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NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit
Electricity Update

December 2018

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

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Key points

+ ***Emissions continue to climb – now four years in a row***

As we helped confirmed in the RMIT ABC fact check in December, Australia's national emissions continue to rise since the repeal of the carbon price. This is evident in the quarterly update of the NGGI, the *Australian Petroleum Statistics* and the *Australian Energy Statics*.

+ ***Fall in electricity emissions easily offset by increasing emissions in all other sectors***

While emissions from the largest polluting sector, electricity production have fallen 7% since 2005, emissions have increased in transport (23%), stationary energy (21%), and fugitive energy (41%), more than offsetting the electricity reductions. This is without factoring in emissions from agriculture and the land use sector.

+ ***Renewables continue to displace gas generation rather than coal***

High wholesale gas prices mean that increasing wind and solar generation is displacing gas, rather than coal, meaning that emission reductions are less than they would be if coal were being displaced.

The astonishingly fast growth in commercial scale rooftop solar installations is an important but largely ignored change in electricity supply

The Clean Energy Regulator is reporting monthly on new installations of commercial scale rooftop solar systems. Installations of between 100 kW and 5 MW capacity rooftop solar, accredited under the Large Renewable Energy Target, but, in the great majority of cases, are not required to register with AEMO, are also embedded within distribution networks. Most of their output is consumed behind the meter, meaning that even less is known about how much they supply. We calculate that the current 210 MW total capacity of these installations could currently be generating just under 0.2% of total NEM annual electricity consumption, but this could more than double in two years if current rates of growth continue.

Introduction

Welcome to the November 2018 issue of the *NEEA Electricity Update*, with data updated to the end of October 2018. 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). From time to time it will also include information and commentary on other fossil fuel related emissions, including emissions from consumption of petroleum products and natural gas. This will replace the quarterly *National Energy Emissions Audit Report*, which will no longer be published on a regular quarterly basis. This change will facilitate the reporting of important new data about Australia's energy combustion emissions, as and when such data become available.

Demand for electricity

Demand trends during November showed little change from those seen over preceding month (Figures 1 and 2). Grid demand in the NEM as a whole showed almost no change; an increase in Queensland, quite probably caused by the extremely hot weather experienced during the month, was offset by small decreases in Victoria, South Australia and Tasmania. In Western Australia demand decreased quite sharply during November. Whether this is the start of a trend or a one-off change, possibly also related to weather – in this case unusually mild – may become clearer over the next few months

Figure 1

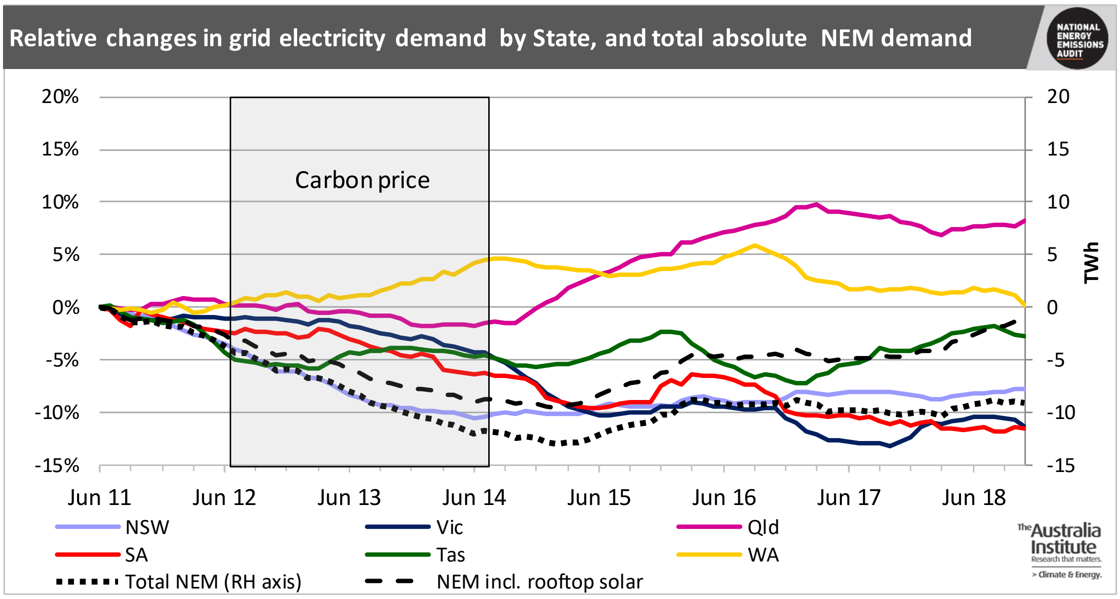
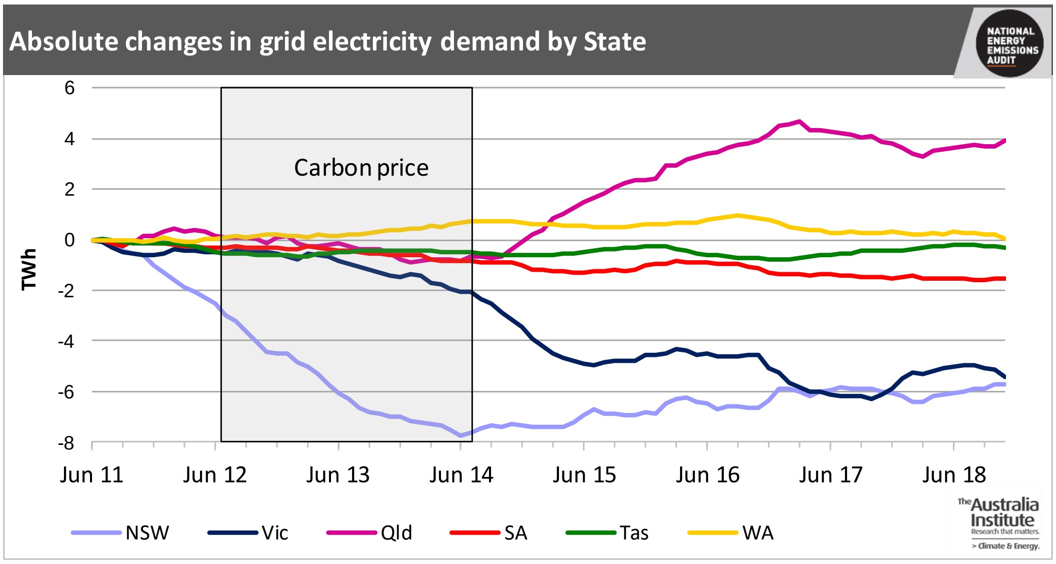


Figure 2



When rooftop solar generation is added to grid demand, to obtain a more complete estimate of total annual electricity consumption, the result is a small but steady increase across the NEM as a whole.

