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NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit
Electricity Update

August 2018

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

Author: Hugh Saddler

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Level 1, Endeavour House, 1 Franklin St
Canberra, ACT 2601
Tel: (02) 61300530
Email: mail@tai.org.au
Website: www.tai.org.au

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Introduction

Welcome to the August 2018 issue of the *NEEA Electricity Update*, with data updated to the end of July 2018. *Electricity Update* is the companion publication to the quarterly *National Energy Emissions Audit Report*, the next issue which will be in September 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 continue the examination of the proposed National Energy Guarantee (NEG) by focussing on what the *Final Detailed Design* report, publicly released on 1 August, says about the expected growth of renewable generation in the NEM with and without the NEG in place.

Key points

- ***New records for wind generation and total renewable generation in July***

Average daily wind generation in the month of July was at a record level, easily beating the previous record set in September 2017. The wind share of total NEM generation in the year to July 2018 also reached a new record level of 7.3%. Total grid renewable generation in the same period also reached a new record share of grid generation, at 16.1% (exceeding the previous record of 15.6%). The renewable share with rooftop solar also included reached 19.2%, another record. The corresponding share for Victoria alone went up to 18.4%.

- ***Renewables provided almost half of all power generation in the southern states during July***

During July, South Australia, Victoria and Tasmania operated well with a 44% share of renewable generation. Average spot wholesale prices in Victoria and Tasmania reached their lowest levels since December 2016.

- ***Southern states exported wind power to NSW in July, without any need for imports (when the wind wasn't blowing)***

The southern states were able to export excess generation to NSW when wind generation was high and *did not* import any black coal generation from NSW to offset variations in wind generation.

- ***The latest report on the NEG design confirms that the Government expects <u>no</u> new wind or solar farms to be built after 2020-21, thus implying the rapid collapse of a previously booming, renewable energy industry***

The modelling results published in support of the NEG shows that the Government expects the currently booming wind and solar farm construction industry to drop off completely in 2021-22, with no new project commissioned until after 2030. It is surprising that the employment and skills implications of this expectation are not more widely known. Even more problematic will be the need to revitalise the renewable industry a decade later to replace the 9,000 MW of coal generation capacity commissioned in the 1980s, which will be past their 50 year life-spans in the 2030s.

- ***A growing renewable share of generation continues to push NEM emissions down, by displacing coal fired generation***

Annual emissions from NEM electricity generation are now 14.4% lower than they were in the year to June 2005. Thus we have already achieved more than half the total emissions cuts needed to meet the Government's proposed 26% reduction target by 2030 for the electricity sector.

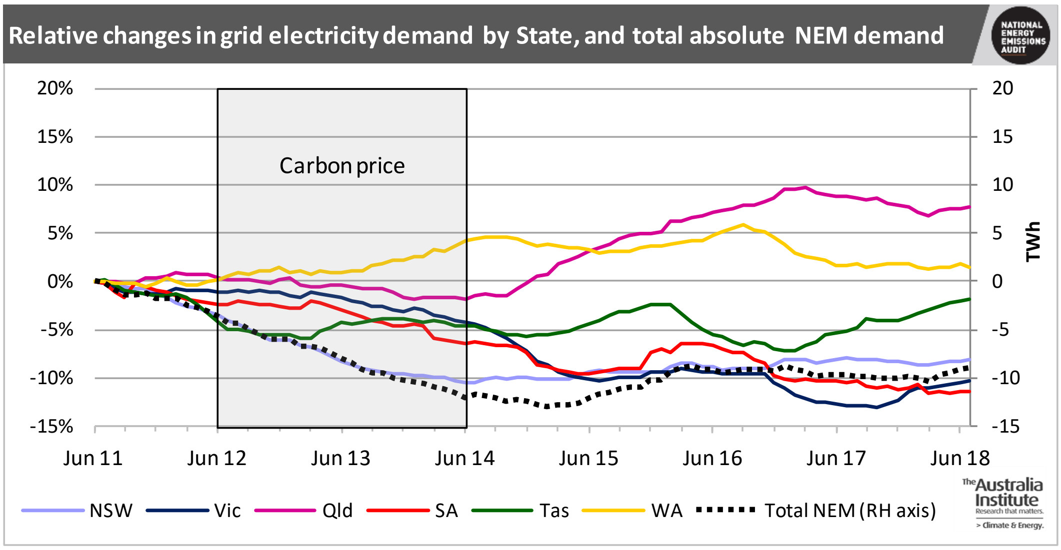
+ ***Electricity consumption continues to gradually increase, with faster growth when rooftop solar generation is included in the calculation.***

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 July, are shown in relative terms in Figure 1, together with the absolute change in total NEM demand. In the past few months annual electricity consumption of electricity supplied through the grid has been growing slowly in all NEM states except South Australia, meaning that total NEM consumption has also been growing. Taking a somewhat longer term view, however, total annual NEM consumption has scarcely changes for two years.

