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NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit Electricity Update

December 2019

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

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KEY POINTS

- ***In South Australia over the majority of the past two years, wind and solar have supplied more than 50 per cent of all electricity generated during the month.*** *In November 2019, the monthly wind plus solar share in South Australia reached nearly 65 per cent.*

- ***South Australia's electricity prices are benefitting from the renewable boom.*** *Monthly average wholesale prices in South Australia have been lower than in Victoria since January 2019, lower than in New South Wales since August 2019, and the lowest of all five state regions in the NEM in the last two months.*

- ***The recent fall in sales of diesel fuel reported in the last report, which gave rise to hopes that transport emissions might at last start to fall, have now been reversed.*** *Transport emissions continue to grow as a source of domestic emissions, with no credible policies to limit this growth.*

- ***The most recent update of Australia's quarterly emissions allows for a clear contrast of emission in the five years before 2014 where they trended down and the five years after where they have since trended upwards.*** *The Emissions Reduction Fund which commenced in 2014 has certainly done much less to reduce emissions than the carbon price did, and it is, in fact, hard to see that it has had any significant impact.*

- ***The reductions in agriculture sector emissions over the past two years, and also in the period 2005 to 2008, are largely attributable to the reduction in livestock numbers because of drought.*** *Emissions associated with livestock husbandry, particularly beef cattle, accounted for 45 per cent of Australia's total agriculture emissions in 2017. Hence falling livestock numbers mean falling emissions, but if and when graziers re-stock after drought, emissions will increase again.*

- ***The government's most recent projections of emission over the next ten years indicate very little further reduction in emissions.*** *If Australia is to meet its Paris Agreement target without using Kyoto carry over credits (for which there is no legal basis) another 13 per cent emissions reduction will be required.*

- ***The new interconnector between South Australia and New South Wales, now called EnergyConnect, will have two unique benefits not provided by interconnectors which are oriented north-south.*** *Firstly, the 30 minute time difference in South Australia will make a small contribution to making peak* *demand occur slightly later there than in NSW and Victoria. Secondly, by allowing solar farms in south west NSW to reach major demand centres on the East Coast, it will ensure that solar generated electricity continues to be available later in the evening than most of the rooftop solar generation in NSW.*

+ ***During November, wind and solar generation, including rooftop solar, contributed a record 22 per cent of all electricity produced in the National Electricity Market (NEM).***

+ ***On Tuesday November 12th, total renewable generation, including hydro, contributed over 50 per cent of all electricity supplied for about 2 hours during the middle of the day.***

INTRODUCTION

Welcome to the December 2019 issue of the *NEEA Electricity Update*, with data updated to the end of November 2019. 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). Since the start of 2018 we have been charting the rapid growth in wind and solar generation. There can be no doubt that Australia's electricity system is well along the road to a fundamental transition in terms of both the means by which electricity is generated and the system through which electricity is supplied to consumers.

This addition looks at the latest data from the quarterly emissions, the annual emission projections and the latest emissions around liquid fuel sales.

OVERVIEW OF MAIN TRENDS

Demand for electricity

Consumption of grid supplied electricity in the NEM was the same in November 2019 as in November 2018, meaning that there was no change in total annual consumption between October and November. A similar pattern was observed in each of the five states in the NEM. In Western Australia, though, there was a distinct, though small increase in electricity consumed in the South West Interconnected System (SWIS).

