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> Climate & Energy.

NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit Report

January 2021

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

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Key points

+ Grid generation in the National Electricity Market (NEM) continues to fall, reaching in the year to November 2020 a level 9.6% below the historic maximum in 2008
+ Annual emissions from electricity generated in the NEM was 26.5% below the maximum level reached in the year to September 2008.
+ In the fourteen months from September 2019 to November 2020, annual NSW coal generation fell by 4.3 TWh, representing a drop of just under 8%; equivalent figures for Queensland coal generation are 3.6 TWh, also equal to just under 8%.
+ Annual total renewable generation, including small ("rooftop") solar, is now above 27% of total electricity supplied in the NEM.
+ New South Wales Electricity Infrastructure Investment Act is a very important development to manage variability of wind and solar generation
+ National emissions in the calendar year 2020 are estimated to have been 4.5% lower than in 2018.
+ In 2018, 78% of all agricultural emissions arose from livestock (mainly cattle and sheep) and cropping activities.
+ Australian national herd and flock in 2020 is forecast to have reached its lowest levels since the early 1990s. However, it is expected to rebound to pre-2018 levels as drought conditions improve. The related emissions will rebound too.

Introduction

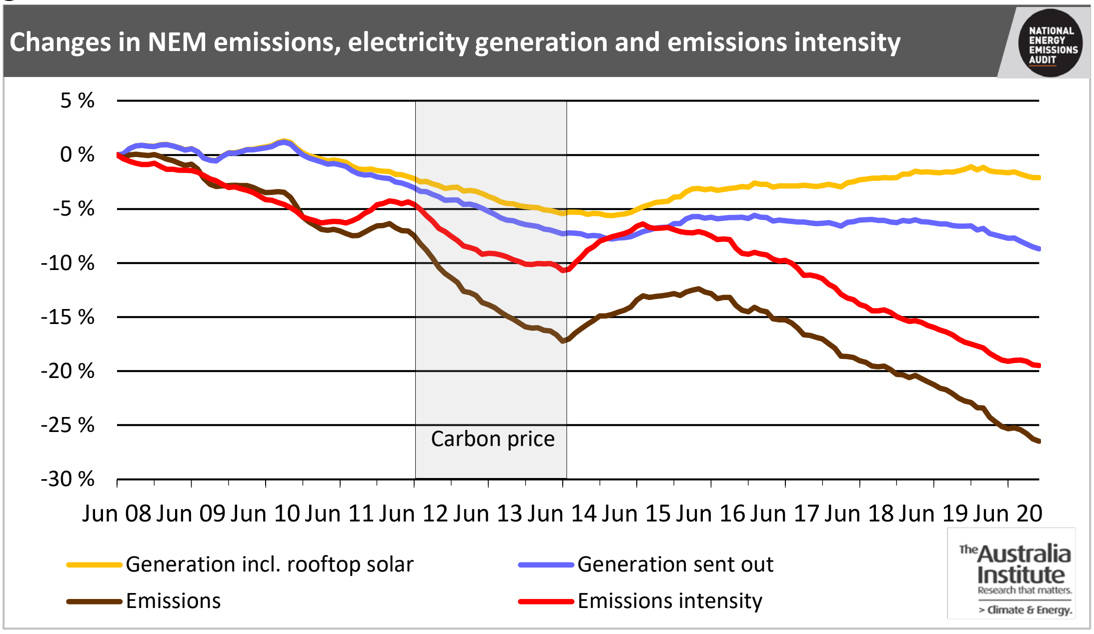
Welcome to the December 2020 / January 2021 issue of the *NEEA Report*, with data relating to electricity in the National Electricity Market updated to the end of November 2020. This includes a short summary of the very important investment initiatives in New South Wales, announced by Minister Matt Kean at the end of November.

This issue also includes commentary on the June 2020 Quarterly Update of the National Greenhouse Gas Inventory, which was released at the end of November 2020, and includes preliminary estimates for the whole inventory year 2019-20.

WHAT HAPPENED IN THE NEM DURING NOVEMBER?