Figure 1



As was the case with the July 2018 *Electricity Update*, inclusion of electricity supplied locally from rooftop solar installations, shows a stronger growth in consumption, and this has also been included in Figure 1, at the whole of NEM level (state level data for years before 2016 are unavailable) . Annual growth in total consumption over the past year has been 1.2%, whereas growth in grid consumption was only 0.4%. AEMO expects these trends will continue for some years to come, meaning that there all new generation capacity in the NEM will displace output from existing generators. Only when one of the existing coal fired power stations retires, as is planned for Liddell in 2022, will there be an immediate need for new replacement generation capacity. In theory, the fact that most net growth in electricity consumption is being offset by growth in electricity supplied by zero emission rooftop solar systems should make a steady transition towards reduced emissions from electricity generation easier than it would otherwise be. In practice, of course, political conflict is presenting significant obstacles to such a smooth transition.

Generation and emissions

As noted in the July issue of *NEEA Electricity Update*, for twelve months prior to April this year, annualised emissions from NEM electricity generation fell steadily as the effect of closing Hazelwood, Australia's most emissions intensive power station worked through the annual numbers. Since then, however, as also noted last month, emissions and emissions intensity have both continued to fall, as shown in Figure 2 and 3. Figures 3 and 4 confirm that recent declining emissions are caused by the displacement of both black coal and gas generation by steadily growing renewable generation. Brown coal generation in Victoria appears to be steady at a new, lower level. With the large numbers of new wind and solar farms now being brought on line right across the NEM, the displacement of fossil fuel generation by renewables is a trend which is likely to continue for several years.