Figure 1

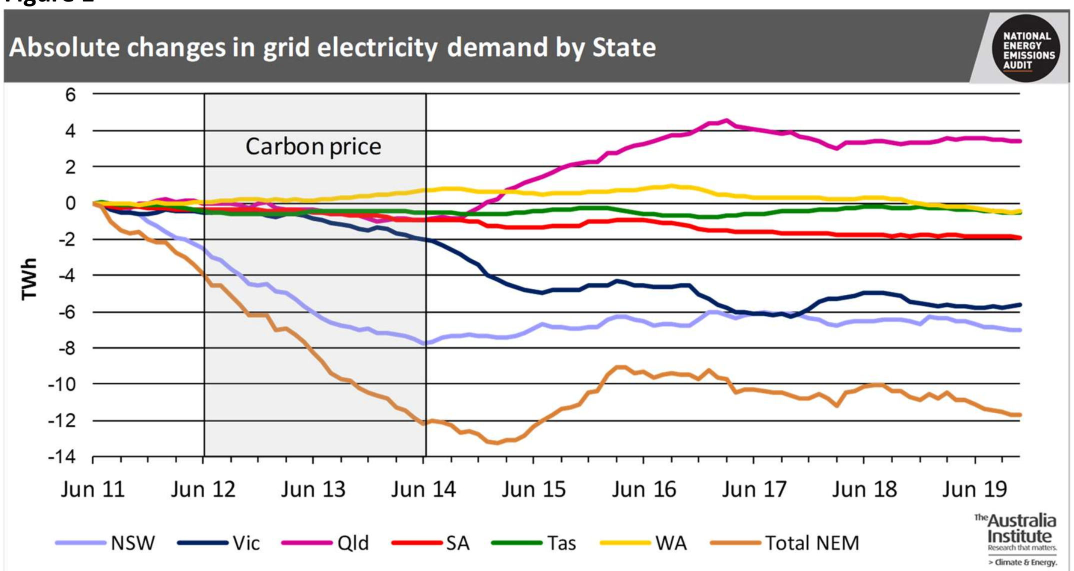
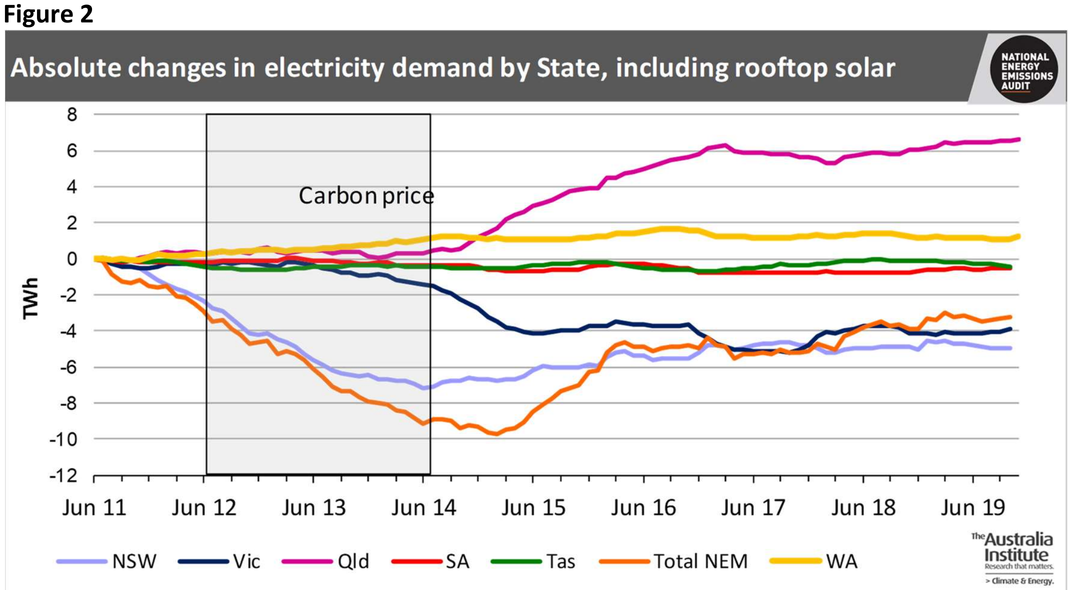


Figure 2

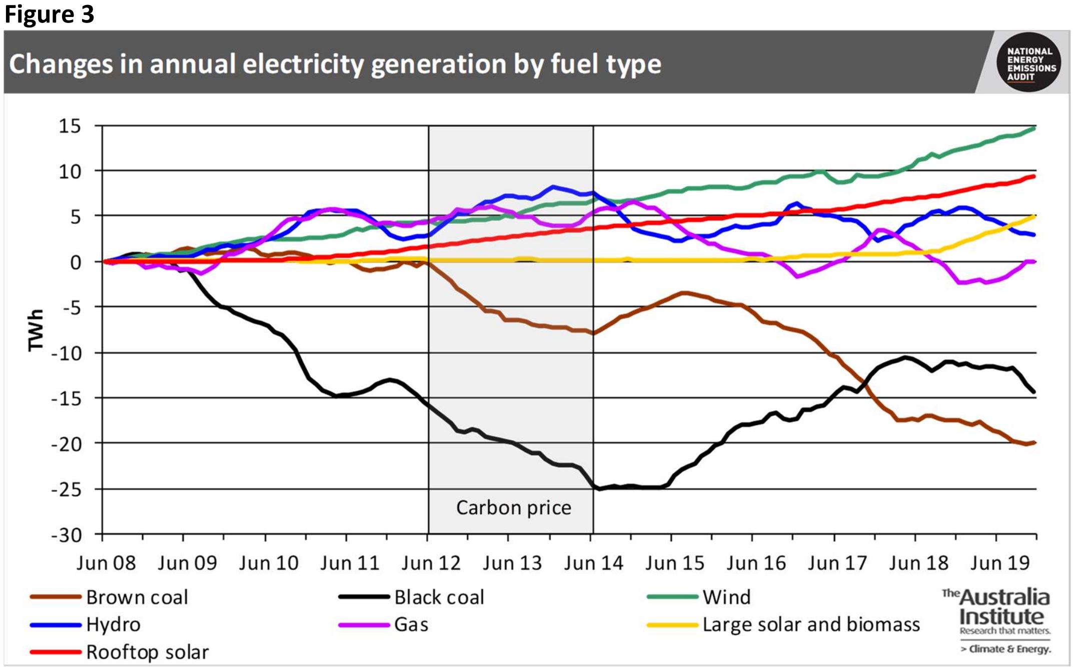


However, when electricity generated by rooftop solar installations is added to electricity supplied through the NEM grid, consumption is seen to be increasing in the NEM as a whole, in most individual states in the NEM, as well as in Western Australia (Figure 2). In other words, demand for electricity is growing slowly, but at a lower rate than output from rooftop solar.