Figure 1 shows that total annual sent out grid generation in the NEM continues to fall, reaching in the year to November 2020 a level 9.6% below the historic maximum, which occurred in the year to February 2009. Total consumption of electricity, including electricity supplied by small (rooftop) solar has also been falling, though more slowly, as supply from small solar installations have continued to grow strongly. The total reduction in moving annual consumption in the NEM over the nine months from February to November 2020 was 0.6%. Consumption reductions were larger in Victoria and Queensland, while in New South Wales reductions were about the same as in the NEM as a whole. Consumption increased in South Australia and Tasmania. Given these variations between states, it is hard to say whether or not the consumption changes were caused by the pandemic lock downs.

Figure 1



At the end of November 2020, annual emissions from NEM generators were 26.5% below the maximum level reached in the year to September 2008. This has of course been caused almost entirely by the decrease in coal fired generation, in both relative and absolute terms, as shown, respectively, in Figures 2 and 3. Over the past year or so, it is almost entirely black coal generation which has fallen. In the fourteen months from September 2019 to November 2020, moving annual New South Wales coal generation fell by 4.3 TWh, representing a drop of just under 8%; equivalent figures for Queensland coal generation are 3.6 TWh, also equal to just under 8%. The average annual sent out capacity factor for New South Wales coal generation has fallen from 61% to 56%, while in Queensland the fall has been larger, from 68% to 61%. Over the same period, the three brown coal power stations in Victoria have slightly increased their overall average capacity factor, from just under 71% to just under 73%. However, this increase is attributable to increases at the newer stations, Loy Yang A and Loy Yang B, both of which had annual sent out capacity factors, as at November 2020, of above 75%. The capacity factor of Yallourn is below 65% and falling; its first unit was commissioned in 1973, making it, after Liddell, the second oldest coal fired power station in the NEM.