Figure 2

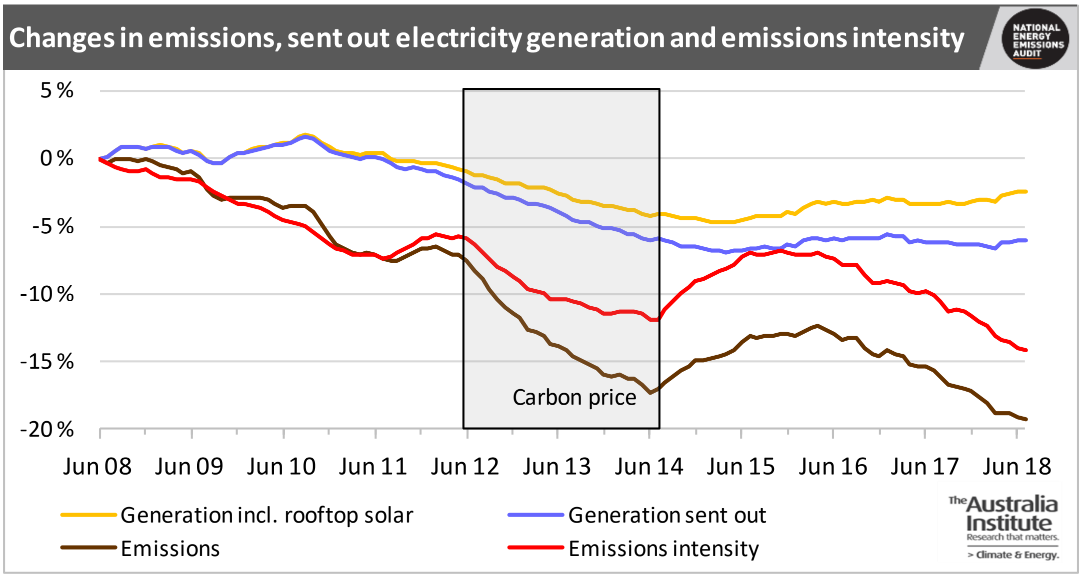


Figure 3

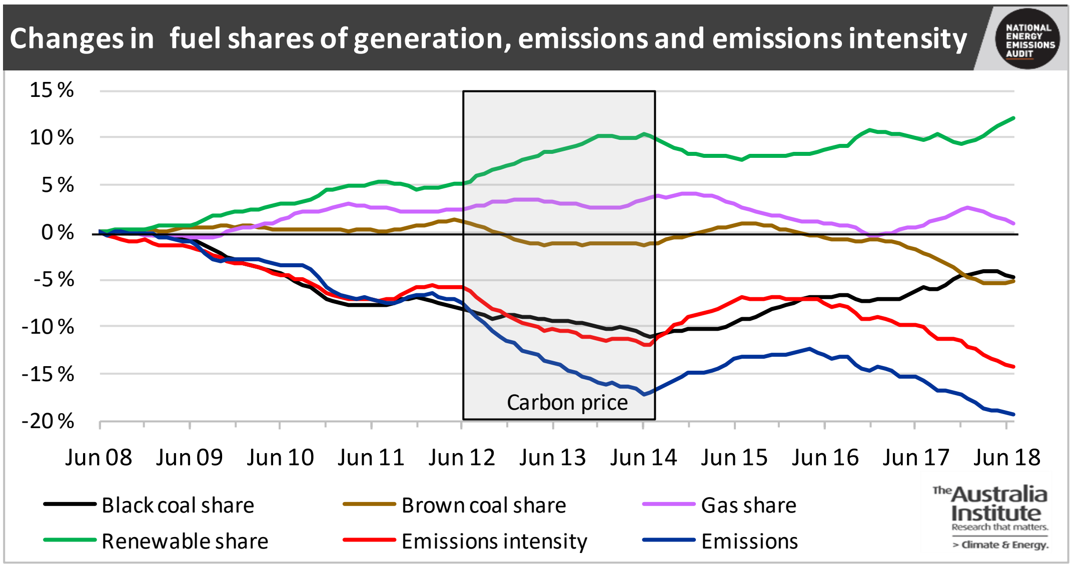


Figure 4

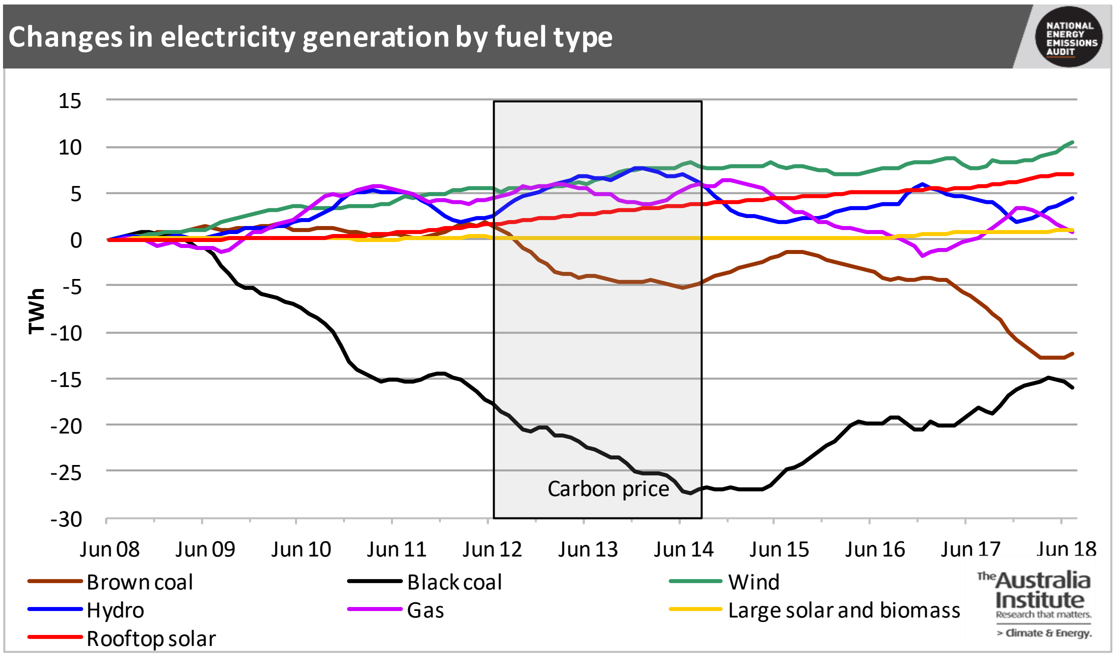


Figure 5 is a new graph for *NEEA Electricity Update*, showing total generation by fuel type, rather than changes from a starting date. Over the past ten years, total renewable generation, including rooftop solar, as a share of total NEM generation has grown from 7.0% in the year to June 2008 to 19.2% in the year to July 2018. Over the same period, coal generation has fallen from 83.7% to 73.8%. Total generation, and hence consumption of electricity, has fallen over the same period by a relatively modest 2.3%. However, the growth in rooftop solar has meant that grid generation of electricity has fallen by 6.0%, i.e. by more than twice as much.