Generation and emissions

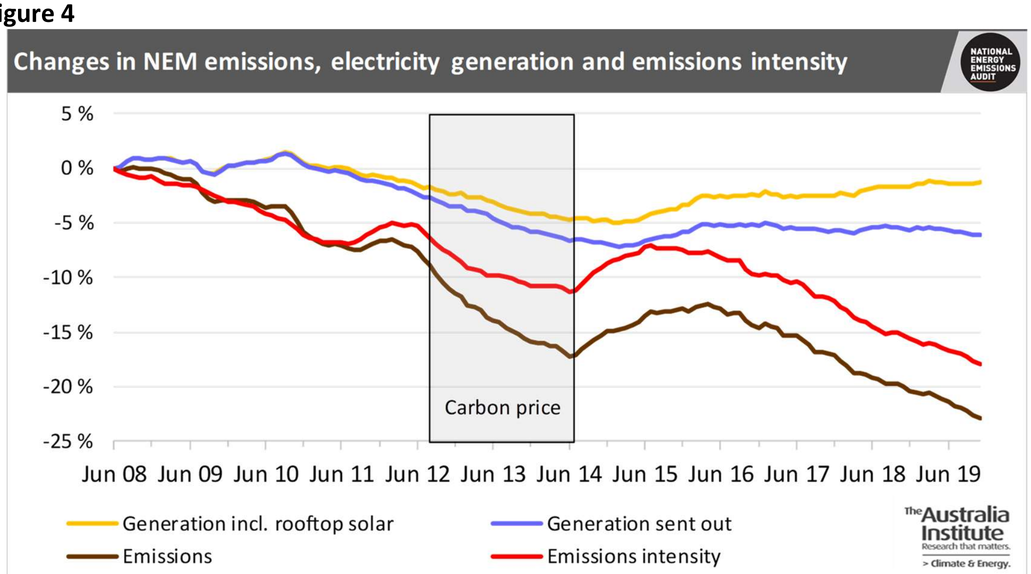
The sharp drop in black coal generation, noted in the last NEEA Report, continued during November (Figure 3). The major output reduction was in New South Wales, where annual electricity sent out from the state's five coal fired power station fell by 2.7 per cent over the two months from September to November, because four of the eight machines at Eraring and Bayswater power stations, the largest in the state and also in Australia, were out of service for periods of some weeks. Unit 4 at Bayswater is undergoing a major performance upgrade, following a similar upgrade which put Unit 1 off-line for five months during 2018. The other unit at Bayswater, and two at Eraring, have presumably been undergoing regular maintenance. Wind and solar generation continued to grow strongly throughout the NEM, and were able to make up most of the shortfall in coal generation. Some this increase was in New South Wales and some in other states, supplied via increased interconnector flows to New South Wales.

Figure 3



Total emissions from generation in the NEM are now 43 million tonnes CO_2-e, equivalent to about 23 per cent below the peak level reached eleven years ago (Figure 4).

Figure 4



SPECIAL TOPICS

Tracking the transition to renewables in the NEM

Last month's NEEA Report noted record levels of total wind and solar generation in the NEM, in each of the three preceding months. Another record was set in November, with average monthly combined wind and solar generation reaching 4.77 GW, equal to 22 per cent of total average electricity consumption for the month, inclusive of rooftop solar. When hydro and bagasse generation are also included the total generation reached 6.07 GW in November, which was 28 per cent of average total NEM generation in November. These achievements are shown respectively in Figures 5 and 6 below.

On Tuesday November 12th, notably a weekday, when electricity consumption is higher than on weekends, total renewable generation, including rooftop solar, narrowly exceeded 50% of total sent out electricity generation for almost 2 hours in the middle of the day. This is shown in Figure 7. Figure 7 also shows very clearly how rooftop solar makes an important contribution to reducing the demand for grid generation at the daily peak on hot days (which 12 November was in most parts of eastern Australia). Because of the contribution of rooftop solar, peak demand on the grid occurred about one hour later, and was about 500 MW (1.9 per cent) lower, than the peak of total electricity consumption.

That said, in the NEM grid as it is currently configured, this achievement is probably more important as a symbolic achievement than in practical terms, because at times of peak demand and high renewable generation, the interconnectors between regions are often fully loaded. This often means, for example, that additional excess solar and or wind generation in South Australia cannot be provided to Victoria or New South Wales. The new interconnector between South Australia and New South Wales, now called EnergyConnect, construction of which is proposed to start in 2021, will help to reduce such congestion. This is particularly the case, because its east-west orientation will deliver two additional benefits not provided by interconnectors which are oriented north-south. Firstly, the 30 minute time difference in South Australia will make a small contribution to making peak demand occur slightly later there than in New South Wales and Victoria. Secondly, by allowing solar farms in south west New South Wales to reach major demand centres on the east coast, it will ensure that solar generated electricity continues to be available later in the evening than most of the rooftop solar generation in New South Wales.

