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> Climate & Energy.

NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit Report

July 2020

Providing a comprehensive, up-to-date indication of trends in Australia's energy combustion emissions

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Key points

- The annual emissions intensity of the NEM for the year 2019-20 has decreased by more than 25% below the historic maximum (in 2008).
    - Almost two thirds of the total reduction in emissions intensity is due to the changing mix of generation, away from coal and towards wind and solar.
    - 22% of the total reduction is due to the growth of rooftop solar installations and subsequent decreased demand for grid connected generation.
- Over the decade the volume of electricity used by final consumers has decreased, whilst the population and GDP have grown.
    - Just under 8% of the total reduction in emissions intensity is due to the decrease in electricity used by final consumers, driven by increased efficiency, changing energy use behaviour and the cessation of some electricity intensive activities, notably the closure of two aluminium smelters.
- In Victoria and South Australia the combined wind and solar share of generation has almost doubled in the past four years, from 15% to 29%. Total renewable share, including hydro, was just under 33% in 2019-20.
    - The coal share of generation in Victoria and South Australia combined has fallen from 72% to 53% since 2016.
- In QLD and NSW the transition from coal to renewables has progressed only half as far as in Victoria/South Australia. The wind and solar share of generation in 2019-20 was 14.5%, whilst total renewable share including hydro was 16%.
- The average coal generation capacity in New South Wales has fallen below 60%. If the rate of fall continues for the next two years, it may approach 50% by April 2022, when AGL plans to begin closing Liddell power station. Liddell should be closed by 2023 depending on the outcome of the Liddell Taskforce review.
- The average coal capacity factor in Queensland is about 69%. However, it has been falling longer and faster than in New South Wales. On current trends it may reach the current New South Wales level of 60% by 2025, putting at least one of the older power stations under strong financial pressure.
- Coal plant closures should be timed with investments in new renewable generation capacity, together with investments in storage, transmission, and other technologies, to avoid the surge in wholesale prices that followed the closure of Hazelwood power station.

INTRODUCTION

Welcome to the July 2020 issue of the *NEEA Report*, with data relating to electricity in the National Electricity Market updated to the end of June 2020.

Being the last issue for the 2019-20 financial year, this issue presents a series of new graphs, showing the progress, since the start of the NEM, in the transition from coal to wind and solar generation. There are also graphs showing the steady decline in utilisation of the stock of coal fired power station, measured by falling average capacity factors.

THE STATE OF THE NEM AT THE END OF 2019-20

To mark the end of the financial year 2019-20 we present a series of the regular graphs updated to June 2020. Figure 1 shows that total sent out grid generation in the NEM in the year 2019-20 was 8.3% below the historic maximum, which was reached in the year to February 2009. The historic maximum level of annual emissions was reached just a few months earlier, around September/October 2008, and in the year 2019-20 emissions had fallen by over 25% from that maximum level.