Figure 2

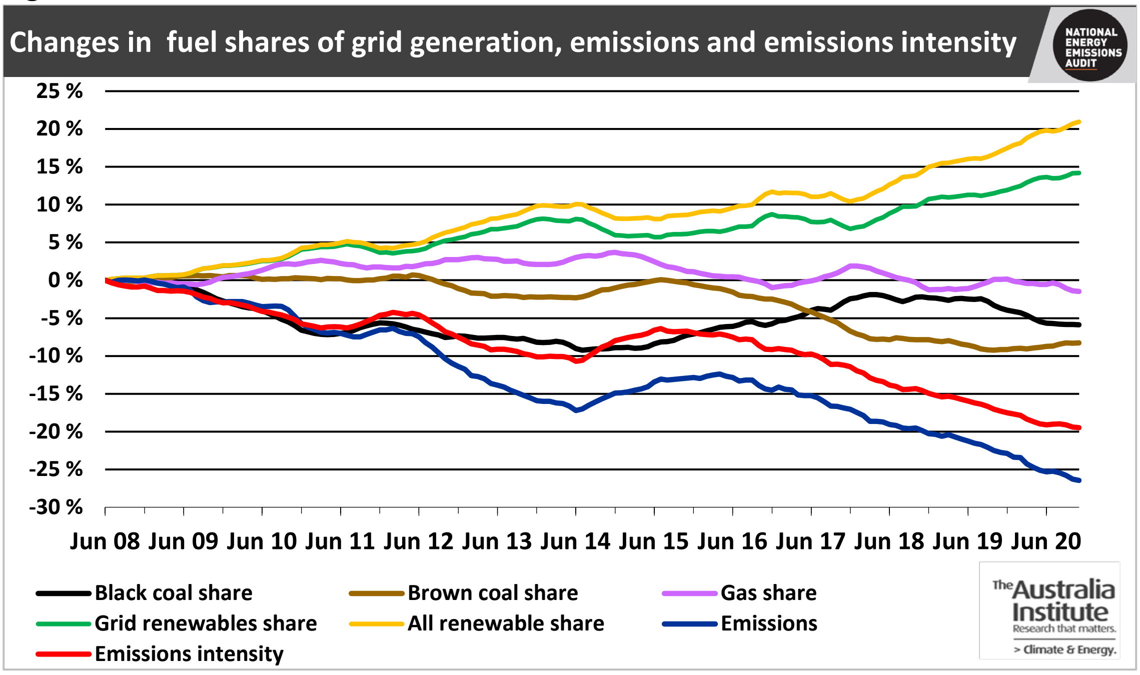
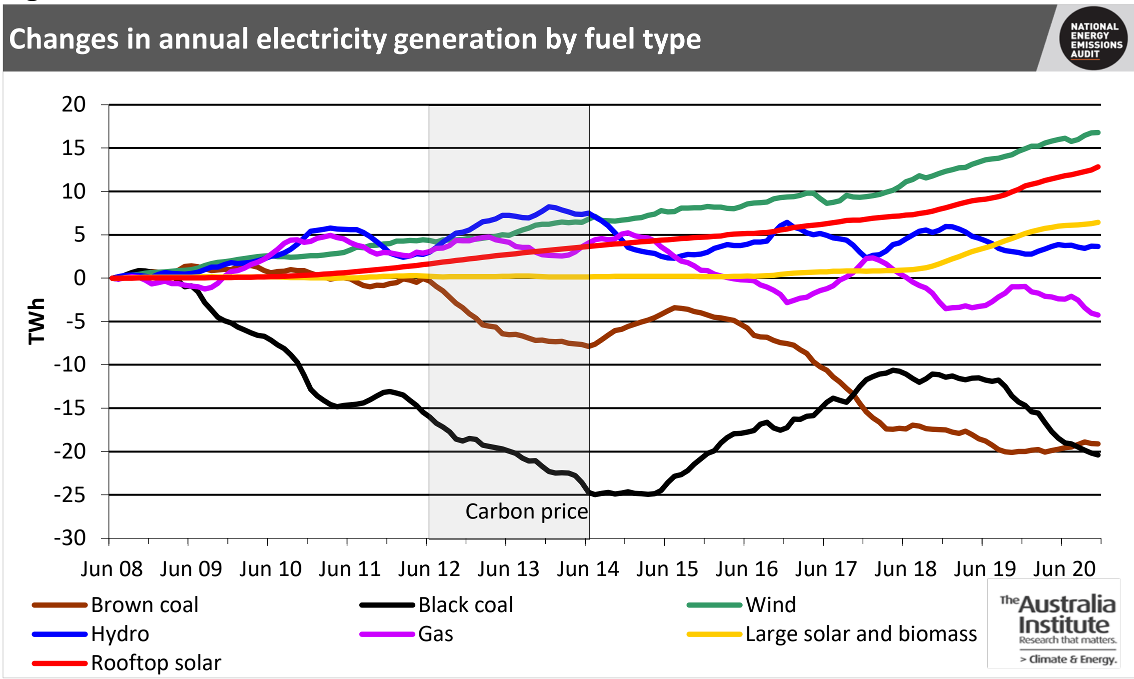


Figure 3



Figures 4 and 5 provide more detail of the growth in wind and grid solar generation, again in absolute and relative terms respectively. Annual total renewable generation, including small ("rooftop") solar, is now above 27% of total electricity supplied in the NEM.