Figure 5

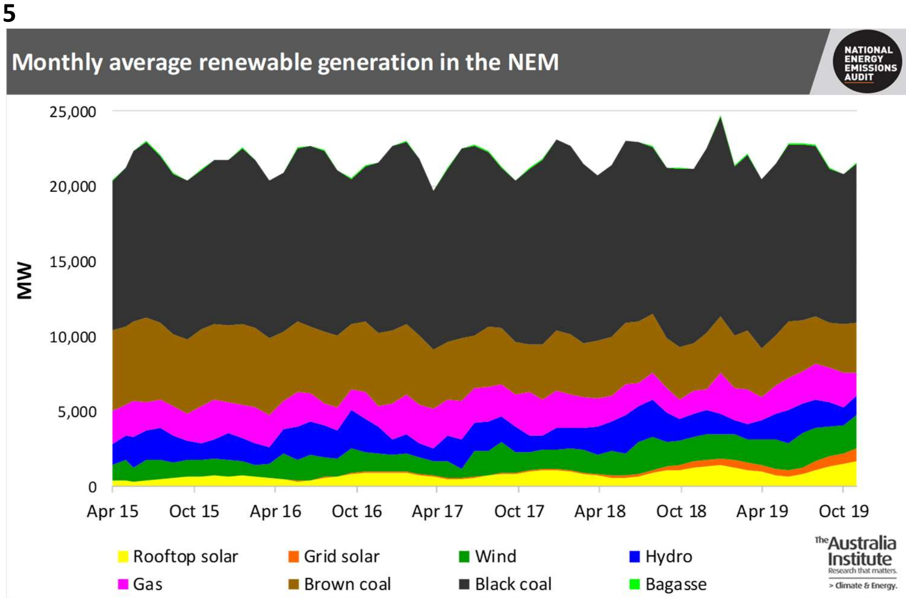


Figure 6

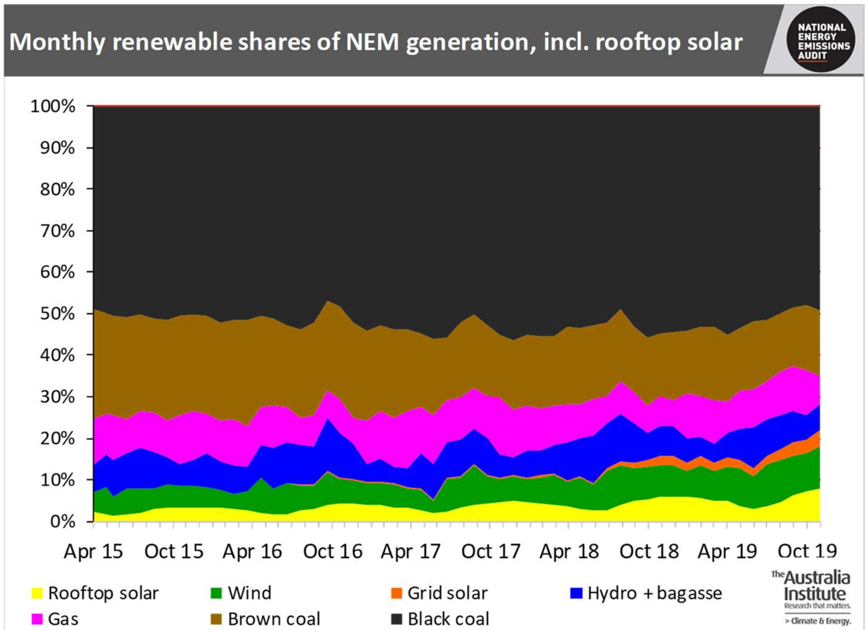
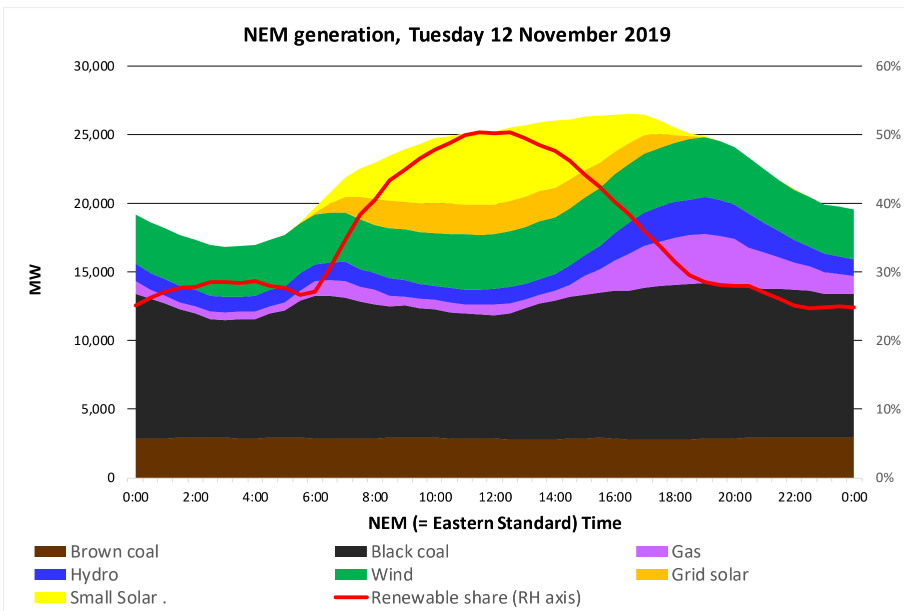