Figure 5

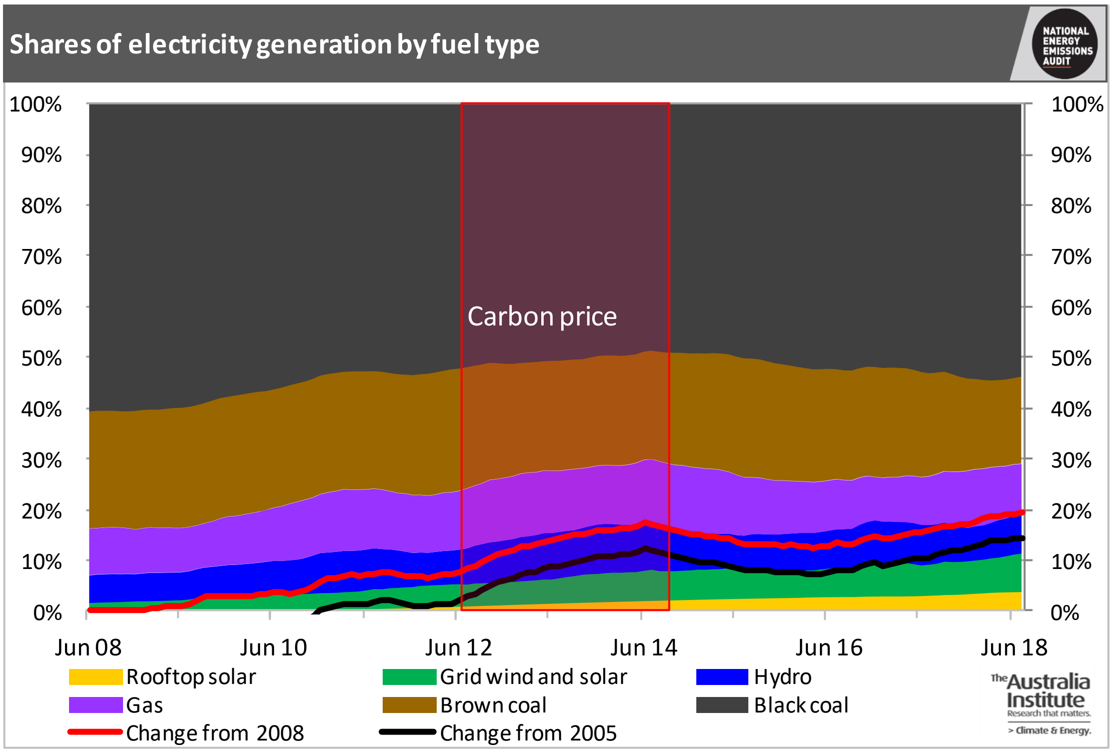
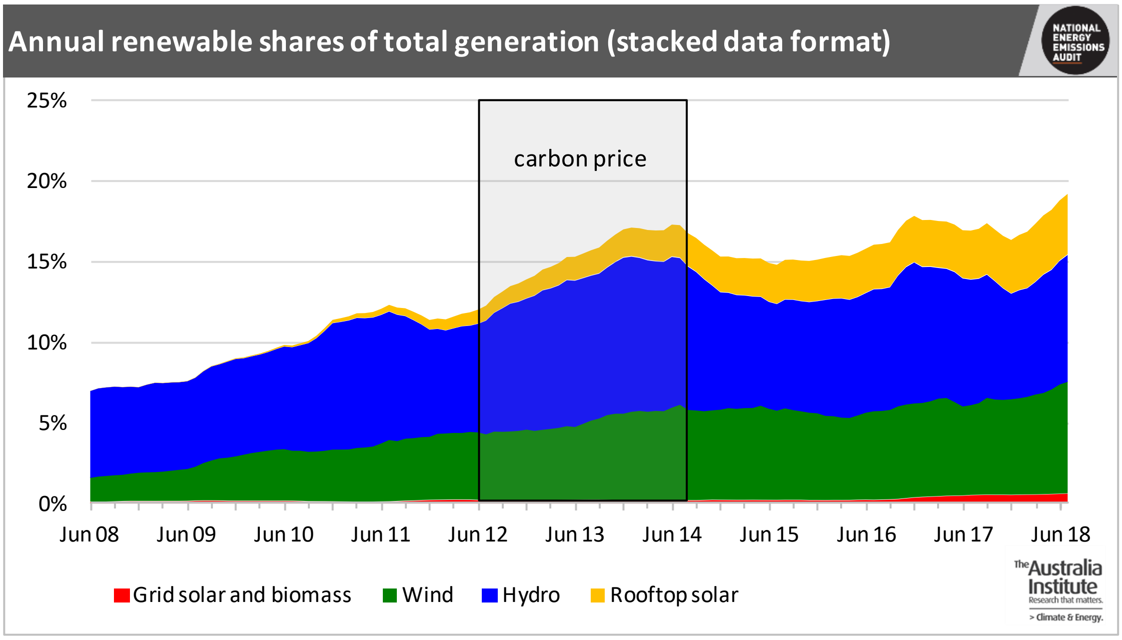


Figure 5 also shows the decrease in emissions over this ten year period. Annual emissions from NEM electricity generation are now 19.3% lower than they were in the year to June 2008. They are also 14.4% lower than they were in the year to June 2005, having increased significantly between 2005 and 2008. The 2005 level is important, because it is the reference against which emission reductions that Australia has signed on to under the Paris Agreement are measured. The Commonwealth government currently says that it plans to reduce NEM emissions by 26%, relative to 2005, by the Paris Agreement deadline year of 2030. Thus changes in the NEM over the past ten years, chronicled by *NEEA Electricity Update* and its predecessor publications, have already achieved more than half the total emissions reduction required by 2030.