Figure 4

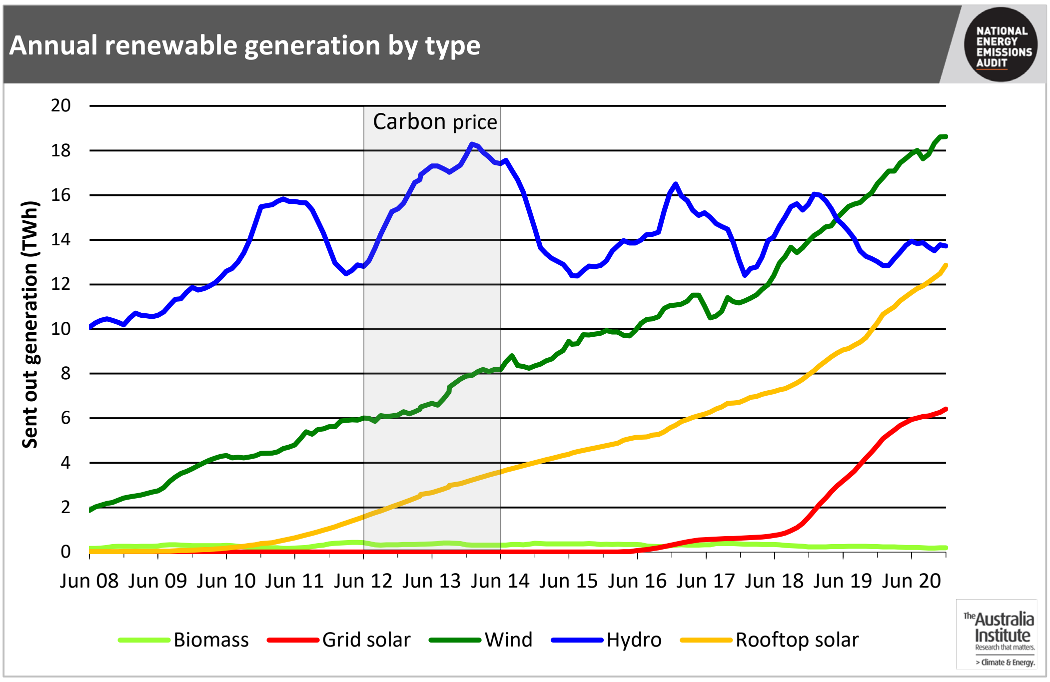
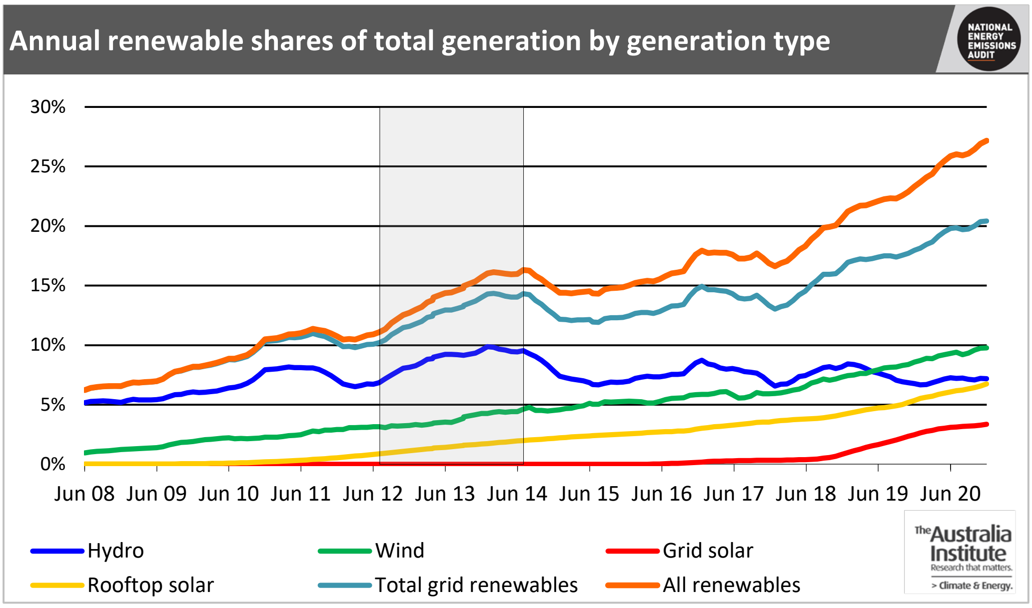


Figure 5



Finally, Figure 6 shows total shares of wind and solar combined in each of the five NEM states, while Figure 7 shows the same data, but in absolute terms.