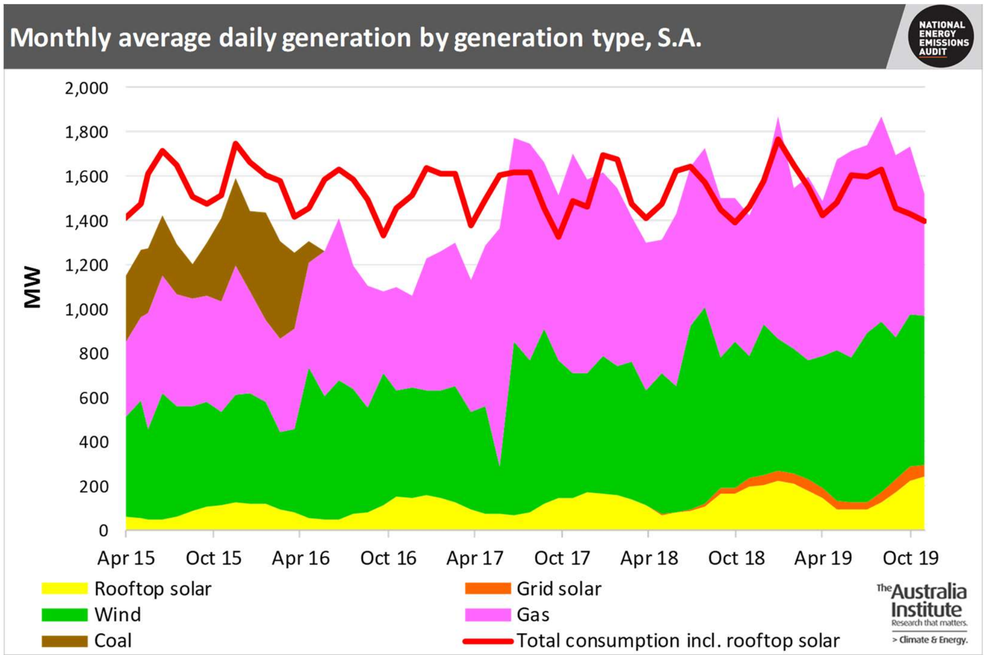
Figure 7



Tracking the transition in South Australia

The electricity system transition to low emission supply is of course much further advanced in South Australia than in any of the three much larger NEM regions. Figures 8 and 10, which correspond, in terms of presentation format, to Figures 5 and 6 above, chart the progress of this transition.

Figure 8



In Figure 8, the white areas, below the demand line, represent net imports of energy from Victoria, while when the demand line is below total generation, the area between represents net exports.

Figure 9 shows that the growth in wind and solar generation appears to have changed the state from a net importer to a net exporter of electrical energy. As Figure 10 shows, since the very start of the NEM, in December 1998, South Australia has almost always been a large net importer of electricity.