Figure 1

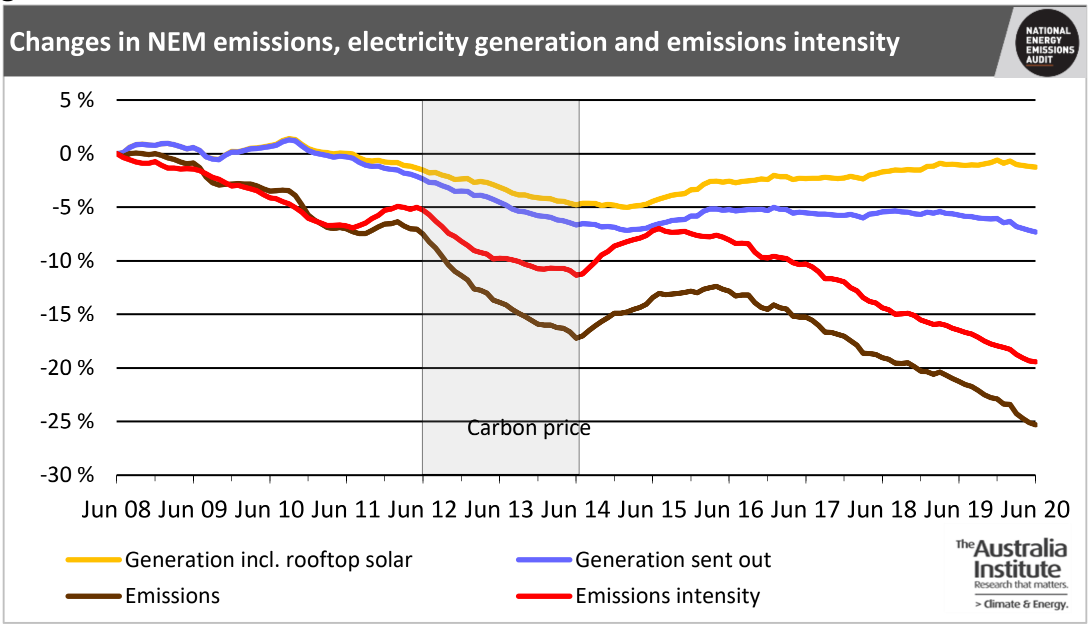


Figure 2

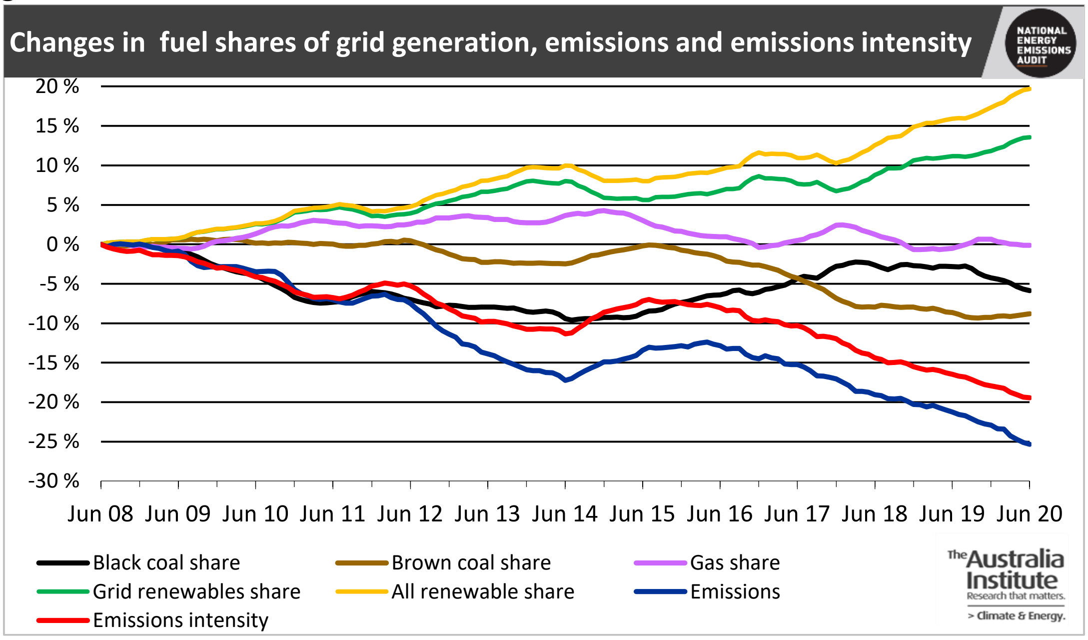
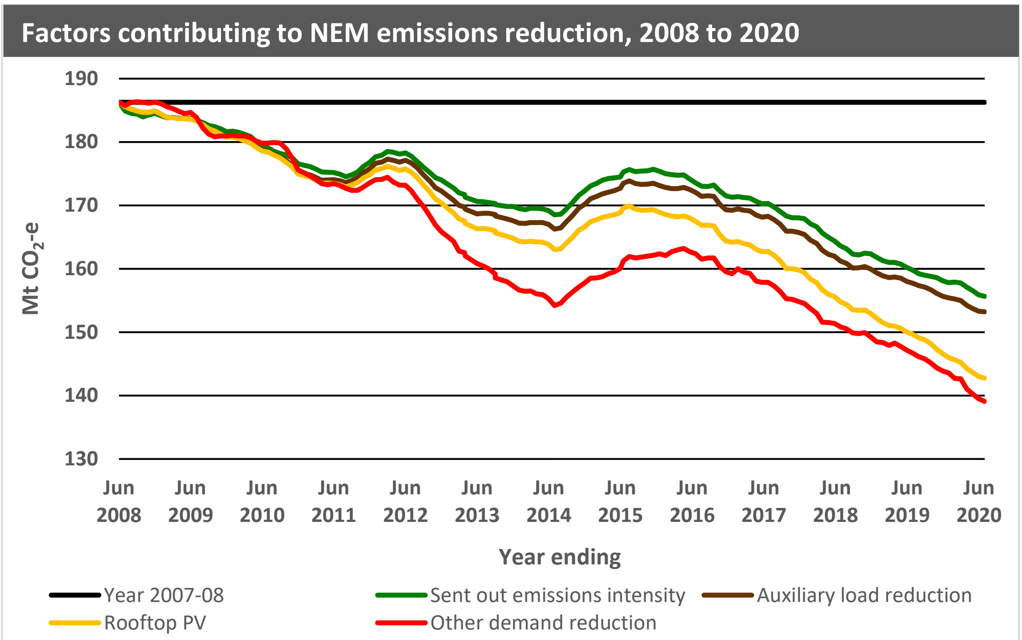


Figure 2 shows the changing mix of generation, which has been a major cause of the reduced demand, with brown coal generation, in particular, being much less than in 2008, and renewable generation much more. Figure 3, which is a new graph designed specifically for this issue of the NEEA Report, shows, in stacked format, the relative contributions of the various factors affecting total emissions.