Figure 6

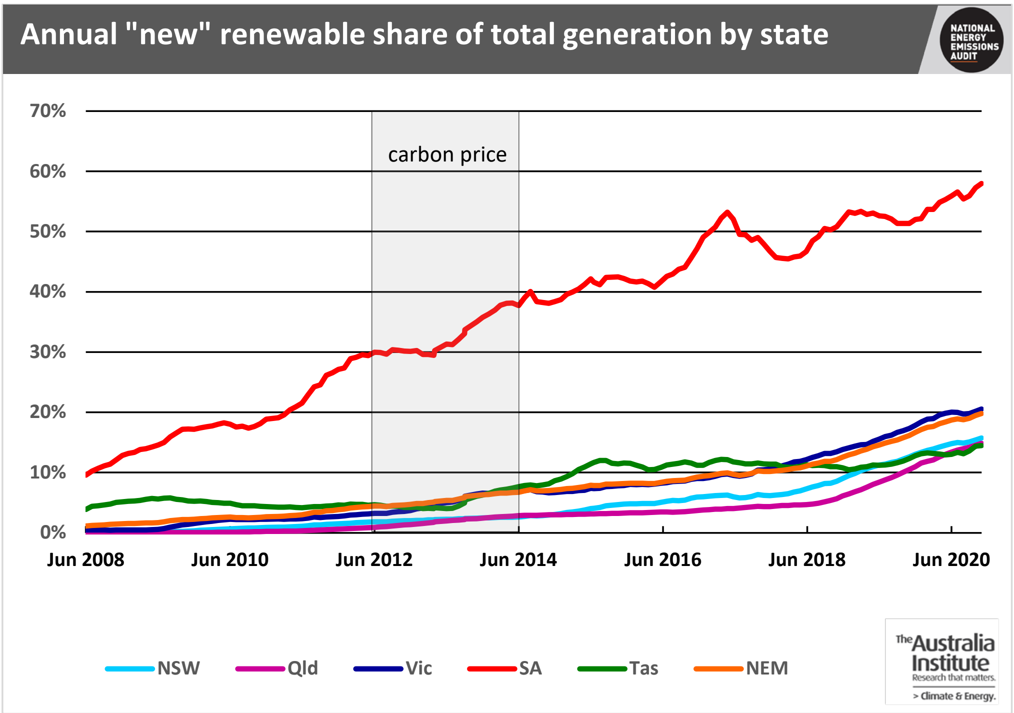
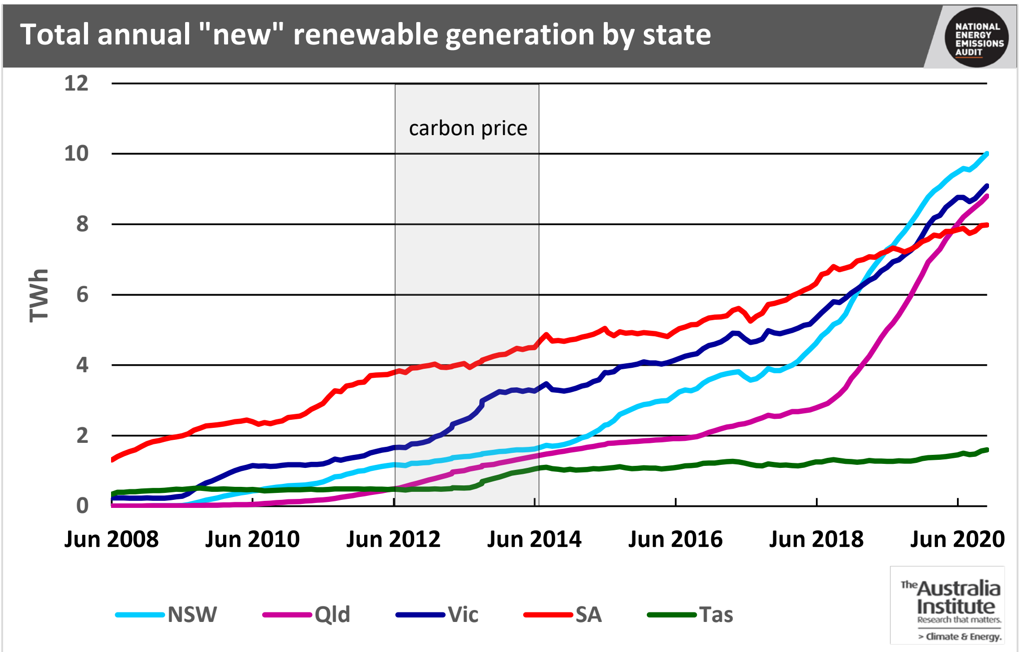