Figure 9

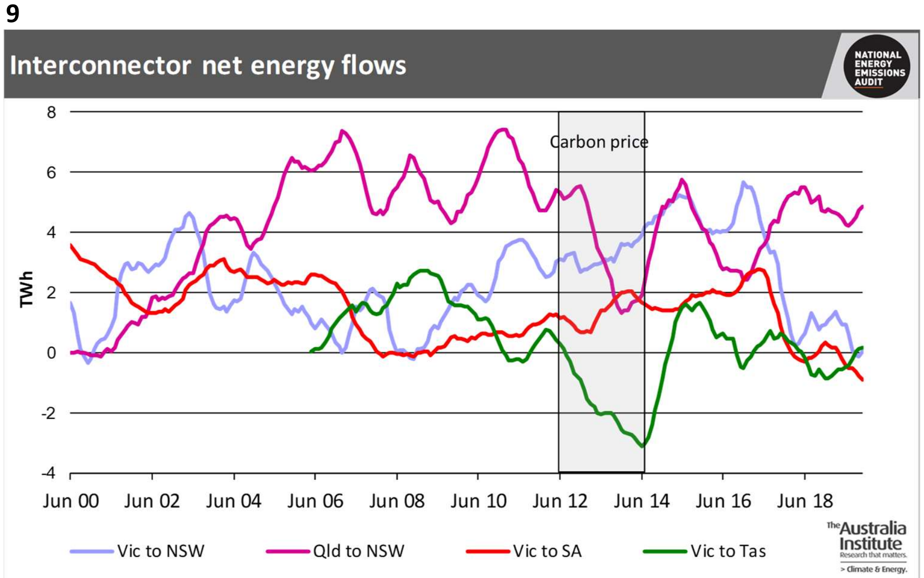


Figure 10

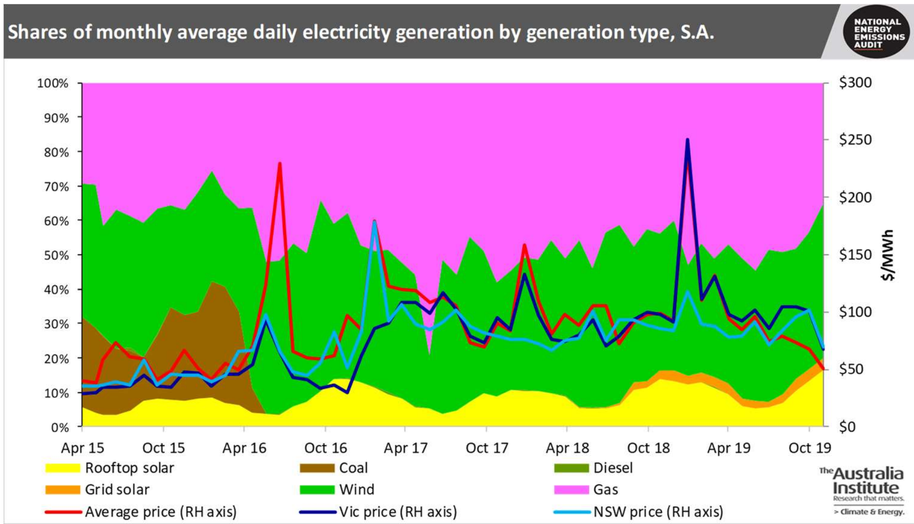
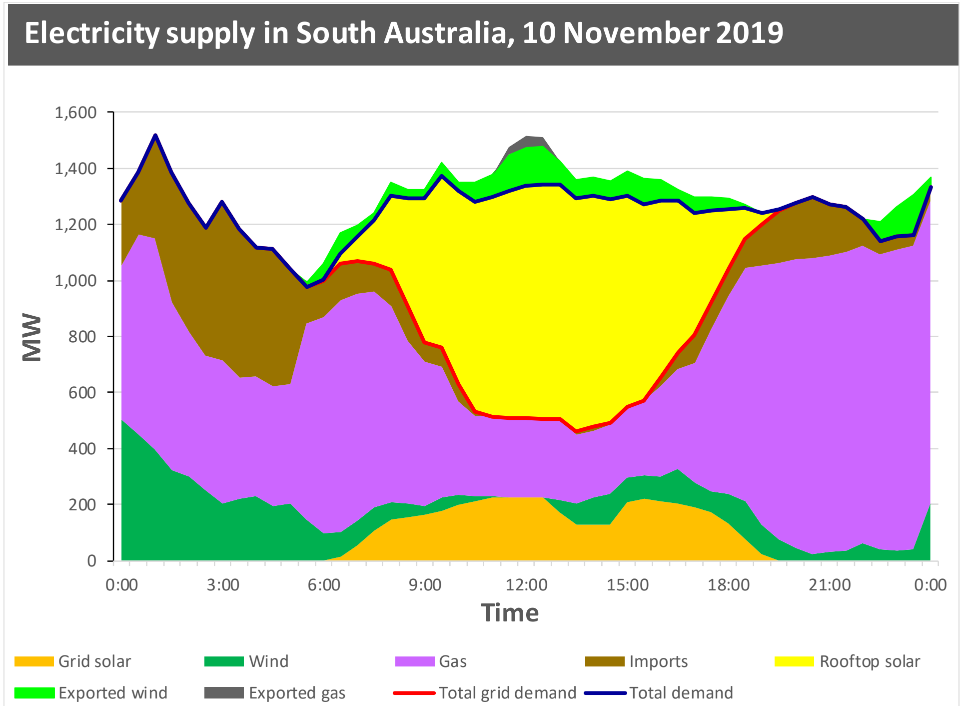


Figure 10 shows that in November wind and solar generators, including rooftop solar, supplied almost 65 per cent of the total electricity generated in the state. Also shown are simple average monthly spot wholesale prices in South Australia, Victoria and New South Wales. For most of the period shown, wholesale prices were higher in South Australia than in the other states, as has almost always been the case for the whole history of the NEM. Since mid 2017, following the closure of Hazelwood, prices in South Australia have been at or below prices in Victoria. However, since August of this year, average prices in South Australia have also been lower than those in New South Wales, and in October and November, average South Australian wholesale prices were lower than those in Queensland and Tasmania also, i.e. they were the lowest of all five NEM regions. This happened on only three previous months over the past 21 years – October 2008, March 2011 and June 2012 – and never on successive months or by such a wide margin as in November.

Figure 11



One of the biggest challenges of managing a system with a high volume of rooftop solar generation is ensuring that the grid remains in a secure operating condition at all times. The problem arises when output from rooftop solar reaches such a high level that it begins to approach the level of total electricity consumption, drastically reducing the notional requirement for supply from the grid. As currently built, all electricity grids require some supply from synchronous generators to remain in a secure operating state. Several years ago AEMO started planning for how the system would be operated under when rooftop solar reached high levels.

On Sunday November 10, rooftop solar output reached more than 60 per cent of total consumption over more than 2 hours in the middle of the day, and supply required from the grid fell to below 500 MW for the first time. Figure 11 shows generation and interconnector flows throughout the day. During the minimum period, AEMO maintained operation with just four gas fired units, all operating at their minimum stable condition:

- Two of the four 200 MW units at Torrens Island B station, operating at only 60 MW each,
- One of the two 160 MW gas turbine units at Pelican Point, operating at 120 MW, and
- One of twelve new 18 MW reciprocating gas engine units at Barker Inlet.

An update on demand for diesel in Australia

The October NEEA Report included an extensive discussion of diesel consumption in Australia. It was noted that consumption had been growing steadily for many years, and that, over the most recent two or three years in particular, the main driver of consumption growth was road transport and in particular, consumption by passenger and light commercial vehicles. It went on to note that, from January to June, consumption had appeared to slow or even reverse, which, if it persisted, could be an important turning point in the course of Australia's emissions.