Generation and emissions

Figure 3 shows, as in previous months, that total grid generation was almost unchanged in October, while grid generation plus rooftop solar has been gradually increasing since late last year. Both emissions and emissions intensity of grid generation decreased slightly.

Figure 3

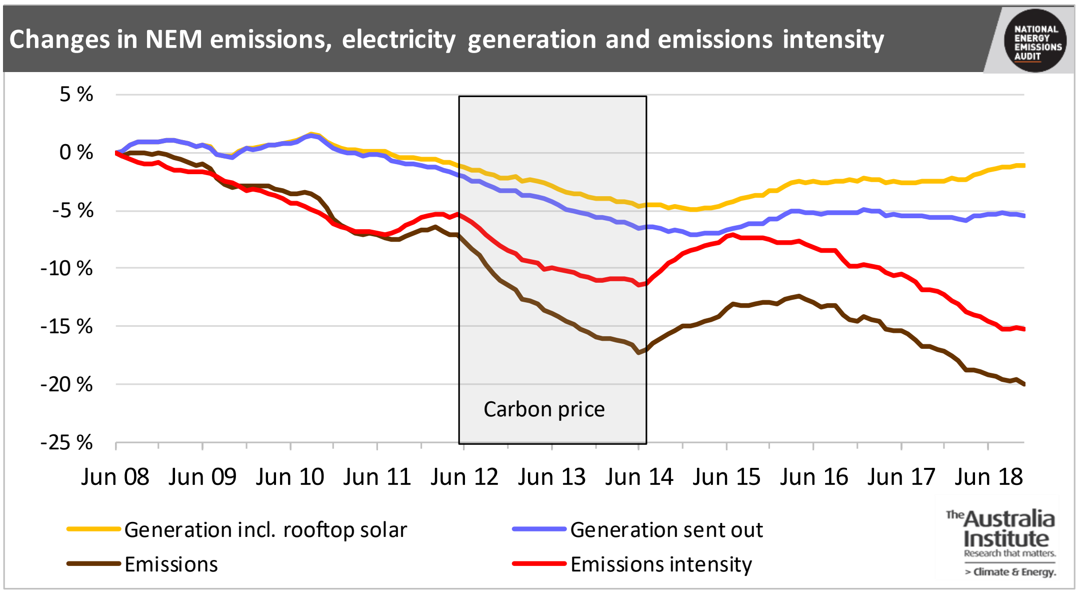


Figure 4

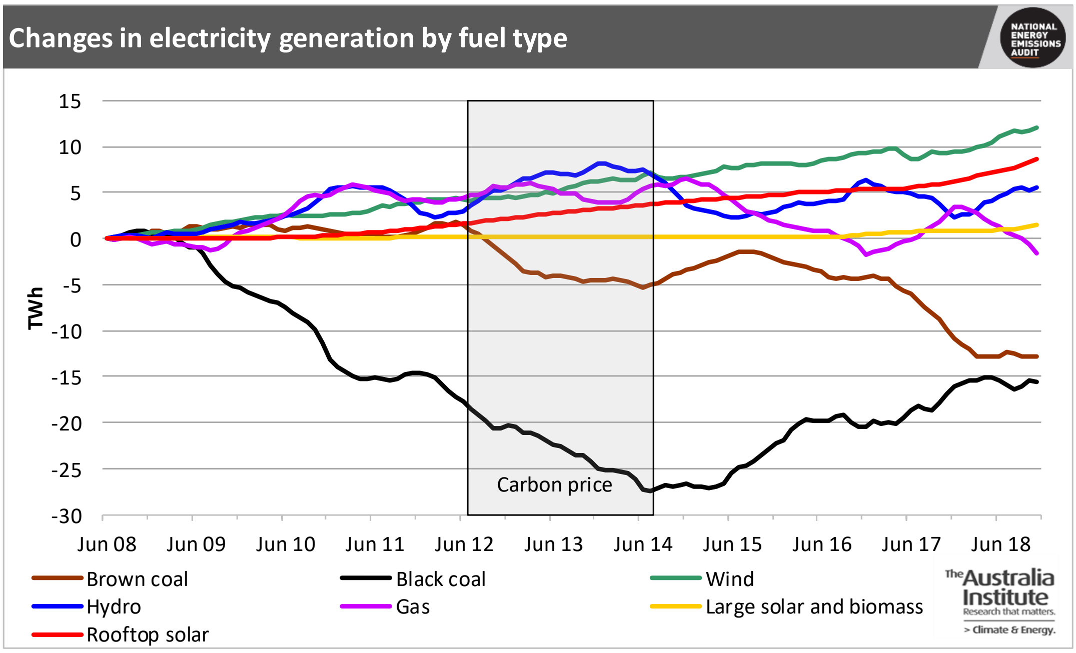
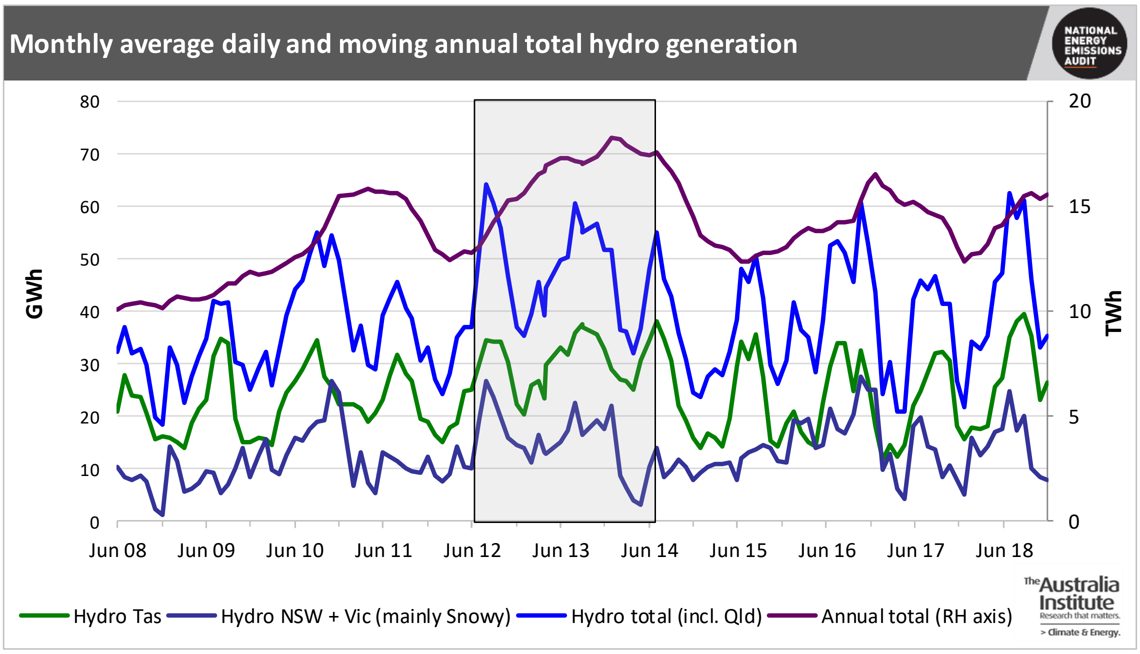


