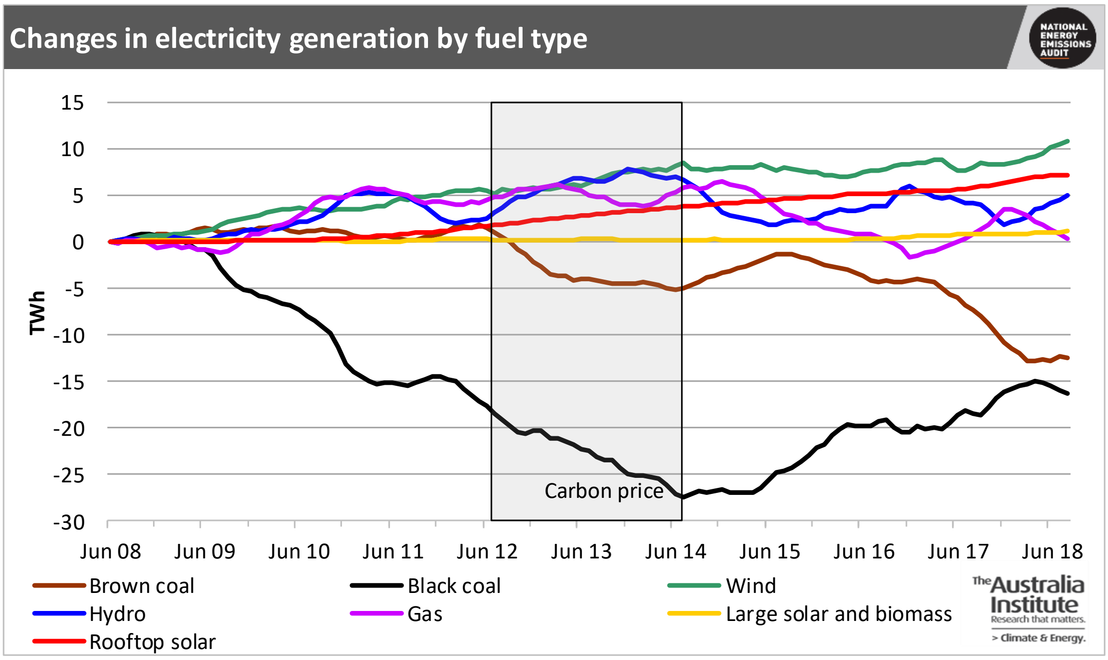
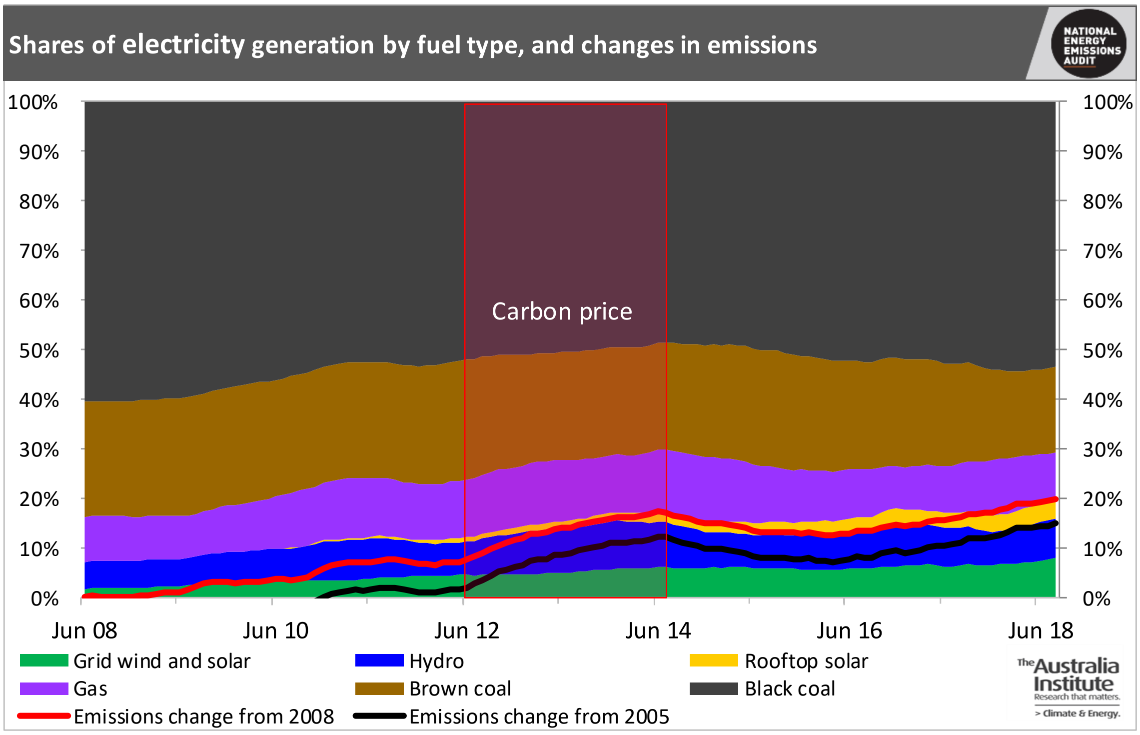