Figure 3

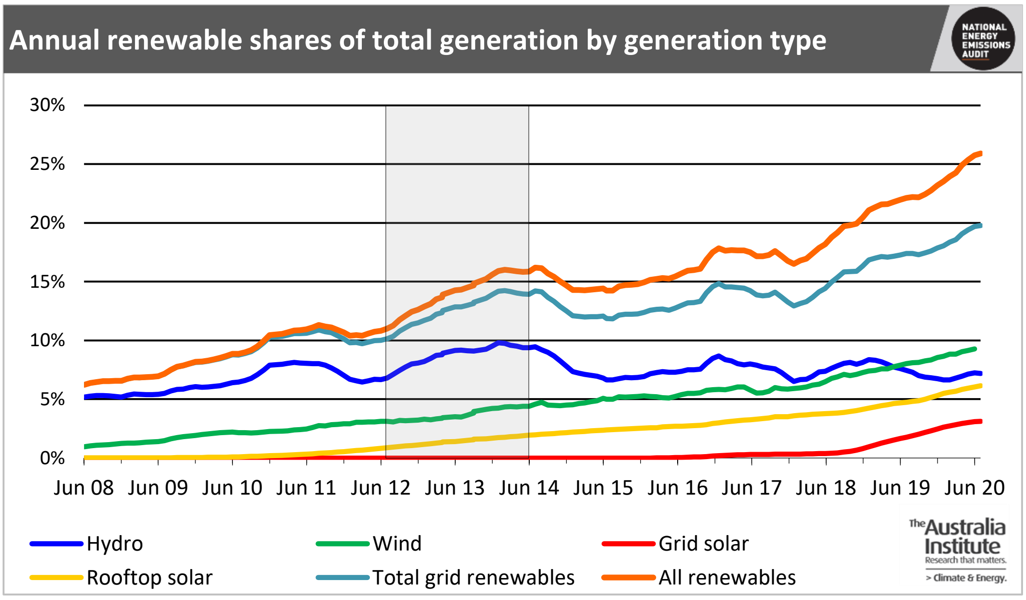


The largest factor, contributing almost two thirds of the total reduction, is the reduced average as generated emissions intensity of NEM generators, caused by the changing mix of generation, away from coal and towards wind and solar. Less coal generation makes a further small contribution to lower emissions, because it means that auxiliary load, the electricity needed to operate, mainly, coal fired power stations is reduced. Reduced auxiliary load has contributed 5% of the 2008 to 2020 emissions reduction. The combination of change from as generated emissions intensity and change from reduced auxiliary loads represents change from reduced sent out emissions intensity.

The third component is the growth in the share of final electricity consumption coming from rooftop solar installations, thereby reducing the demand for grid connected generation; this contributed about 22% of the total emissions reduction. Finally, reduction in the volume of electricity used by final consumers, through increased end use efficiency, changing energy use behaviour and the cessation of some electricity intensive activities, notably the closure of two aluminium smelters, made a contribution of just under 8%. If this component were expressed in terms of reduced electricity consumption per head of population, or per dollar of GDP, it would of course appear to be much larger. It is significant that this component has decreased in recent years, i.e. total final consumption of electricity, including electricity sourced from rooftop solar, has been gradually increasing since 2015, as can be clearly seen also in Figure 1.

Figure 4 provides more detail of the growth in wind and grid solar generation, which increased from about 1% in 2008 of all electricity used by consumers in the NEM, including electricity supplied by rooftop solar, to 12.5% in 2020. Expressed as a share of electricity supplied to the NEM grid, wind and solar contributed 13.3% in 2020. All grid scale renewable generators, including hydro and the small contribution from biomass, contributed just under 20% of all electricity supplied to consumers. When supply from rooftop solar is also included, the renewable share increases to well over 25% of all electricity consumed in the NEM.

Figure 4



Finally, Figures 5 and 6 show, respectively, the annual shares of renewable generation in each state, and the absolute quantities. Tasmania, where the renewable share is almost always more than 90%, is not included in Figure 5. Interestingly, although South Australia has by far the highest share of renewable generation amongst the four mainland NEM states, Figure 6 shows that it now has the lowest total volume of annual renewable generation. Total generation, including both renewable and fossil fuel, in South Australia is currently less than a third of generation in Victoria, and less than a quarter of that in New South Wales and Queensland.