Figure 4 shows that the small decrease in emissions was caused, as we noted in last month's report, by the continuing fall in gas generation. As explained in some detail there, high wholesale gas prices mean that increasing wind and solar generation is displacing gas, rather than coal, meaning that emissions reductions are less than they would be if coal were being displaced.

Hydro generation increased slightly, remaining at a level which is very high, relative to the historic record, as can be seen in Figure 5. This has mainly been caused by very high output by Hydro Tasmania. Average daily generation in Tasmania during August was at the highest monthly level since Tasmania joined the NEM in May 2005.

Figure 5



Growth in renewable generation in the NEM

The high level of hydro generation in recent months has contributed to the growth in total renewable generation in the NEM. This growth is shown in Figure 6, expressed as month by month quantities. Figure 7 shows the same data, but only for the period since April 2015, because that is the month in which estimated generation from small scale rooftop solar generation became available. In this context, small scale rooftop solar means installations qualifying under the Small Renewable Energy Scheme (SRES) which, in the case of solar PV, means installations of less than 100 kW capacity. By far the largest numbers of such installations are on detached houses, but there are also a significant number on small business premises and community facilities.

It can be seen that the total renewable share of generation in the NEM reached a monthly peak in August of this year. For grid generation only, the August share was 22.9%, and, for grid generation plus rooftop solar, the share was 26.2% (of a larger total which included rooftop solar).