Renewable generation during July

July 2018 was a significant month for renewable generation in the NEM. For the past five months total annual renewable generation, including rooftop solar, has been higher than the previous record level, seen in June 2014, at the end of the period of unsustainably high hydro generation, stimulated by the short lived carbon price. However, in July 2018, renewable generation as a share of total NEM generation also decisively overtook the share in the year to June 2014, reaching 19.2%. Without rooftop solar, the renewable share of grid generation reached 16.1%. The previous record level, in the year to June 2014 was 17.3%, including rooftop solar and 15.6% excluding rooftop solar. These results are shown graphically in Figure 6.

Figure 6



Record levels of total renewable generation have of course been driven by increased wind generation in particular, but also grid scale solar generation. The further increase in total generation, inclusive of rooftop solar, has also been driven by the steady growth in output from this source.

Figure 7

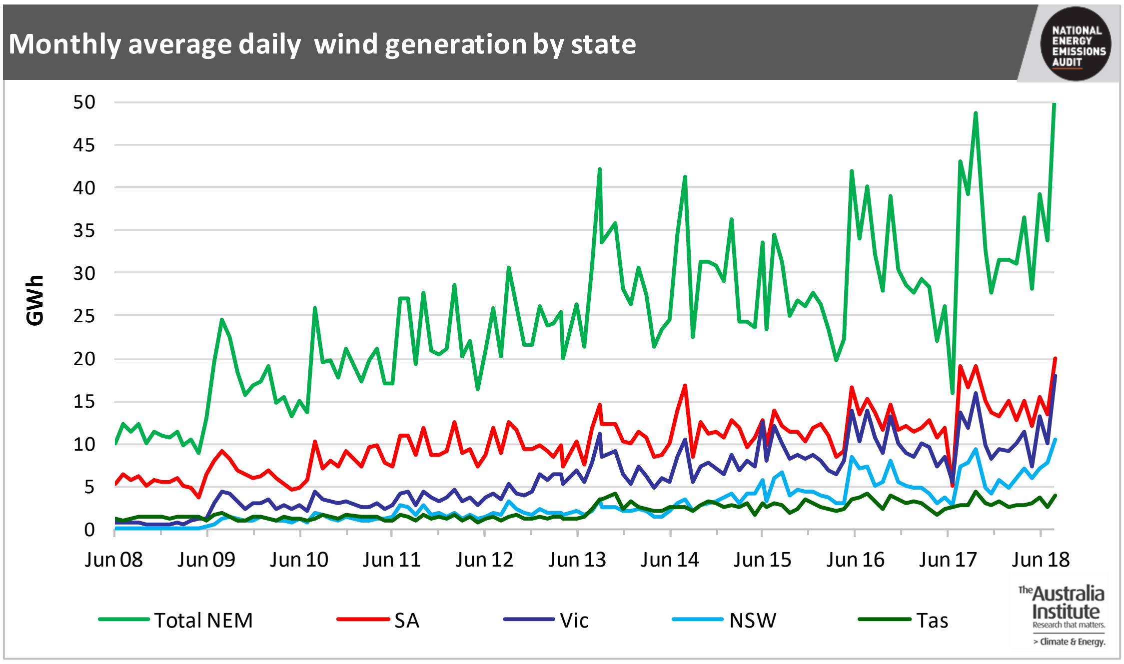
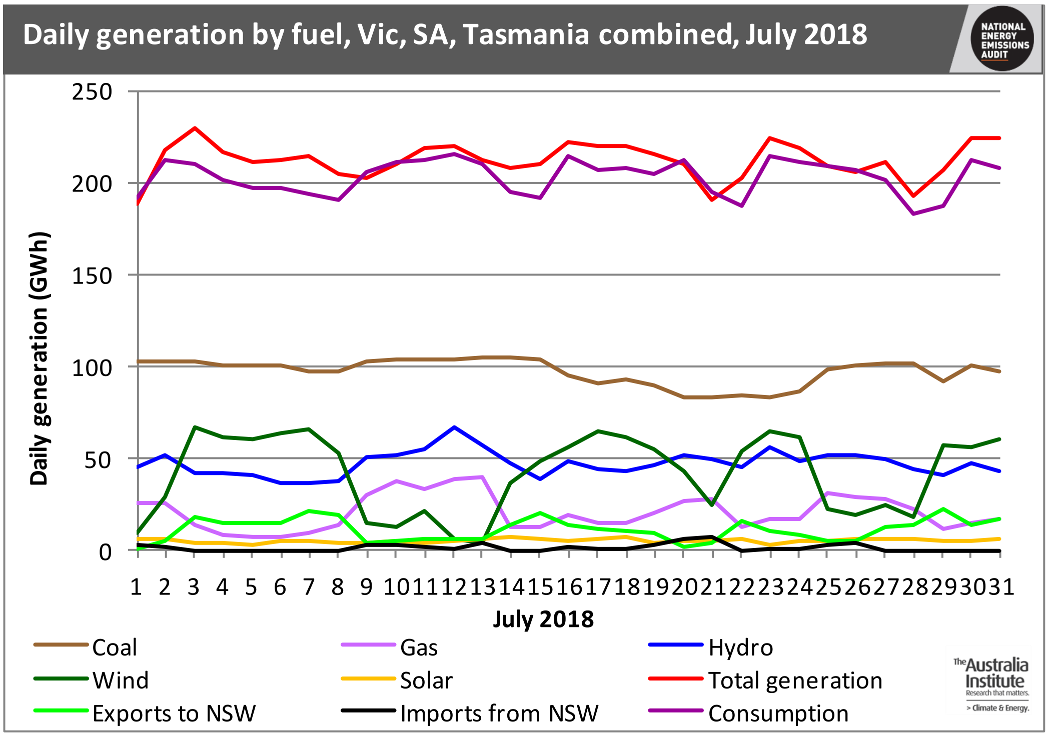