Figure 6, introduced for the first time last month, shows both the continued increase of the total renewable share of generation in the NEM and the decrease in emissions over the past ten years. Total grid renewables as a share of total grid generation reached 16.1% in the year to August 2018, comfortably exceeding the previous peak of 15.6% recorded in the year to June 2014, right at the end of hydro "excess" generation during the period that a carbon price was in place. When generation by rooftop solar is included in both the numerator and denominator of the calculation, the renewable share in the year to August 2018 is 19.7%. Total NEM generation emissions in the year to August 2018 were just under 15% below the level recorded in the year to June 2005, which was the reference year for the government's former NEG proposal.

Figure 6



NEW RENEWABLE GENERATION

Record levels of renewable generation

After a record performance in July, more new records for average daily output from both wind and grid scale solar generators were set in August. With hydro generation also close to its highest ever level, total renewable generation also reached a record level in August. Figure 7 shows average daily sent out generation in each month over the past ten years, in GWh, while Figure 8 shows the same data expressed as a fraction of total average daily NEM generation. In August, grid renewables, including hydro, supplied 23% of all grid generation, while variable renewables, i.e. wind and grid scale solar, supplied 11% of grid generation. If rooftop solar is also included, the total renewable share of all electricity supplied in August rises to 25.6%.

Figure 7

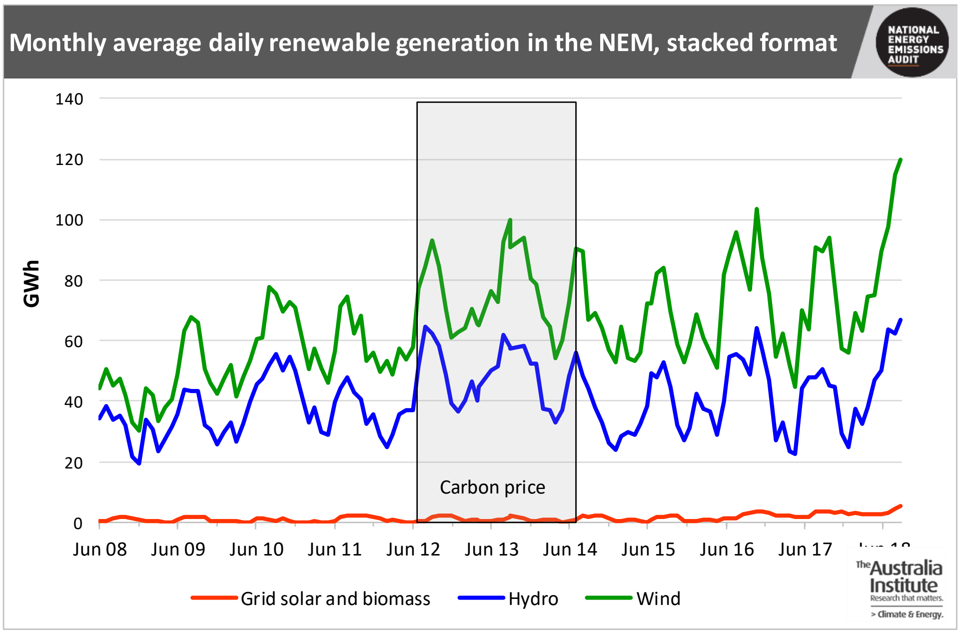
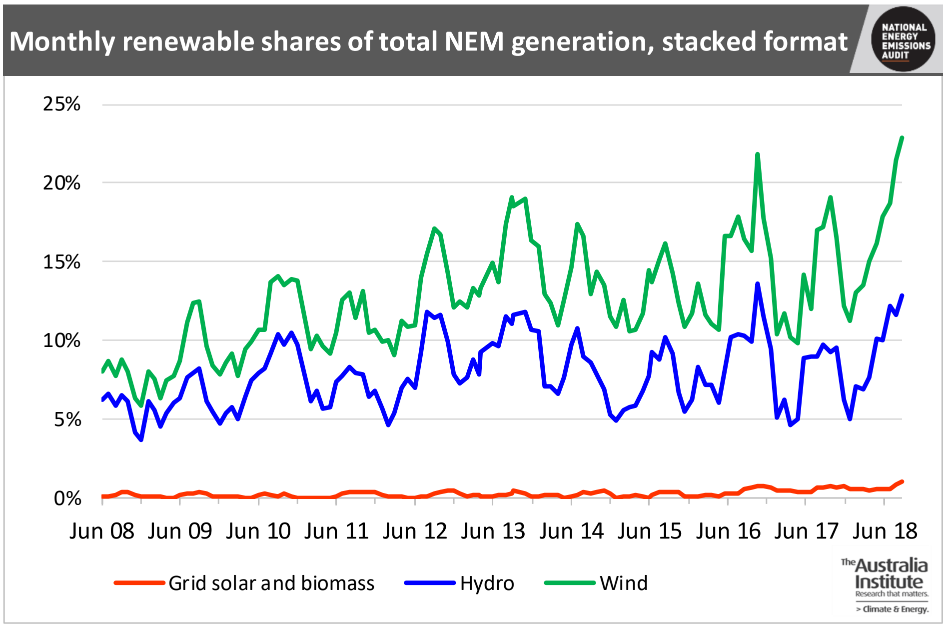


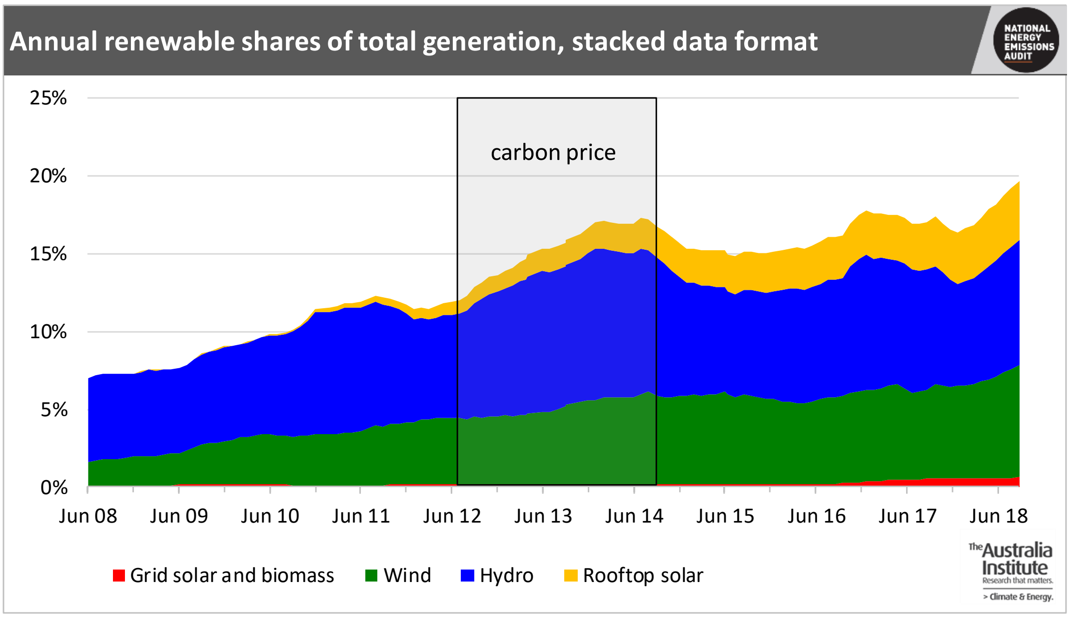
Figure 8



It should be noted that renewables appear relatively larger in absolute terms than when expressed as total GWh supplied, because, as seen in Figure 2, total demand for electrical energy (as distinct from peak instantaneous demand) is higher in the winter months than in summer.