Figure 6

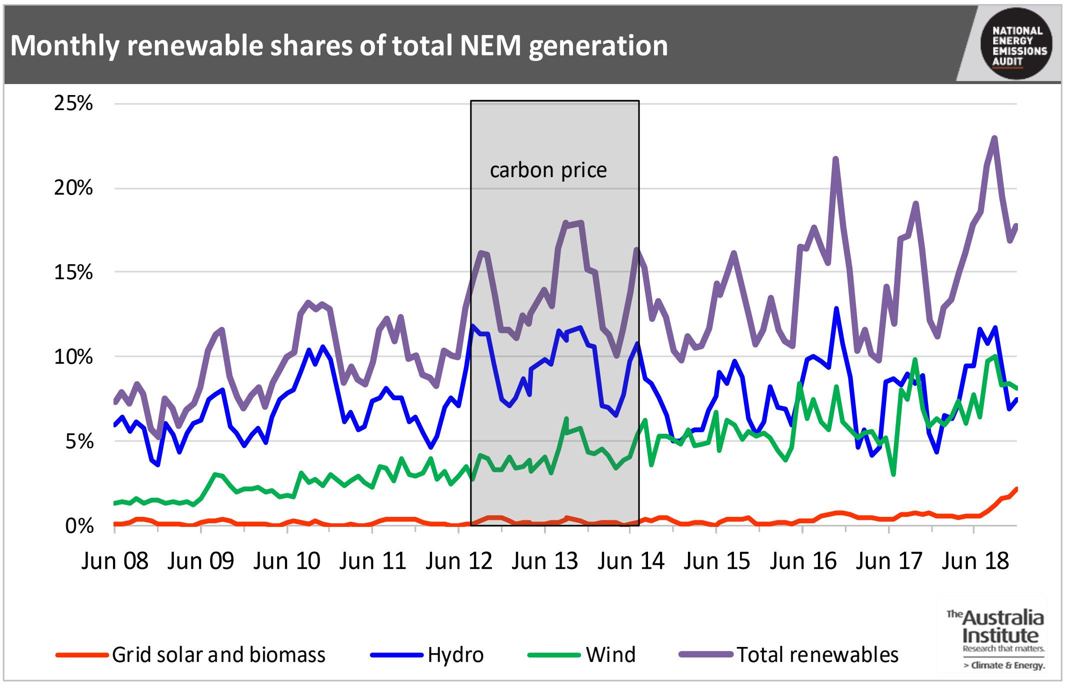


Figure 8

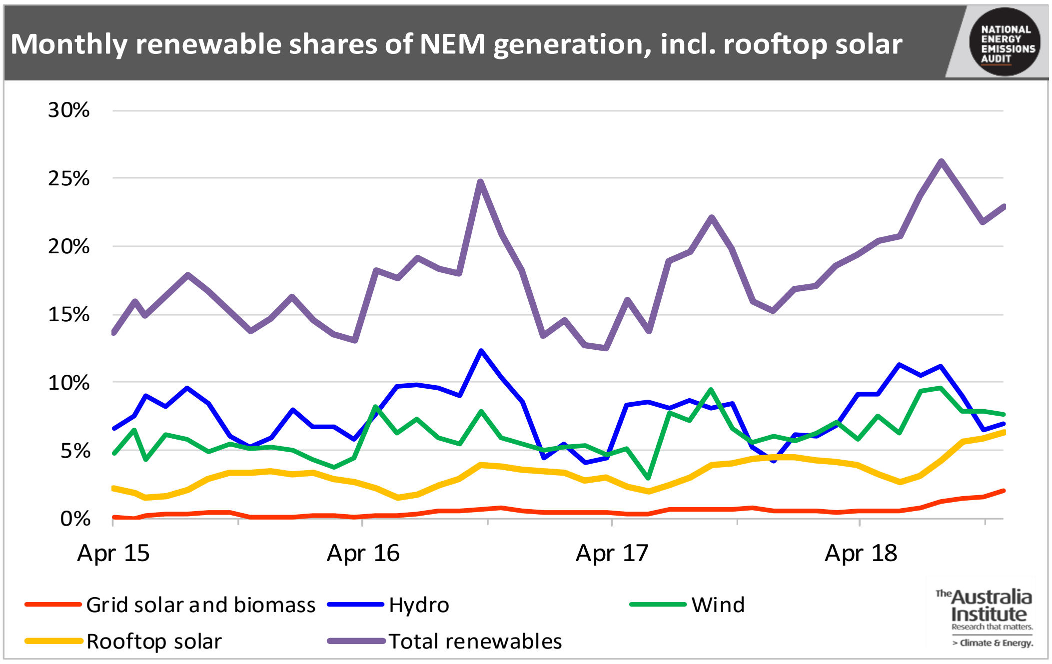
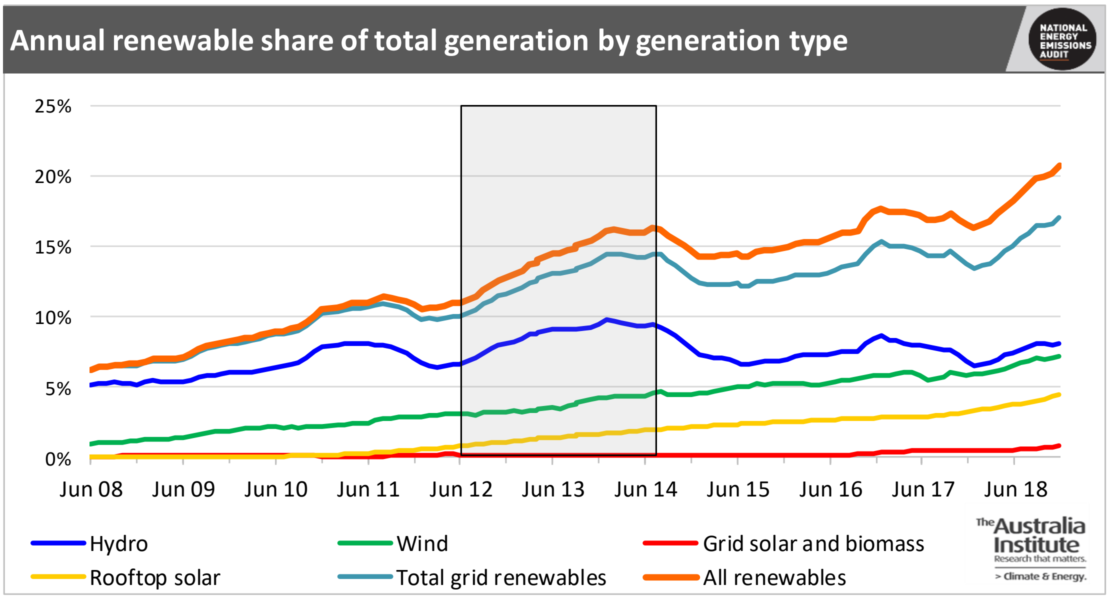


Figure 9 shows that same data, but expressed as moving annual totals for each generation type. It will be noted that this graph includes rooftop solar generation starting from 2008. For the period between 2008 and 2015 the estimates are taken from past issues of AEMO's annual *National Electricity Forecasting Report*, which include estimated annual totals. Interpolation of these annual values give a smoothed month by month curve.

Finally, it should be noted that lack of detailed data means that these graphs slightly under-estimate the total quantity of electricity supplied from renewable sources. According to data published by the Clean Energy Regulator, about 740 GWh was generated from landfill gas during calendar year 2017, equal to about 0.4% of NEM electricity consumption. All landfill gas generators are embedded within distribution networks and therefore do not appear in AEMO data.

A further, unknown quantity of electricity was generated by large commercial scale rooftop solar facilities. These are installations of between 100 kW and 5 MW capacity, which are accredited under the Large Renewable Energy Target, but, in the great majority of cases, are not required to register with AEMO. Like landfill gas generators they are embedded within distribution networks, but most of their output is consumed behind the meter, meaning that even less is known about how much they supply. This is a small but very rapidly growing component of Australia's renewable electricity supply. The following section of the report contains more information about this growth.