Figure 7 shows that July 2018 was a very significant month for wind generation, in particular, because average daily generation during July surpassed the previous record, set in September 2017. The previous record was also surpassed in each state except Tasmania, where there are only two windfarms (both very well performing) of which the second, Musselroe, was commissioned in 2013. The record would undoubtedly have been broken in Tasmania also, had any new windfarms been built in the state since then.

For the month of July, as distinct from the year ending July, total renewable generation in the NEM also reached a record level in absolute terms, though as a share for total NEM generation it was lower than in October 2016, when hydro generation was higher, and total generation lower, than in July 2018.

Most of Australia's current wind generation capacity is located in South Australia and Victoria. During July, the wind generation share of total generation in these two states plus Tasmania was 20%, just over twice the corresponding figure for the NEM as a whole. It is therefore interesting to see how the electricity supply system in these three states operated during the month. Tasmania is connected to Victoria by the relatively large capacity DC Basslink cable. South Australia is connected to Victoria by the AC Heywood interconnector, and by the smaller DC Murraylink. Shares of generation for the month as a whole were: brown coal 46%, gas 10%, hydro 22%, wind 20%, rooftop solar 2%, making the total renewable share 44% .Figure 8 shows daily combined generation in the three states.

Figure 8



A number of points are pertinent.

- Daily demand does not vary greatly across the month, even on weekends, and is high; July is consistently the month in the year with the highest average daily consumption in each of these three states, often by quite a wide margin. It is important to distinguish between total energy consumption over a period and peak demand during that period. Peak demand is always higher in the summer months, but, in all states except Queensland, total daily consumption of electrical energy is higher in winter than in summer.

- Variations in wind generation are mainly offset by matching variations in gas generation.
- Exports of energy to New South Wales also help to offset high levels of wind generation.
- By contrast, imports from New South Wales are negligible throughout, meaning that there is no requirement for so-called baseload black coal generation to offset variations in wind generation in the three southern states.
- Hydro generation helps to offset low wind generation, but is mainly used to supply morning and evening peaks (not visible on the daily resolution of Figure 8), which are large, in energy terms, during winter.
- Brown coal generation was fairly consistent throughout the month. Reduced output during the very windy period from 15 to 24 July was achieved by completely closing down Unit 4 at Loy Yang A and Unit 4 at Yallourn W. Brown coal generators are even less flexible than black local generators, and therefore not well suited to matching large variations in wind and solar generation by varying output from individual units.

Finally, it is interesting to note that average spot wholesale prices for the month of July in both Victoria and Tasmania, at respectively $70.10 and $44.85 per MWh, reached their lowest levels since December 2016, before Hazelwood power station closed. While this observation cannot be said to prove that higher levels of renewable generation will reduce prices, it is certainly not consistent with the claim that renewable generation pushes wholesale prices up.

New renewable generation

The last two issues of *NEEA Electricity Update* have included detailed discussions of the forthcoming surge in new renewable generation capacity. Recent publications by AEMO (the *Integrated System Plan*, subject of a separate special *Electricity Update*) and the Energy Security Board (the much-quoted final design document for the National Energy Guarantee) provide detailed figures of new wind and grid scale solar generation capacity, plus grid scale storage, now certain to be built over the next three years. These capacities are shown, using values for AEMO's detailed modelling results, in Figure 9, together with changes over recent years.

Figure 10 extends the data to 2029-30 with the projections prepared by AEMO for its *Integrated System Plan* (ISP) Neutral or mid case. AEMO bases its projections on what it calls "policy directives currently in place", which include both the Victorian and the Queensland renewable energy targets. It also assumes that old coal fired power stations will be closed when they reach the age of 50 years. The result, as shown in Figure 10, is a steady flow of new wind and solar construction throughout the 2020s, with the outcome that by 2029-30 renewable generation accounts for 42% of total grid generation in the NEM. If the contribution of steadily increasing rooftop solar generation is included, the renewable share increases to 48%.