Figure 5

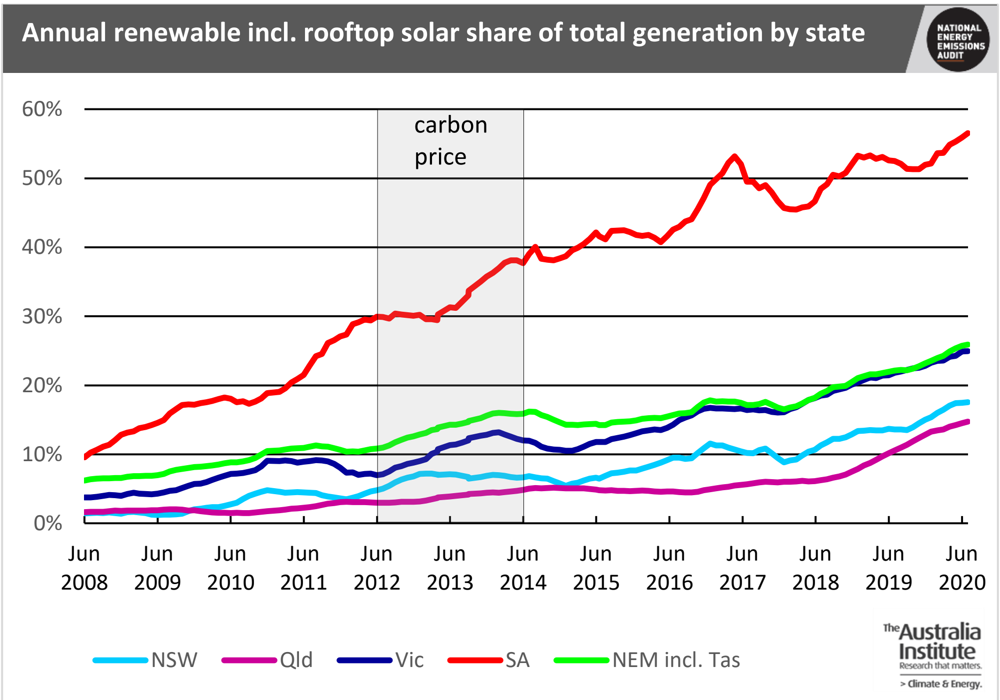
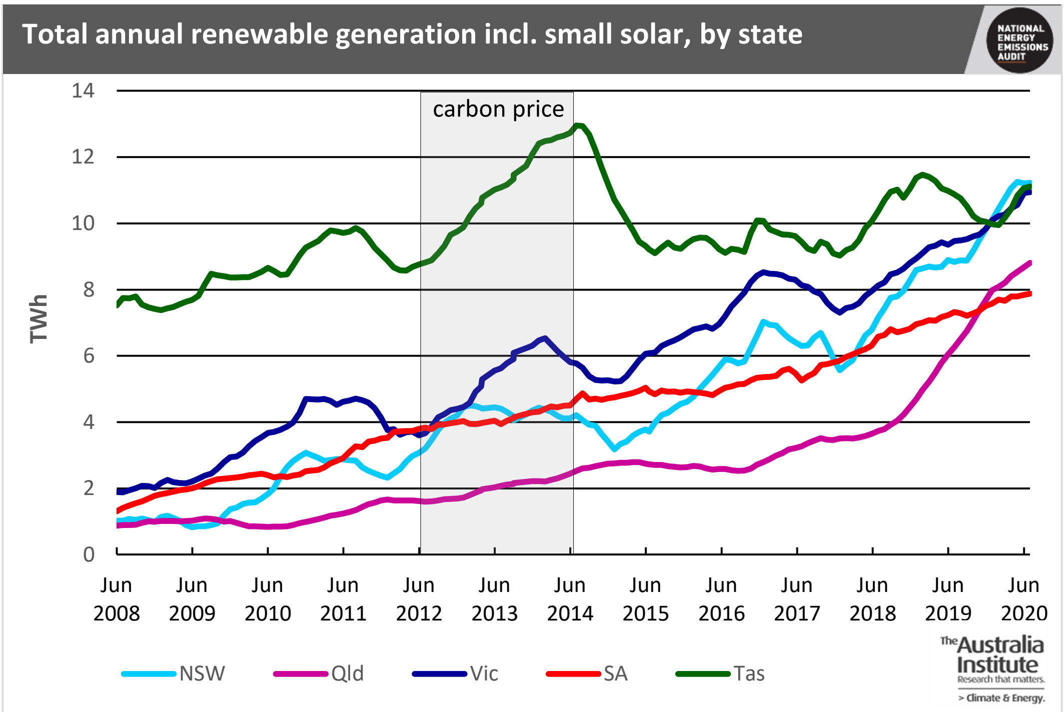


Figure 6



A LONGER TERM LOOK AT THE NEM IN TRANSITION

The NEEA Report of August 2019 included graphs of annual generation and installed capacity in the NEM from 1998 to 2019, showing the transition from coal to wind and solar over that period. In this issue those graphs are updated to June 2020, and separated into separate graphs for Victoria and South Australia combined, and New South Wales and Queensland combined.