The very high renewable generation in July and August translates into record levels of annual renewable generation. In the year to July 2018 the share of grid renewables in the NEM just beat the previous record share, which occurred in early 2014, during the closing months of the carbon price period. By the end of the year to August 2018 the grid renewables share was decisively higher, reaching 15.9%. The total renewables share, including rooftop solar, was much higher, at 19.7%. In Victoria, the share in the year to August 2018 was 18.9%, having increased from 12.3% just three years earlier, in the year to August 2015. The state has a legislated goal of reaching a total renewables share of generation in the state of 25% by 2020. On current trends, it is likely to reach that target.

Figure 9

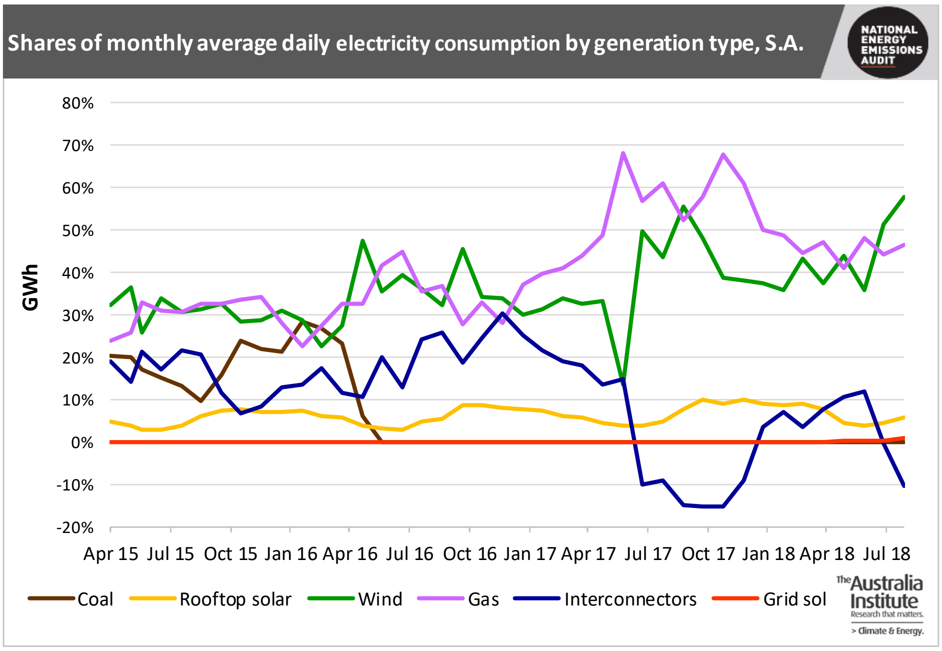


Renewable generation in South Australia

Wind generation in South Australia in August reached record levels, in terms of both average daily generation and share of total electricity supplied in the state during the month. This is shown in Figure 10. Wind generation and grid scale solar generation contributed 58.5% of total electricity supplied in the state and gas generation 46.2% of total electricity supplied, with a further 5.7% from rooftop solar. Clearly these fractions add to more than 100%, so South Australia was a net exporter of electricity to Victoria during August, as it also was in July.

On most days during July and, particularly, August, average spot wholesale prices were at or below the levels seen in the other mainland states. For August as a whole, average wholesale prices were $72 per MWh in South Australia, $79/MWh n Victoria, $82 per MWh in Queensland and $93 per MWh in New South Wales. However, during July, South Australia had a higher average price, because on several days during the month prices spiked to very high levels for short periods. As the recent ACCC report has pointed out, these price spikes occur much more frequently in South Australia than in the other NEM regions, mainly because the ownership of generators is highly concentrated, meaning that competition between generators is frequently absent.