Figure 7



As is well known, the variability of wind and solar generation, presents challenges to the operation of legacy electricity supply systems, which are designed to operate with generation technologies developed in the closing decades of the 19th century. Perhaps the clearest way to illustrate the key aspect of the challenge, which is the variability of wind and solar generation, is to graph total daily, i.e. 24 hour, electrical energy supplied by wind and solar generators over an extended period.

Figure 8 plots these numbers for wind and solar generation separately, together with the two sources combined, for South Australia over the six months from the start of June to the end of November. Renewable generation is expressed as a fraction of total demand for electricity. Supply from small solar generation forms a major component of both generation and demand. Figure 9 shows just the combined total of wind and solar generation in the four mainland NEM states as a share of total daily demand.

Figure 8

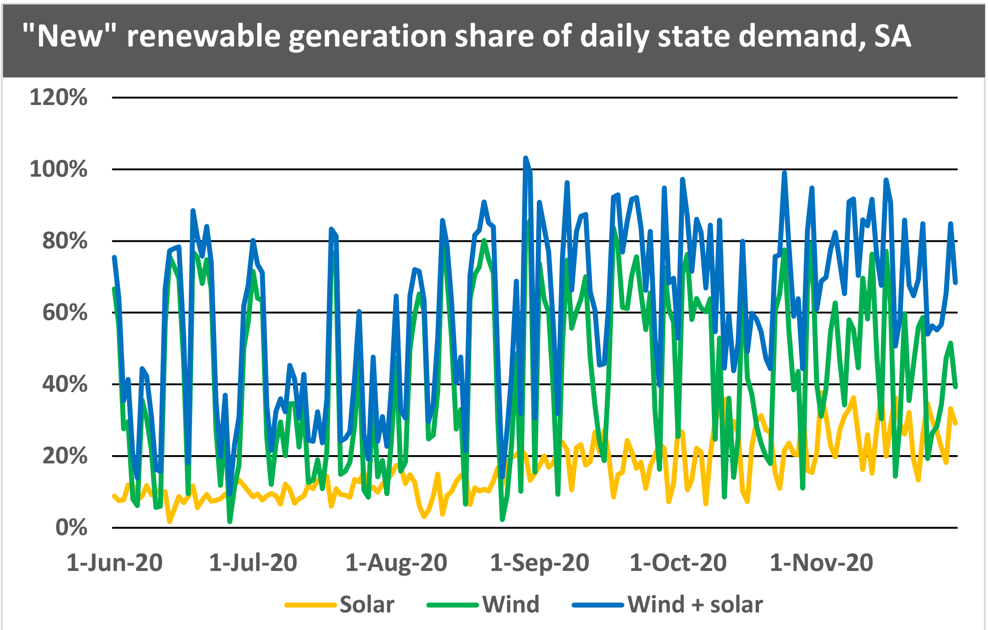
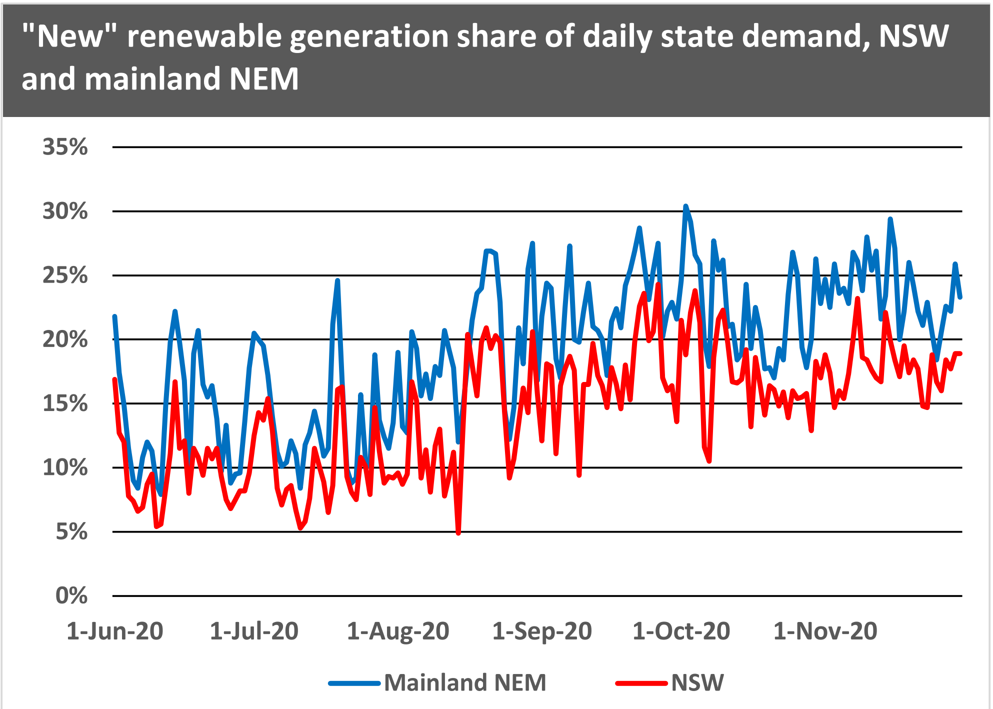