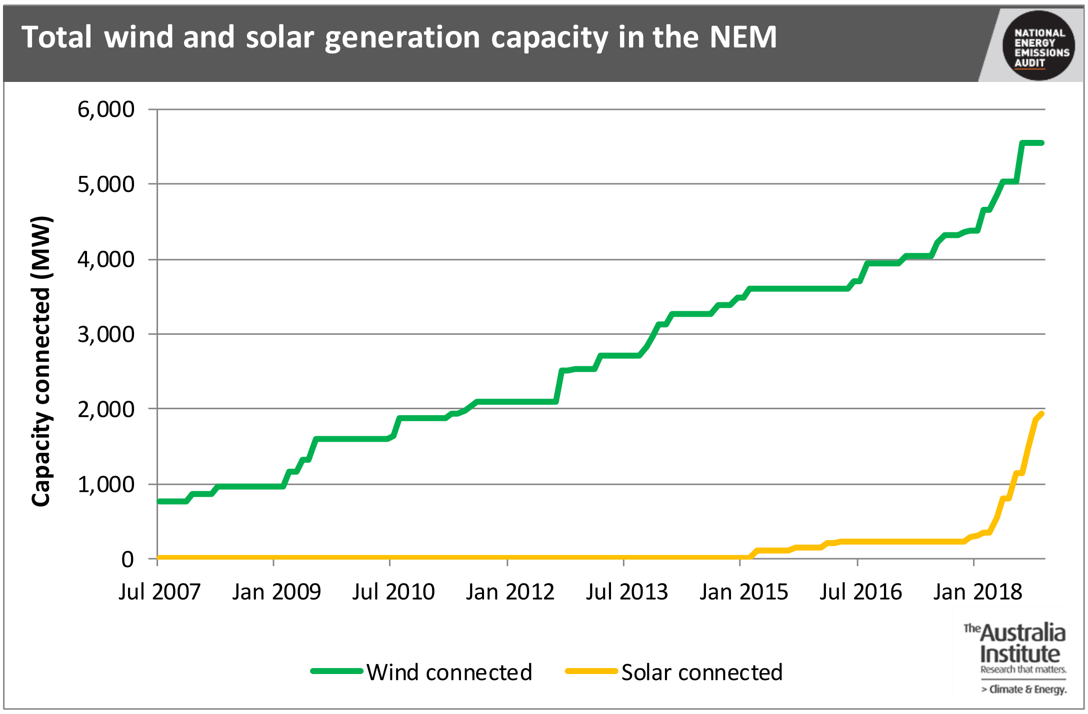
Figure 9



New renewable generation connections

Figures 10 shows grid connected capacity of wind and solar generation at the end of each month. During November no new windfarms started generating and only one new solar farm, the 88 MW AC Wemen, in north west Victoria. It is likely that this hiatus in new supply has been caused by delays in approval to start operating, because of transmission capacity constraints in several parts of the NEM system.

Figure 10



Mention was made above to the growing numbers of commercial rooftop solar installations in the capacity range 0.1 to 5 MW. These systems are accredited by the Clean Energy Regulator (CER) under the Large Renewable Energy Target and the CER has recently begun to publish regular updates of the number and capacity of such systems accredited each month, starting from January 2017.

Figure 11

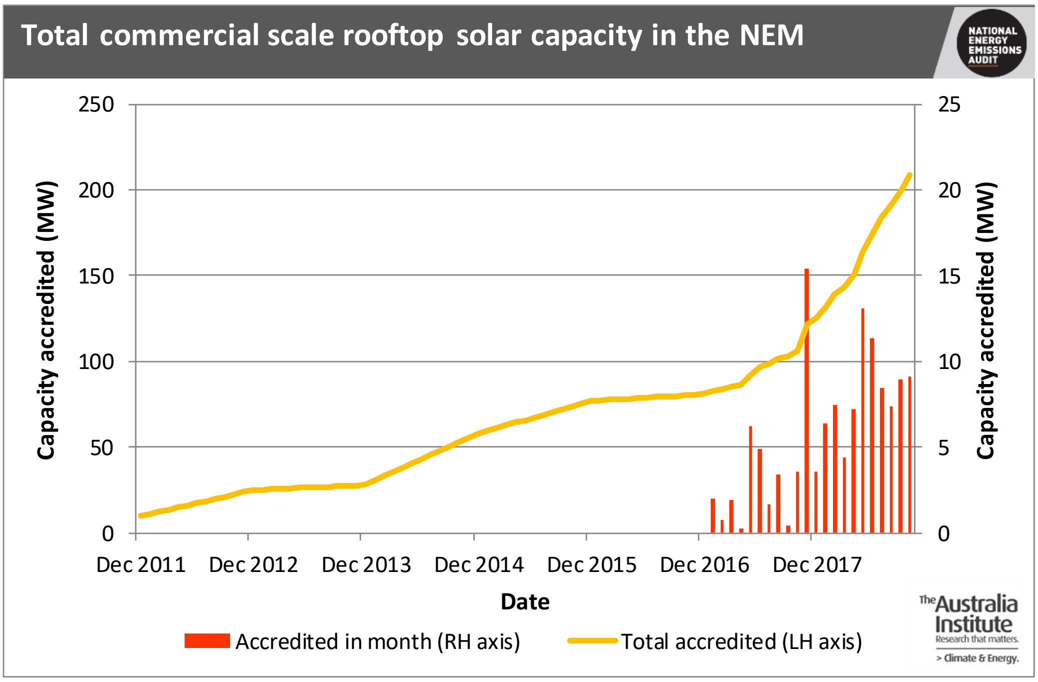


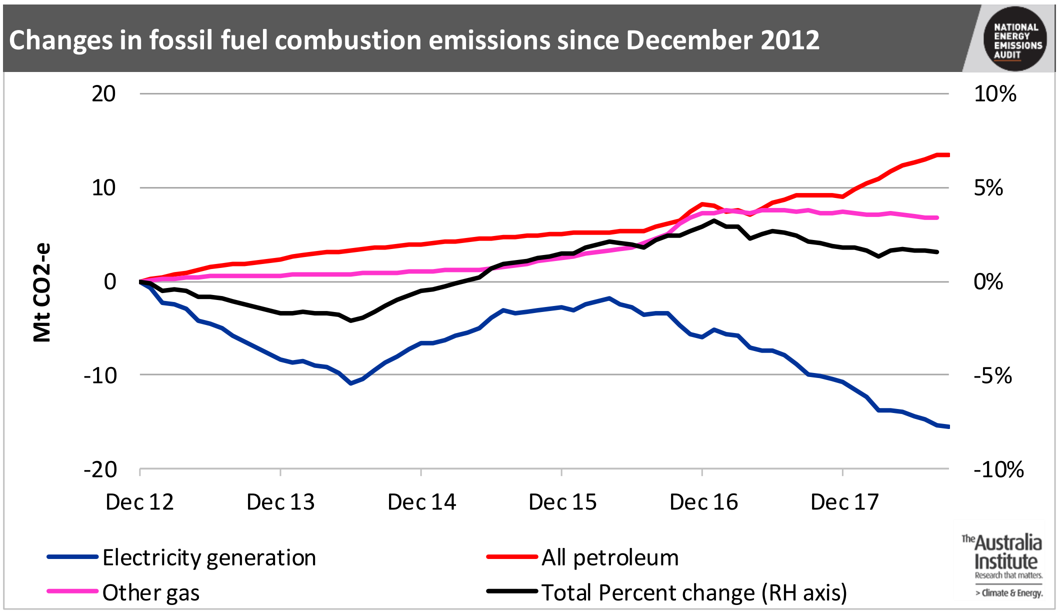
Figure 11 shows total capacity accredited each month in the NEM states, together with the moving total accredited capacity. Data for the period between December 2011 and December 2016 are based on total end of calendar year capacity over that period, reported separately by the CER. The trend line has been constructed by simple linear interpolation. The delayed effect of the uncertainty created by the Abbott government's review of the LRET can be seen in the data for 2016 and, to a lesser extent 2015. By contrast, there has, since then, been a boom in new installations, undoubtedly stimulated by both the falling cost of photovoltaics and the rising cost of purchased electricity. As with household scale rooftop solar, but even more clearly, the value to the host site of electricity generated by these installations is maximised if as much as possible is consumed behind the meter, to displace purchased electricity. The impact of such generation on the NEM as a whole will therefore mainly be seen as reduced demand for grid supplied electricity.