Regrettably, the most recent petroleum sales data suggest that consumption growth may have resumed. Sales data for October, released in mid December, show annual diesel consumption up again, with bulk sales at a record level and retail sales also on the way back up. This is similar to the data for the months of August and September, strongly suggesting that the sales decrease earlier in the year was just a brief interruption to a pattern of growth. If this trend persists, diesel consumption will continue as a major driver of steadily increasing greenhouse gas emissions in Australia. National government failure to provide any leadership on policies to reduce motor vehicle exhaust emissions will remain as an impediment, perhaps a bigger impediment even than electricity policy failure, to Australia achieving genuine emissions reductions in the years ahead.

Which leads naturally into a discussion of the most recent quarterly update of Australia's emissions.

Australia's total greenhouse gas emissions, now and into the future

The official quarterly update of Australia's greenhouse gas emissions to June 2019

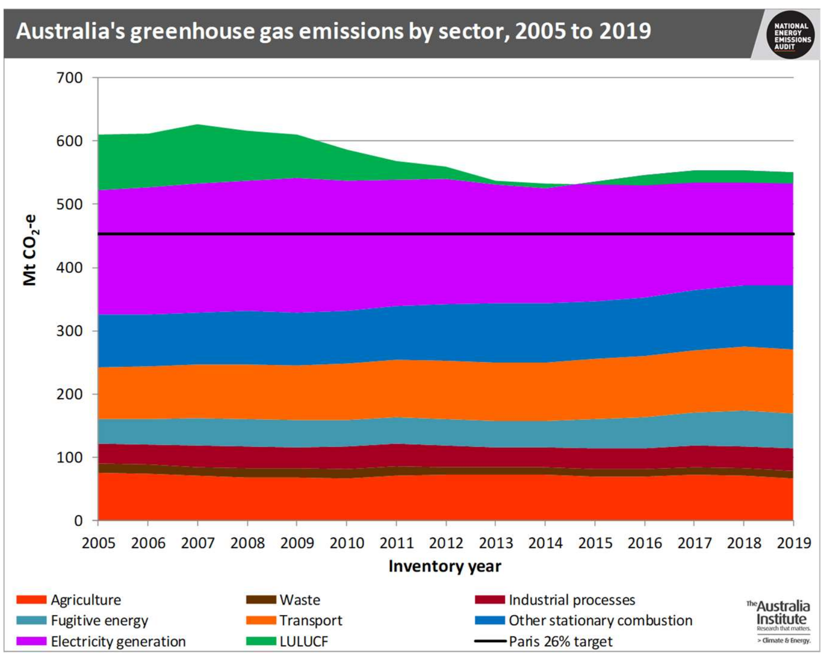
At the beginning of December the government released its *Quarterly Update of Australia's National Greenhouse Gas Inventory: June 2019*. Estimates of emissions, albeit provisional only, are therefore available for the whole year 2018-19, making it possible to construct a complete annual series up to 2018-19. In our opinion, a consistent annual series provides a far better guide to the progress Australia is making, or not making, in reducing its emissions. Not only does an annual series align with Australia's official international reporting requirements under the UNFCCC, it also the need to rely on unavoidably uncertain seasonal adjustments to construct a consistent time series. It also makes it much more difficult for any commentator who may wish to obfuscate or mislead about the reality of Australia's emissions reduction performance.

Figure 12 shows the annual trend in the major components of Australia's emissions from 2005, the base year for the Paris Agreement, to 2019. It also shows the Paris agreement target reduction of 26 per cent below 2005, to which the government says it is committed.

This graph confirms what is well known, though sometimes denied:

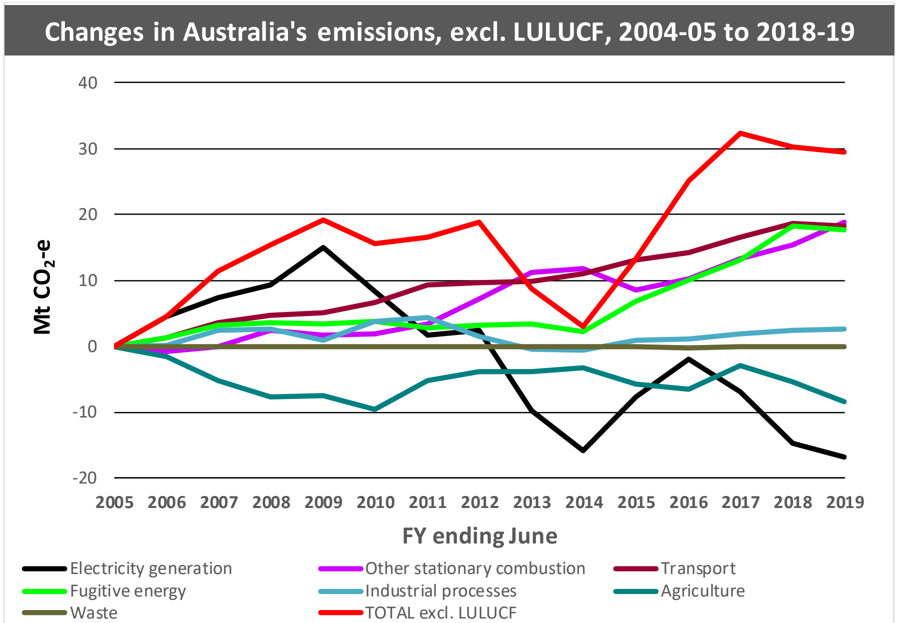
- The only major source of emissions reduction since 2005 is the major fall in land sector (Land Use, Land Use Change and Forestry, generally abbreviated as LULUCF) emissions between about 2007 and 2012, largely driven by restrictions on land clearing imposed by the state governments of New South Wales and Queensland.
- Electricity generation emissions have fallen significantly since about 2012, but nevertheless
- Combined emissions from all sources other than LULUCF have increased since 2005.