Figure 10



New renewable generation

The last three issues of *NEEA Electricity Update* have included detailed discussions of the forthcoming surge in new renewable generation capacity. The August issue included graphs of the annual grid connected wind and solar generation capacity in the NEM, as projected, separately, by AEMO and the Energy Security Board in the final (most complete) version of the so-called final design document for the National Energy Guarantee, which the government released just before that policy was abandoned. This version contained an appendix with a list of every individual wind and solar power station which the Board expected to be connected by the start of 2021. We have used that list to calculate total expected capacity in January 2021. These capacities are shown in Figure 11, which is a new graph, to be included in future *NEEA Electricity Update*s.

The sharp increase in new connections of both wind and solar generators during the past few months is clear to see. The additional output from these new generators is one of the two main factors, together with the very windy weather conditions in southern Australia, responsible for the record levels of renewable generation in the NEM during July and August. Figure 12 places the recent new connections in a longer term context, extending back eleven years. The accelerated rates of new capacity connection during the past six months, particularly for solar farms, are clear to see.

It is ironic, or perhaps symbolic, that these dramatic changes are so clearly demonstrating the success of policy in place since 2009, with a 2020 completion date, in the same month that the government finally abandoned any attempt to design energy and emissions policy to follow on through the 2020s.

Figure 11

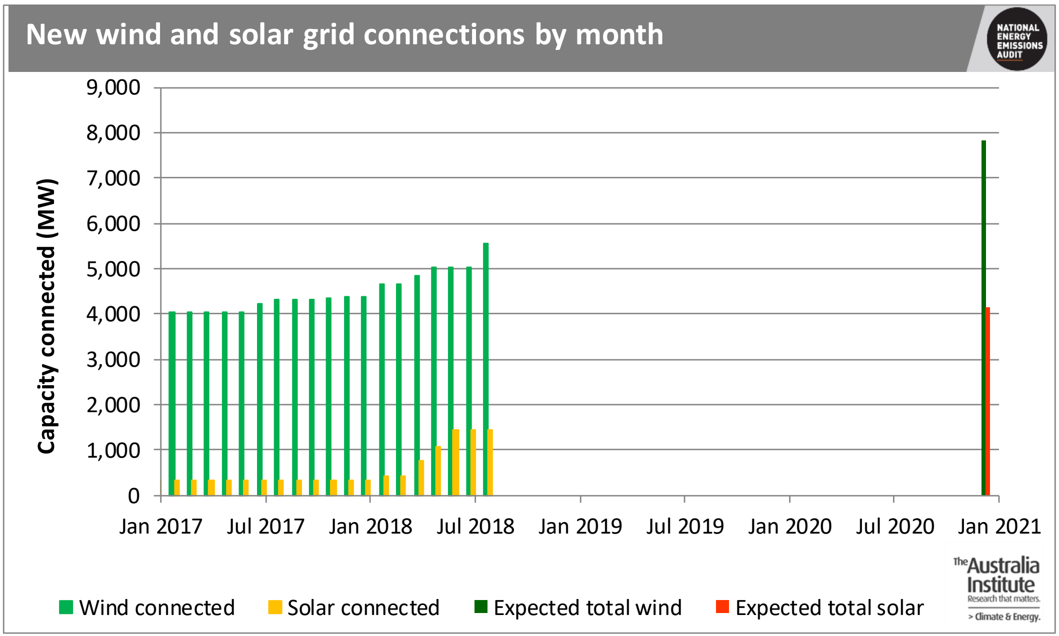
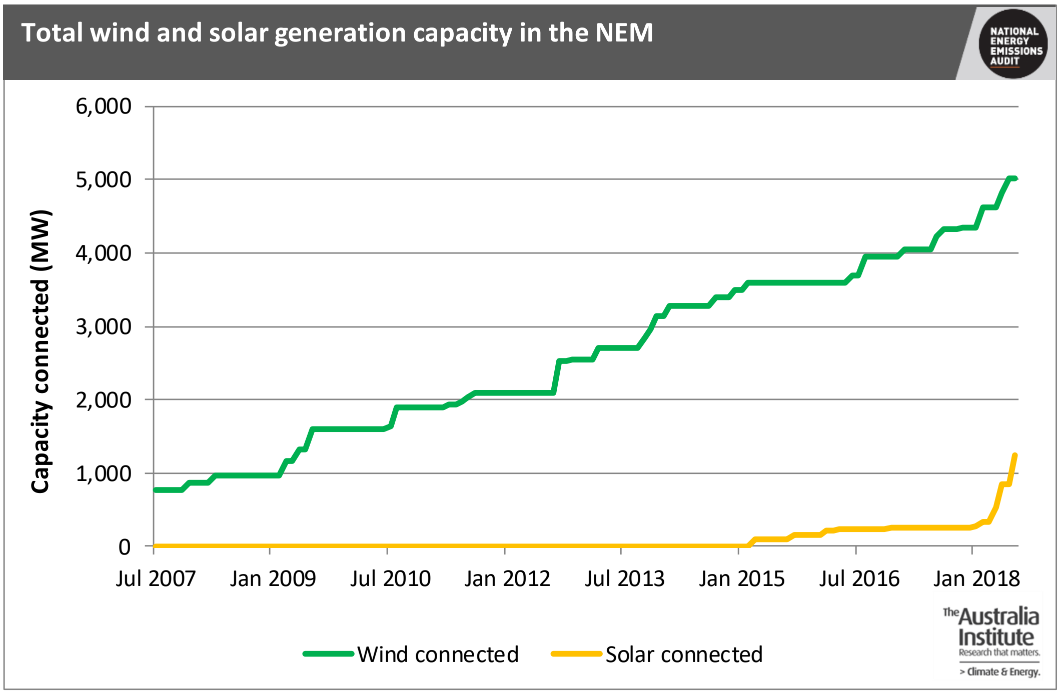