On plausible assumptions about average annual capacity factors, the current 210 MW total capacity shown in Figure 11 could generate less than 0.2% of total NEM annual electricity consumption. However, if capacity continues to grow as rapidly as it has been over the past year, this figure could soon become quite significant.

TOTAL ENERGY EMISSIONS TO SEPTEMBER 2018

Over the three months between June and September 2018, total fossil fuel combustion emissions, as reported by the NEEA, stayed almost constant, as shown in Figure 12. Reductions in emissions arising from electricity generation just slightly offset increases in the combined total arising both transport fuel use and all other stationary combustion activities.

Figure 12

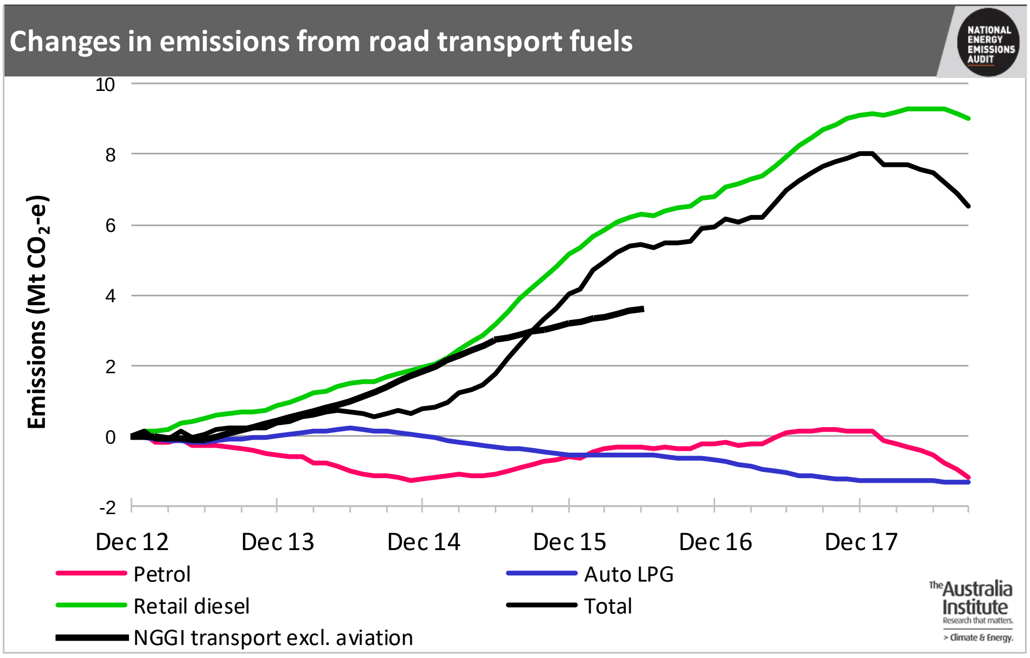


The trend in natural gas emissions clearly shows the effect of processing gas consumption at the three LNG plants in Queensland, suggesting that these may have added about 5 Mt CO_2-e to Australia's emissions.

The presentation of emissions from petroleum use in this Figure has been revised since its last publication in the September 2018 NEEA Report. For the period from December 2012 to June 2016 emissions data have been taken from the 2015-16 National Greenhouse Gas Inventory (NGGI), and interpolated. The previous data, calculated from sales data in *Australian Petroleum Statistics*, did not reconcile with the either NGGI data or *Australian Energy Statistics* data, and showed an implausible break in trend at the start of calendar year 2016. A further check on the data since the start of 2016 was made by undertaking a similar reconciliation for the year ending June 2017, i.e. using the most recent issue of *Australian Petroleum Statistics*. It was found that the two sources now reconcile well. This finding confirms that the introduction of mandatory company reporting for *Australian Petroleum Statistics* has been successful in achieving a material improvement in the quality of official data.

Figure 13 shows trends in emissions from the main categories of road transport fuels, calculated from *Australian Petroleum Statistics* data, and also shows the 2015-16 NGGI figures for road transport emissions. It can be seen that emissions appear to turn down from the beginning of 2018. While it would be tempting to think that this trend might be related to the increase in petrol and diesel prices over recent months, the slowdown in emissions growth (caused of course by reduced consumption) appears to have started before the price increases. It is clearly too soon to speculate whether a major change in trend is emerging or merely a blip in an otherwise continuing upward trajectory of road transport fuel consumption and emissions.