Figure 7 shows that in Victoria/South Australia, total wind and solar capacity has almost doubled over the past four years and, consequently, the combined wind and solar share of generation has almost doubled, from 15% to 29%. Total renewable share, including hydro, was just under 33% in 2019-20. Since 2013 several brown coal fuelled power stations have closed in both Victoria and South Australia; the largest and most recent closure was Hazelwood, in Victoria, in March 2017. Since 2016 there has been no coal generation in South Australia, and over the four years since then the coal share of generation in the two states combined has fallen from 72% to 53%.

Figure 7

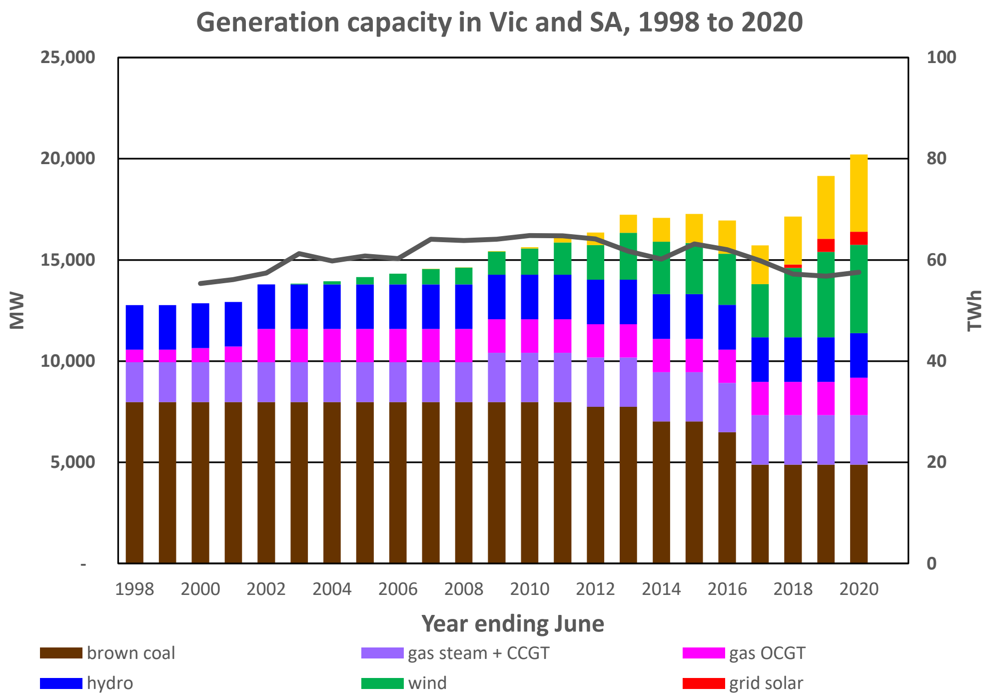
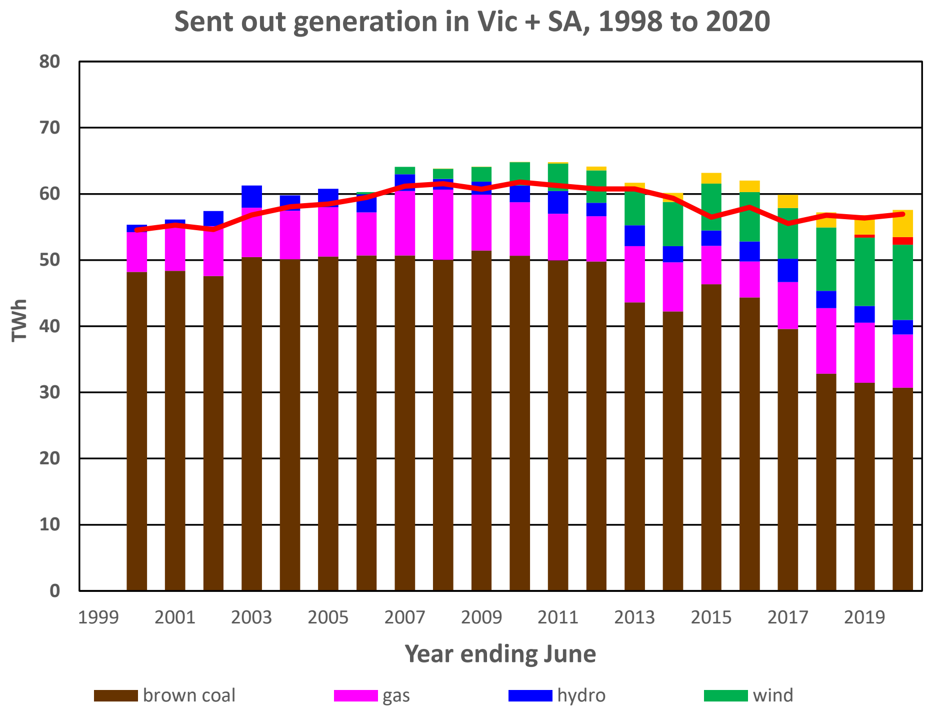