Figure 12



It is certainly symbolic of the current government's energy policy confusion that they should be calling for new investment in generation capacity while ignoring the new capacity currently being built. The data in Figure 11 correspond to an increase of about 2,800 MW in the full capacity operation of wind generators, and of about 3,100 MW in the full capacity solar generators. Using conservative average capacity factor assumptions of 35% for wind and 28% for solar leads to the conclusion that these new wind and solar generators will supply over 16 TWh electrical energy to the NEM every year from 2021 onward. 16 TWh per annum is just under 9% of current total NEM generation, almost exactly equal to the output of Eraring, Australia's largest power station, over the past year, and about twice the output of Liddell, the foreshadowed closure of which in 2022 is of such interest to the government. These observations are, of course, completely consistent with the previously quoted conclusions of AEMO, in its most recent *Statement of Opportunities.* In its earlier *Integrated System Plan*, previously discussed in *NEEA Electricity Update*, AEMO described the other investments in NEM grid infrastructure, which will be needed to ensure that the system continues to operate securely and reliably when all this new renewable generation comes on line.

It is not clear why government statements ignore that this new capacity, now coming on line, will contribute to lowering wholesale electricity prices, while emphasis is placed on the prospect of prices being reduced by a new coal fired power station, which could only begin operation in, say, five years time. The preference for coal is made even more incomprehensible, given that a coal-fired generator must, at the bare minimum, realise a price that covers the cost of the coal it is burning, whereas wind and solar generators have zero fuel costs.

Regrettably, it appears that the current government has no policy to address the serious task of, in the words of AEMO's *Statement of Opportunities*, ensuring the construction after 2020 of "new utility-scale renewable generation…complemented by storage, distributed energy resources (DER), flexible thermal capacity, and transmission".