Figure 13



NATIONAL EMISSIONS FROM ALL SOURCES

The Department of Environment and Energy recently released its *Quarterly Update of Australia's National Greenhouse Gas Inventory to June 2018*. The most recent complete National Greenhouse Gas Inventory (NGGI) is for 2015-16. Hence the most recent *Quarterly Update*, which can reasonably be considered as a first draft of the complete national inventory, carries estimates of Australia's greenhouse gas emissions forward by two full years. The following graphs summarise the resultant trends in national emissions since 2005, which is of course the reference year for the Paris emission reduction targets. Australia's total emissions in 2005 were 609.5 Mt CO_2-e. Taking Australia's target as 28% below this level by 2030 translates to a total national emissions level of 438.8 Mt CO_2-e in that year.

Figure 14

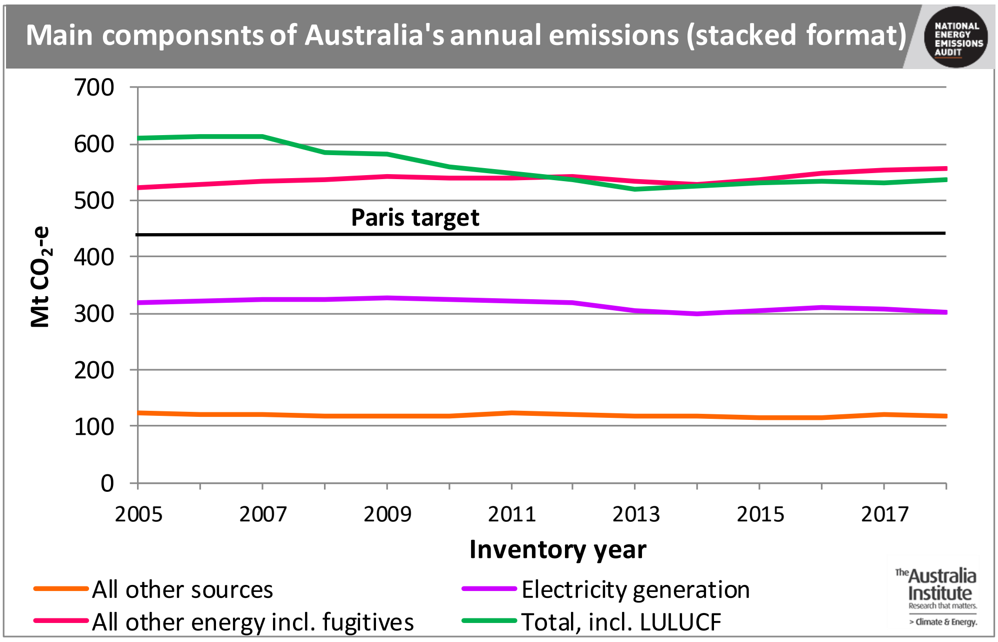
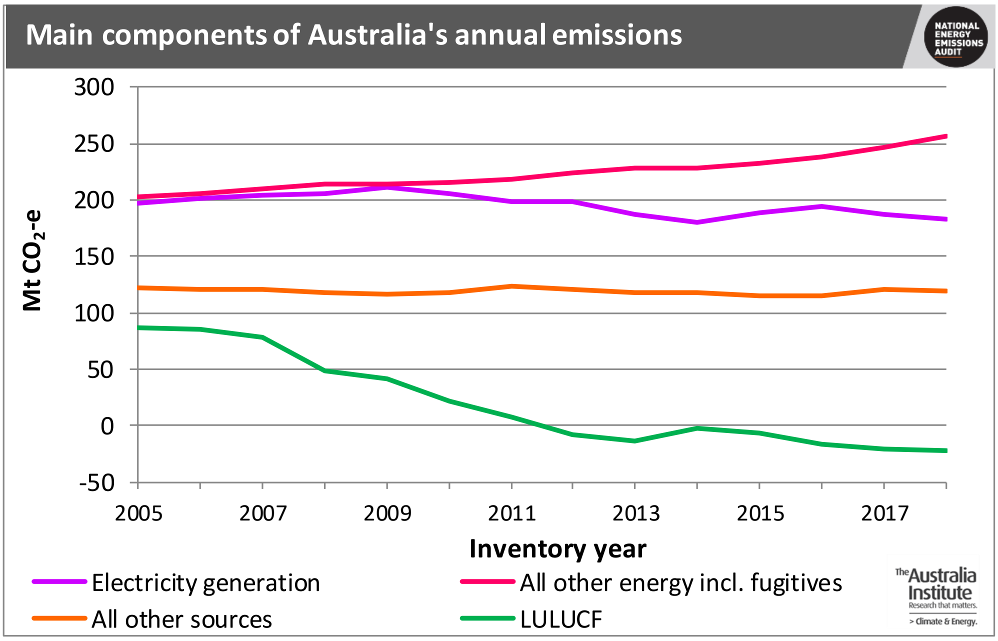


Figure 14 shows that from 2005 until 2013 Australia's total emissions fell steadily, thanks almost entirely to large reductions in emissions from what is called, in the official IPCC definition of emissions source categories, as Land Use, Land Use Change and Forestry (LULUCF). The main driver for this reduction was reduced land clearing in Queensland and, to a lesser extent, New South Wales, following various legislative changes introduced over the years immediately prior to 2005. In 2012 this source became a net sink for emissions, meaning that carbon dioxide sequestered by growing vegetation exceeded carbon dioxide emitted as a result of land clearing and related activities.