Figure 9

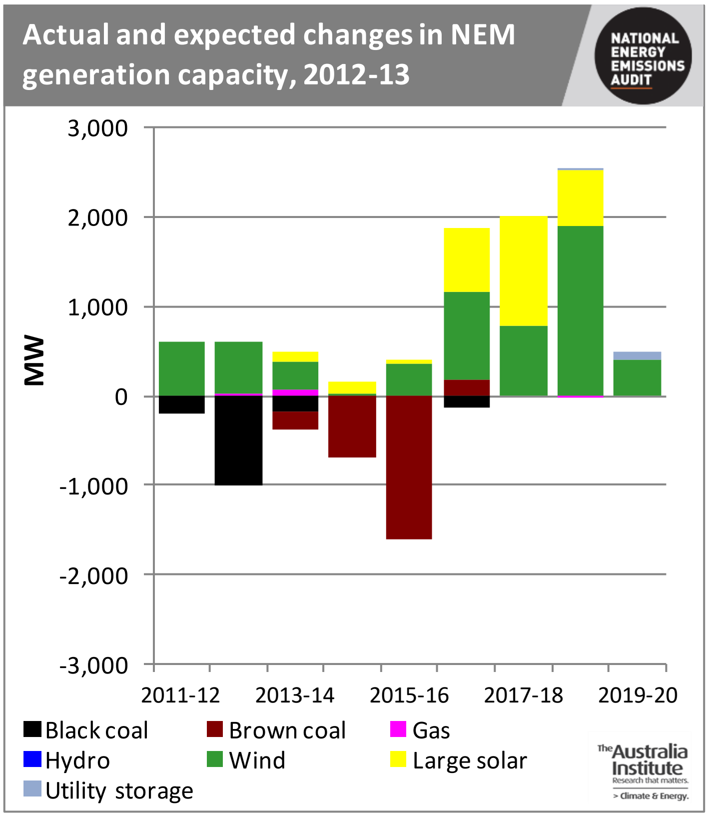


Figure 10

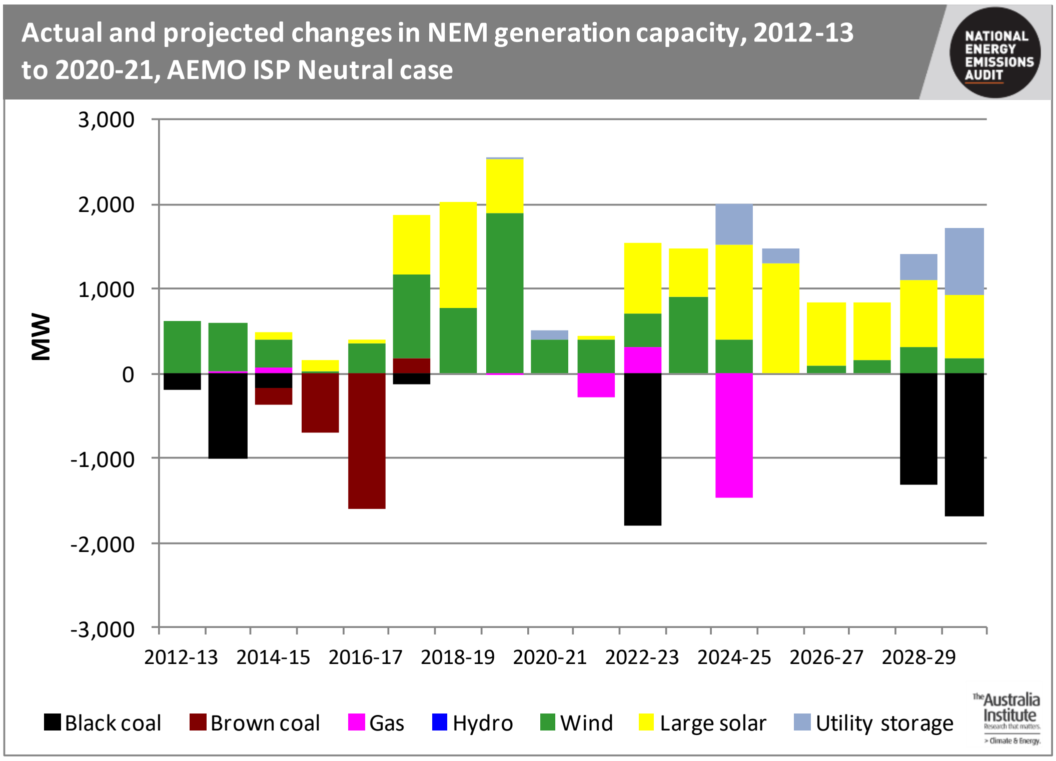
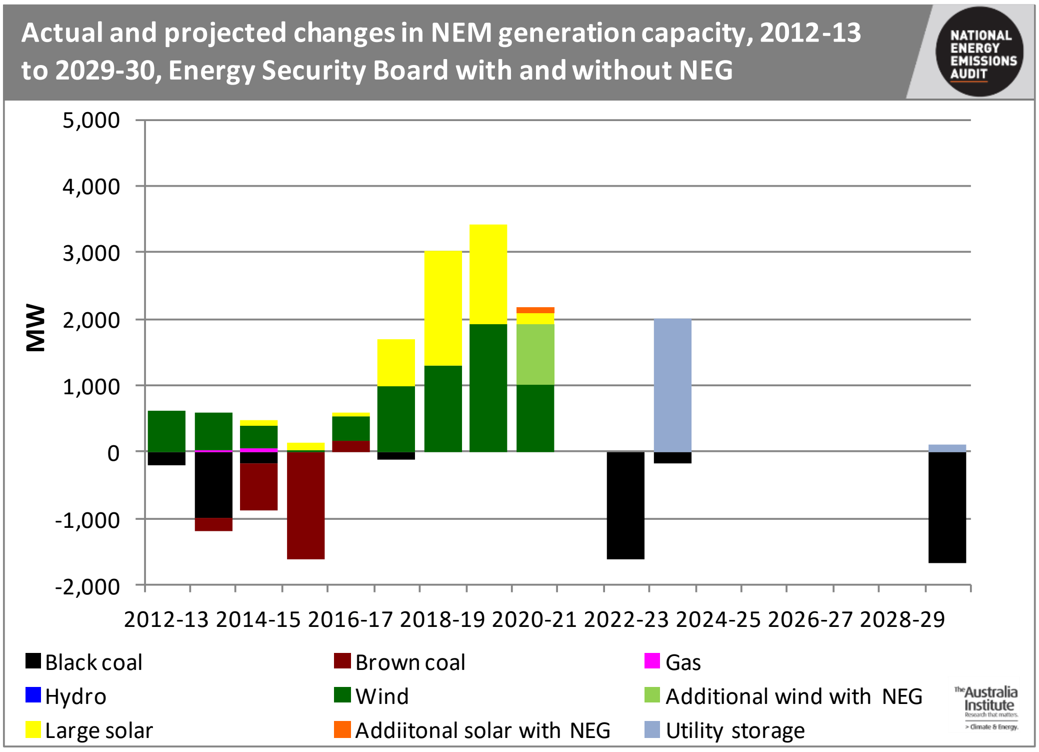