Figure 8



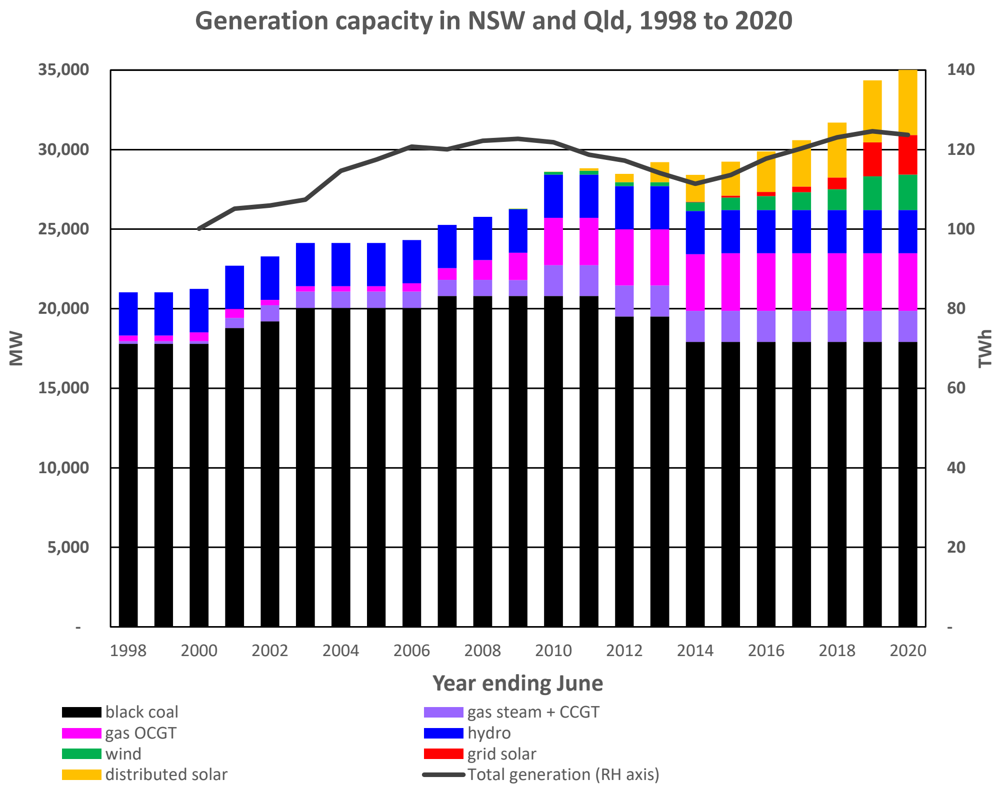
The corresponding graphs for capacity and sent out generation in New South Wales and Queensland combined are shown in Figures 9 and 10. In these two states, the transition from coal to renewables has progressed only half as far as in Victoria/South Australia. The wind and solar share of generations in 2019-20 was half – 14.5% versus 29% - as was the total renewable share – 16% versus 33%. Moreover, in Victoria/ South Australia, total coal generation has, apart from an interruption during the two year carbon price period, been decreasing steadily for ten years. By contrast, in New South Wales/Queensland, coal generation has been decreasing only for the past two years, though it did also decrease for several years after 2009.

That said, the rapid growth in solar and wind generation capacity does suggest that a genuine transition is now underway. A slightly different perspective is provided by Figures 11, 12 and 13, which show the trend in overall state capacity factor for coal generation in Victoria, New South Wales and Queensland respectively.

In Victoria, the closure of Hazelwood in March 2017 enabled the other three coal power stations to achieve significant capacity factor increases, as shown in Figure 11. Capacity factor fell again during 2018-19, but over the past year it has remained roughly constant, at a level of just under 80%. The state average coal generation capacity factor in New South Wales is much lower, having just fallen below 60%, and has been steadily falling over the past twelve months. If the rate of fall continues for the next two years, the overall average capacity factor may be approaching 50% by

April 2022, when AGL has said it plans to close one unit at Liddell power station, with the other three to follow twelve months later. That of course depends on the outcomes and potential interference from the Federal-NSW Liddell Taskforce, which has been operating since August 2019. Many stakeholders and investors, including owner AGL must be wondering why the "report and recommendations expected to be delivered by late 2019"[1] are still not public.