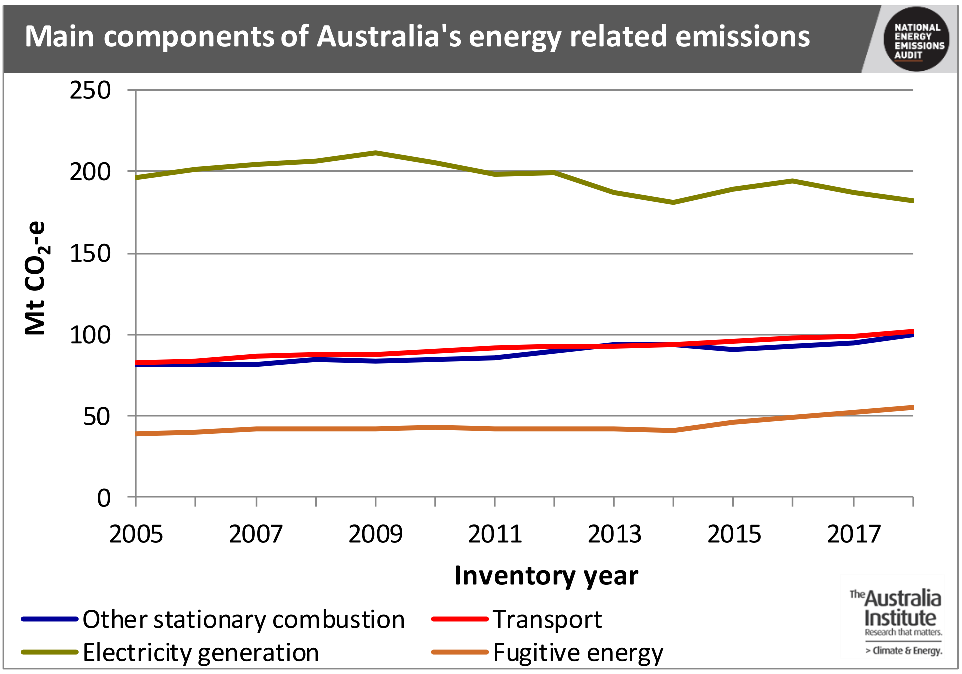
Since then, however, LULUCF emissions have remained roughly constant, as can be seen more clearly in Figure 15. This also shows the modest reduction in emissions from electricity generation, which are tracked each month by the NEEA. Throughout the whole period emissions from what are grouped here as "All other sources" have also remained fairly constant. These other sources are Agriculture, which is the largest, Industrial Processes, which includes leakage of HFC synthetic refrigerant gases, and Waste.

Figure 15



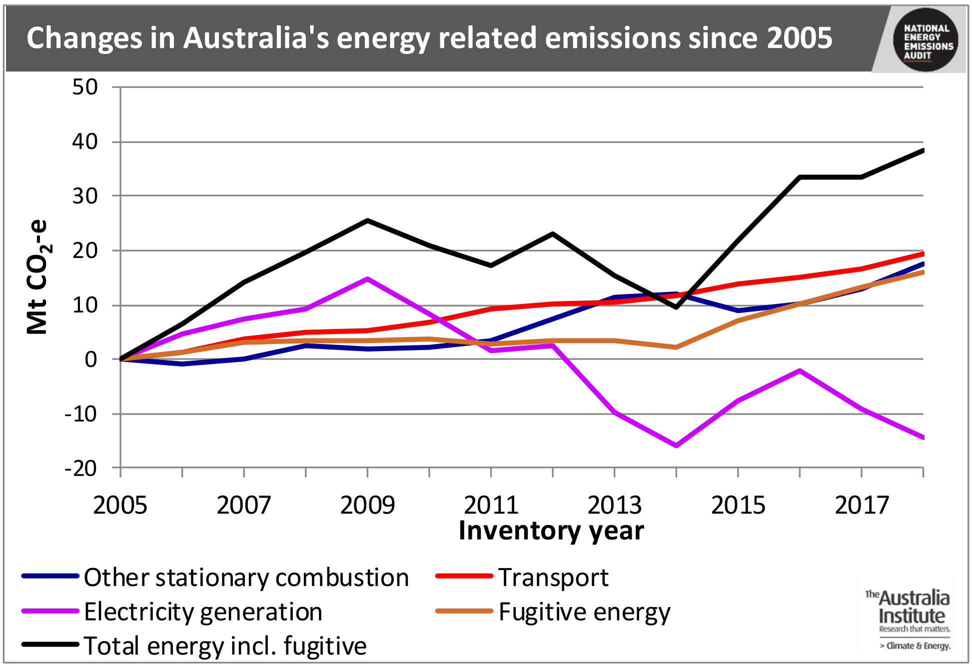
Australia's total emissions fell to a minimum level, and the lowest level since 1996, in 2013. Since then they have steadily increased because of growth in energy related emissions other than electricity generation. In the 2015-16 NGGI total national emissions were 2.5% higher than in 2012-13. Two years later, in 2017-18, total emissions, as estimated in the recent *Quarterly Update*, were 3.6% higher than in 2012-13. This increase is entirely attributable to energy related emissions, which have increased by 5.5% over the same period.

Figure 16



Trends in the major components of energy related emissions are shown as totals in Figure 16, and as changes since 2005 in Figure 17. It can be seen that emissions from transport, other stationary combustion, and fugitive energy sources have all increased strongly: transport by 19 Mt CO_2-e, equivalent to 23%, other stationary energy by 18 Mt CO_2-e, equivalent to 21%, and fugitive energy by 16 Mt CO_2-e, equivalent to no less than 41%. Only emissions for electricity generation have decreased: by 14 Mt CO_2-e, equivalent to 7%, and obviously not nearly enough to offset the increases in other energy related emissions.

Figure 16



Successive issues of the NEEA have explained that growth in transport emissions is almost entirely caused by increased petroleum fuel consumption by road transport. Fuel use by domestic aviation has been near constant for some years, as airlines steadily increase the technical efficiency of their fleets and the productivity of their operations, as has fuel use by railways and coastal shipping.

Other stationary combustion consists mainly of emissions from use of natural gas, and some limited use of coal, in manufacturing activities, and gas use for heating in residential and commercial buildings. *Australian Energy Statistics* show that gas consumption by manufacturing decreased significantly between 2014-15 and 2016-17, presumably because of higher gas prices, while consumption by commercial and residential consumers was almost unchanged. However, consumption by the oil and gas industry, almost entirely caused by LNG production, grew very strongly. Hence higher emissions from other stationary combustion are almost entirely attributable to the LNG industry.

Fugitive energy emissions consist mainly of methane released from coal seams in the course of mining, and emissions of both methane and carbon dioxide associated with the production, processing and distribution of natural gas. While emissions from coal mining are larger than those from oil and gas activities, coal mining emissions have fallen over the last couple of years, while oil and gas related emissions have risen steeply. This is clearly related to the dramatic increase in gas production, and processing to LNG, over recent years; according to *Australian Petroleum Statistics*, total gas production, including coal seam gas, almost doubled over the four years from 2013-14 to 2017-18.

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.