Figure 11 shows the corresponding projections for new renewable capacity under the National Energy Guarantee (NEG), as depicted in the Energy Security Board's (ESB) report. The graph shows that the Board expects considerably more new capacity to be commissioned over the next three years under business as usual assumptions than does AEMO – 4,240 MW of wind compared with 3,070 MW by AEMO, and 3,390 MW of grid solar compared with 1,870 MW by AEMO. In addition, the Board assumes, for reasons which are not provided, that the existence of the NEG as policy will cause an additional 700 MW of wind and 300 MW of solar to be commissioned in 2020-21. These figures are equivalent to increasing the capacity of wind generation at the end of 2020-21 by 7%, from 9,400 MW to 10,100 MW, and the capacity of grid solar generation by 6%, from 5,000 MW to 5,300 MW.

Figure 11



However, it is what is expected to happen after 2020-21 where the differences between the ESB and AEMO's ISP report are so stark. As noted, AEMO assumes that the renewable energy target policies of the Victorian and Queensland governments will remain in place and will be implemented, leading to a steady build of new capacity, as shown in Figure 10. By contrast, the ESB apparently pretends that these policies do not exist, or will not be implemented, except, perhaps, that they have been assumed to contribute to the higher levels of new wind and solar capacity in 2019-20 and 2020-21 under business as usual assumptions than the levels AEMO has modelled. Certainly, none of the ESB's reports mentions these state policies. Nor do the reports at any point mention the growing volume of new renewable electricity being directly contracted by large corporate electricity consumers. And neither do they include the new solar generation which AGL has told its shareholders, and the wider investment community, it will build before 2022-23 as part of its plan to replace the Liddell power station.

The overall result of the ESB's modelling assumptions is that the currently booming wind and solar farm construction industry is killed in 2021-22. Despite the substantial commentary around the impact of the NEG this point seems to have been glossed over. There is now a sizeable industry, from corporations down to smaller business, in renewable construction and management. It seems counter-productive for the Government to develop a policy that assumes, if not encourages, the renewable energy's decline in 2021, only to re-emerge a decade later to replace the 9,000 MW of coal generation capacity commissioned between 1983 and 1985, and therefore likely to close in the 2030s.

The most likely explanation for the lack of comment on the ESB's projection is that it is meant to only serve a short-term political purpose. Serious industry participants know that new renewable generation will continue to be built, in line with AEMO's ISP, because the economic case to do so is compelling. If this is a correct interpretation, what does it say about policy processes in Australia?

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.