Figure 9



Focussing on the 24 hour data, as these Figures do, removes the well-understood intra-day variation of solar generation. This can be significantly ameliorated by the use of batteries, as households which link a home battery to their rooftop solar installation are increasingly recognising. Day to day variability in generation presents different challenges.

South Australia, where daily demand is on average only about 30% of demand in Victoria and 8% of total mainland NEM demand, has been able to accommodate a high share of wind and solar generation by using a combination of relatively flexible gas generation and interconnectors with Victoria. This approach is obviously not an option available for the larger states or for the NEM as a whole. That is why the recent passage of the New South Wales Electricity Infrastructure Investment Act is such an important development. To greatly oversimplify, the legislation establishes a policy and institutional framework designed to:

- prioritise construction of new wind and solar farms in designated Renewable Energy Zones, so as to minimise the need new transmission capacity;
- identify and underwrite the cost of new transmission investment;
- identify and underwrite the cost of investment in longer term (8 hours plus) capacity;
- identify and underwrite investment in equipment needed to maintain what is called system strength (minimum properties of the overall supply system needed to ensure that it is always in a secure operating condition).

All investments will be subject to competitive offers in order to ensure that all requirements are net at least overall cost to electricity consumers.

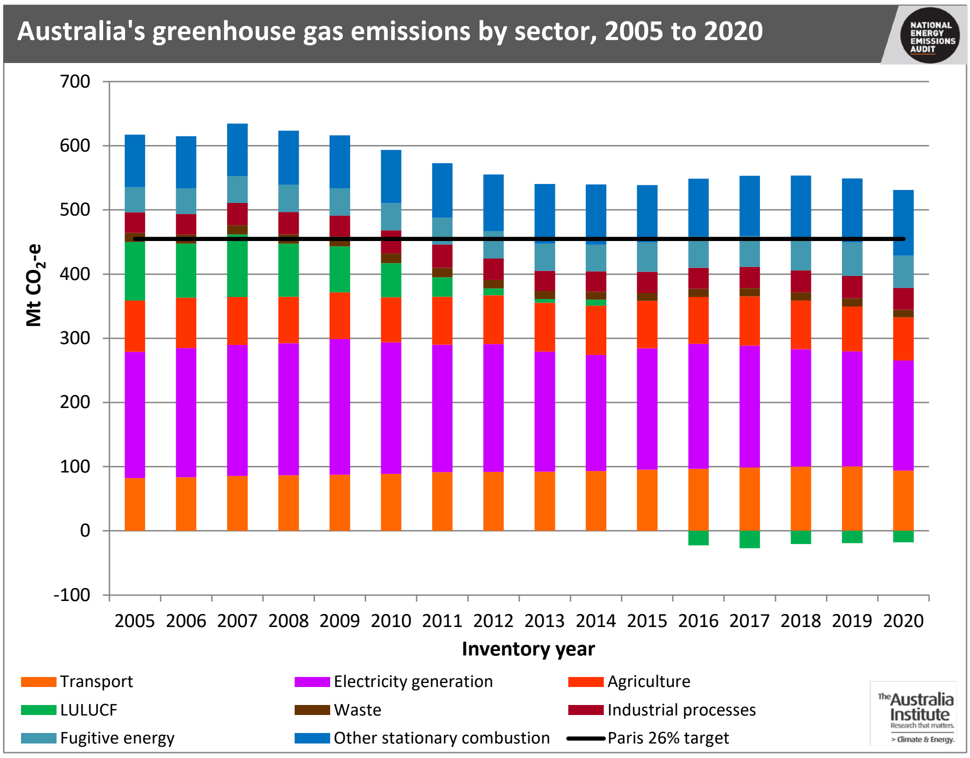
Taken as a whole, it is hard to envisage a policy package announcement which would represent a greater contrast with the un-costed and arbitrary (capricious?) announcements by the Commonwealth to spend huge amounts of public money on Snowy 2.0 and new gas fired power stations.

PROVISIONAL ESTIMATES OF NATIONAL EMISSIONS FOR 2019-20

At the end of November, the Commonwealth released its Quarterly Update of emissions for the June 2020 quarter. These Updates are preliminary/provisional estimates of emissions, which run well ahead to the formal National Inventory. For energy combustion emissions they use some of the same data as the NEEA, e.g. NEM operational data from AEMO and *Australian Petroleum Statistics*, together with a wide variety of other inputs relating to other emission sources.