Finally, it is necessary to respond to an article by Business Council of Australia (BCA) Chief Executive, Jennifer Westacott, published in the *Australian Financial Review* on 30 August. The article aims to defend the BCA's claim that a 45% emissions reduction target for the electricity sector would be an "economy wrecker".[1]

Rather than producing analysis to support this statement, which at time of writing had not been retracted, Ms Westacott attacks The Australia Institute claiming we have spread:

> *Spurious claims that the NEG would result in "no investment in further renewable energy generation after 2021".*

This is a selective quote from the August *NEEA Electricity Update*. The full sentence is:

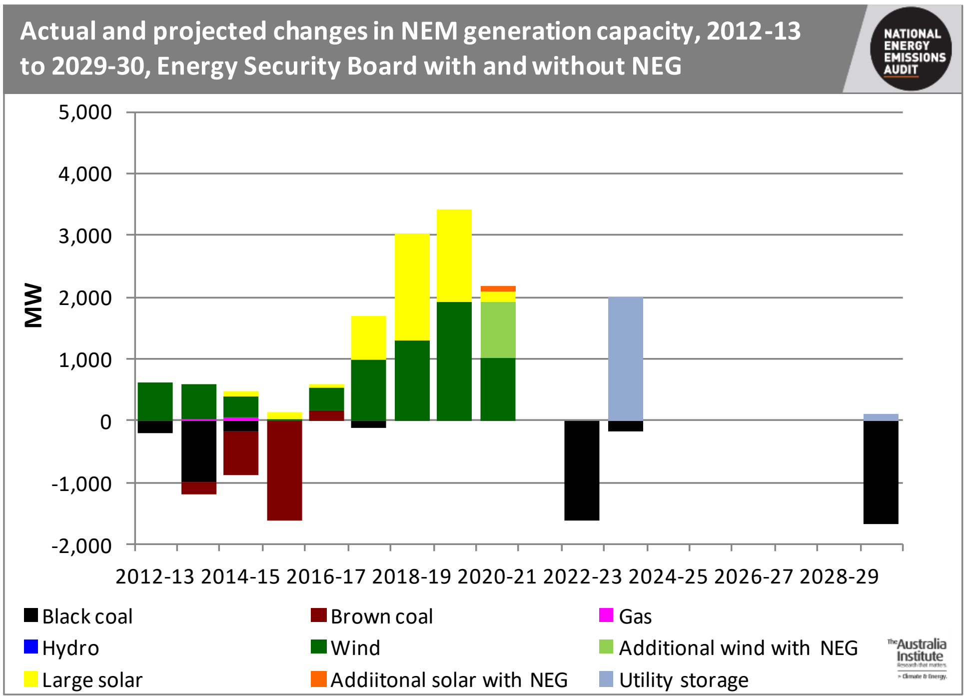
> *Current NEG modelling will effectively create an investment cliff for the otherwise booming renewables sector, with no investment in further renewable energy generation after 2021.*

The 'current NEG modelling' referred to was that of the Energy Security Board (ESB), not the Australia Institute, as claimed by Ms Westacott. The ESB concluded that there would be no new renewable investment after 2021 based on its NEG assumptions. The authorship of this

[1] BCA (2018) *Tweet*, https://twitter.com/BCAcomau/status/1011414577702031361

claim was perfectly clear to any reader of the August update as it included one of the graphs from the Board's document, although in NEEA formatting, shown again below, as Figure 13.

Figure 13



The Energy Security Board's modelling results are obviously a fiction, perhaps prepared in the hope of gaining political favour from government MPs who oppose action on climate change. Our scepticism of the ESB's modelling was clearly stated in the August update:

> *Certainly, none of the ESB's reports mentions these state policies [such as VRET or QRET]. Nor do the reports at any point mention the growing volume of new renewable electricity being directly contracted by large corporate electricity consumers.*

Given that many of the purchasers in such contracts are BCA members, Ms Westacott should be aware that with the steadily falling cost of new wind and solar generation, the current steady stream of direct power purchase agreements (PPAs), could well become a torrent after 2021. This would contradict the ESB's modelling of a halt in new renewable generation.

It is unfortunate that, instead of retracting its unsubstantiated 'economy wrecking' claims and publicly calling out the ESB's fiction, the BCA chose to attack The Australia Institute. While anti-renewable propaganda is common from representatives of the coal industry such as the Minerals Council of Australia, the BCA has until now largely represented the wider energy interests of its members.[2] Hopefully this is not a sign of things to come.

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[2] Swann et al. (2017) *Mainly Coal Advocacy: What does the MCA stand for?*, http://www.tai.org.au/content/what-does-mca-stand

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.