Figure 9



1 Minister Angus Taylor (2019) *Liddell Taskforce to address reliability and power prices* https://www.minister.industry.gov.au/ministers/taylor/media-releases/liddell-taskforce-address-reliability-and-power-prices

Figure 10

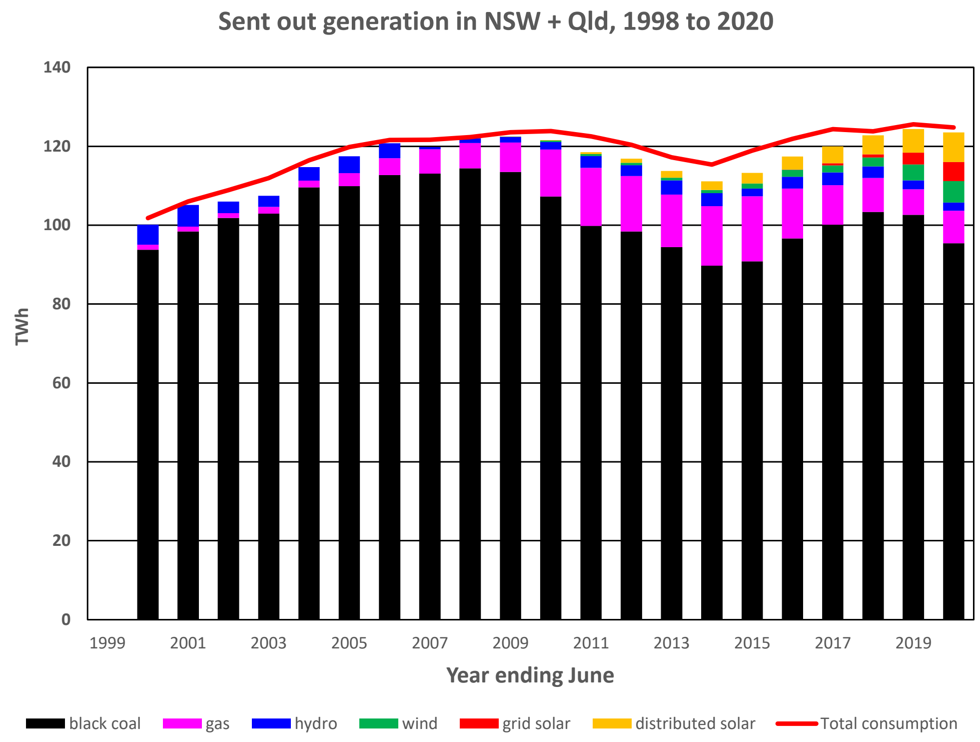


Figure 11

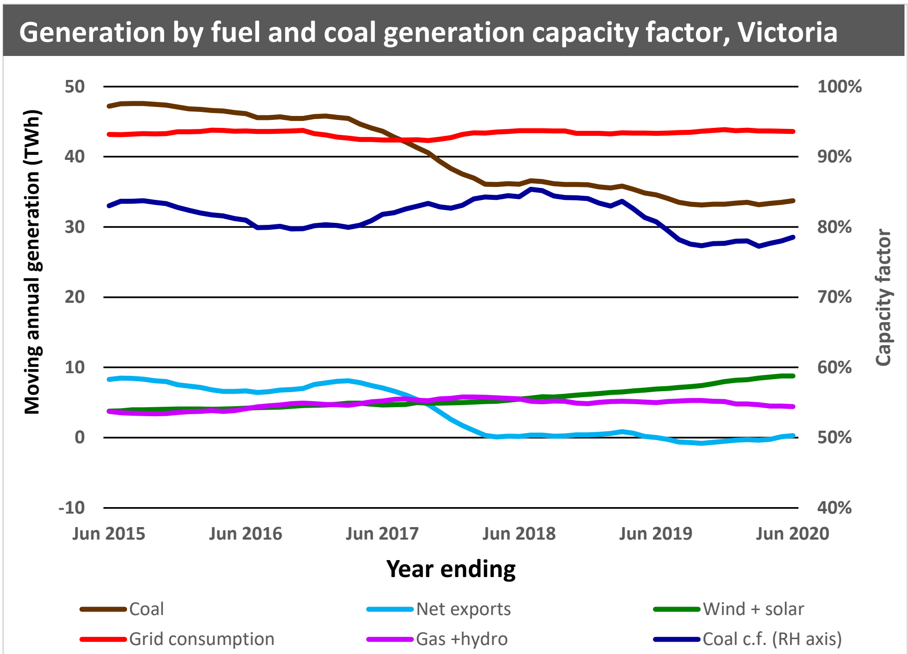


Figure 12

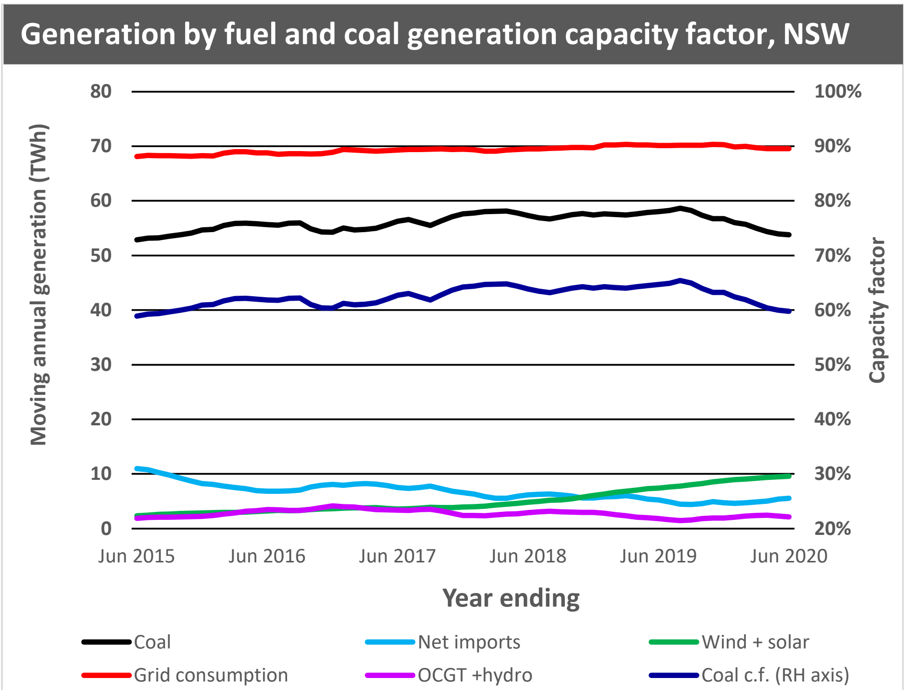


Figure 13

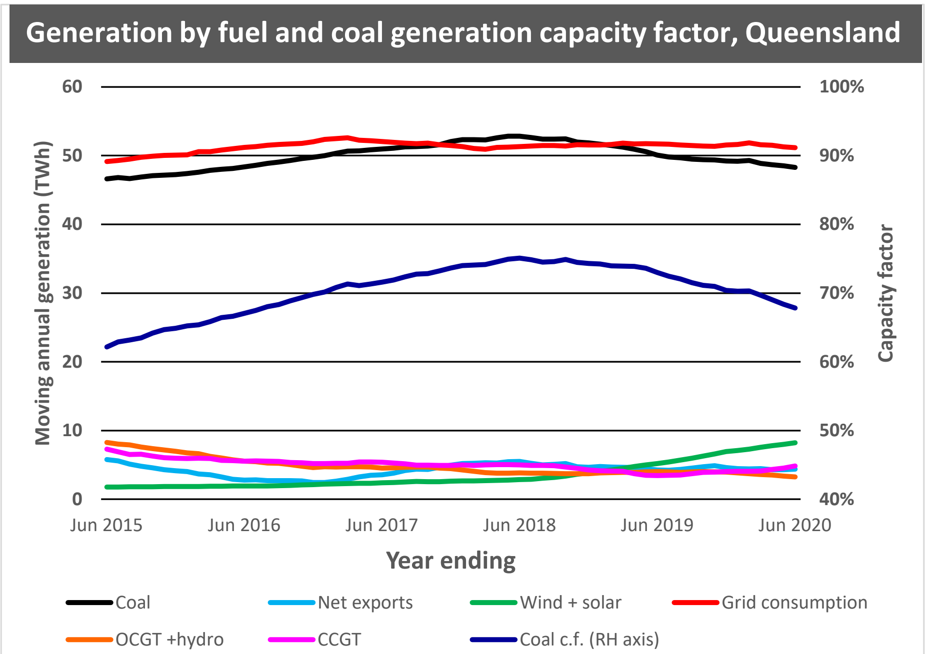


Figure 13 shows that currently the overall average coal capacity factor in Queensland is about nine percentage points higher than in New South Wales. However, it has been falling longer and faster, albeit from a higher starting value than in New South Wales. On current trends it appears likely that by 2025, if not earlier, the average level will reach the level now prevailing in New South Wales, and at least one of the older power stations will come under strong financial pressure.

The financial and technical viability of operating a coal fired power station at an average capacity factor approaching 50%, or lower, will depend on characteristics of each individual power station. There is no doubt, however, that it will become increasingly difficult and owners will choose to close the station at some stage. The fundamental challenge of planning and managing the NEM electricity system in the years to come will be to ensure that the timing of such closures are optimally matched with the timing of investments in new renewable generation capacity, together with investments in storage, transmission, and other technologies needed to "firm" renewable output. Failure to do so would be likely to result in the same sort of surge in wholesale prices as that which followed the closure of Hazelwood, which has only abated during the last twelve months.

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.