Figure 10 shows Australia's national emissions in every year sine 2005, disaggregated by major emissions sector.

Figure 10



It can be seen that estimated annual emissions have fallen in each of the two years since 2017-18, the year of the last complete National Greenhouse Gas emissions Inventory. Emissions in the inventory year 2020 are estimated to have been 4.5% lower than in 2018. The major source of this significant emissions reduction has been electricity generation, as documented every month by the NEEA. Additional reductions have occurred in transport emissions, as also reported by NEEA over the past six months. However, with the end of lock-downs and domestic travel restrictions, transport emissions arising from road transport and domestic aviation are almost certain to revert to their previous steadily growing trend.

The third major source of emission reductions was the agriculture sector. In the 2018 inventory year, 78% of all agricultural emissions arose from livestock – mainly cattle and sheep – and cropping activities. The June 2020 *Update* report explains what has occurred with these emissions Over the two years since 2018 in the following terms.

> "Although drought conditions have eased in the June quarter 2020, cattle and sheep herds are yet to rebound. The lack of feed available during the drought led to elevated levels of turn-off of both sheep and cattle resulting in a contraction in the Australian national herd and flock - forecast to reach its lowest levels since the early 1990s in 2020. As conditions continue to improve, herds are expected to be restocked.
>
> "There has been some rebound in crop production in the June quarter 2020, however wheat production is yet to recover which offsets any gains made in the sector. Due to more favourable climatic conditions, crop production should continue to increase during 2020, with wheat production forecast to rebound strongly."

There are no obvious reasons for thinking that emissions in 2020-21 will do anything other than revert to the trend observed up to 2018. Electricity generation emissions will continue to fall, but, in the absence of any significant policy changes, reductions from this sector will be offset by steadily increasing transport emissions, and total emissions from all sectors other than electricity generation will remain almost unchanged from 2018.

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.