Figure 12



These trends are seen more clearly in Figure 13, which plots changes since 2005, rather than total emissions. The only sectors with decreased emissions are electricity generation and agriculture.

Figure 13



Note that reductions in agriculture sector emissions over the past two years, and also in the period 2005 to 2008, are largely attributable to the reduction in livestock numbers because of drought. Emissions associated with livestock husbandry, particularly beef cattle, account for 45 per cent of Australia's total agriculture emissions in 2017. Hence falling livestock numbers mean falling emissions, but if and when graziers re-stock after drought, emissions will increase again.

Figures 14 and 15 split the changes shown in Figure 13 into two periods. From 2008 to 2014 inclusive, the major policies introduced by the Rudd and Gillard governments were in place: the most important of these the imposition on electricity generation and some other energy related activities, and a very large increase in the Renewable Energy Target. These emissions changes are shown in Figure 14. Since the end of 2013-14 the policies of the Abbott, Turnbull and Morrison governments, included the removal of the carbon price, a reduction in the Renewable Energy Target, and establishment of the Emissions Reduction Fund. The resultant emission changes are shown in Figure 15.

LULUCF emissions have been excluded from Figures 14 and 15 for two reasons: first, because they are so large that they would swamp the other changes, and second, because they are less directly affected by commonwealth government policies as other emissions sources. That said, it is interesting to note that LULUCF emissions fell by 70 million tonnes between 2008 and 2014 and increased by about 44 million tonnes between 2014 and 2019.

Figure 14

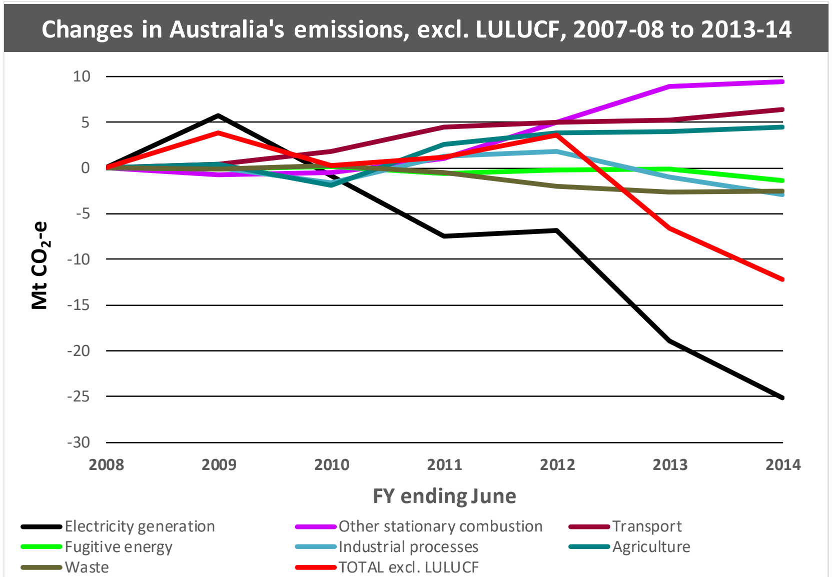
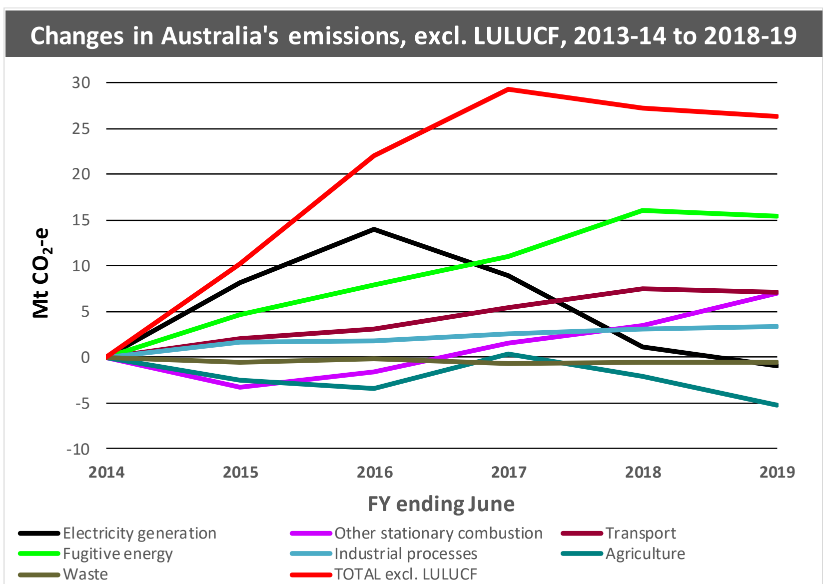


Figure 15

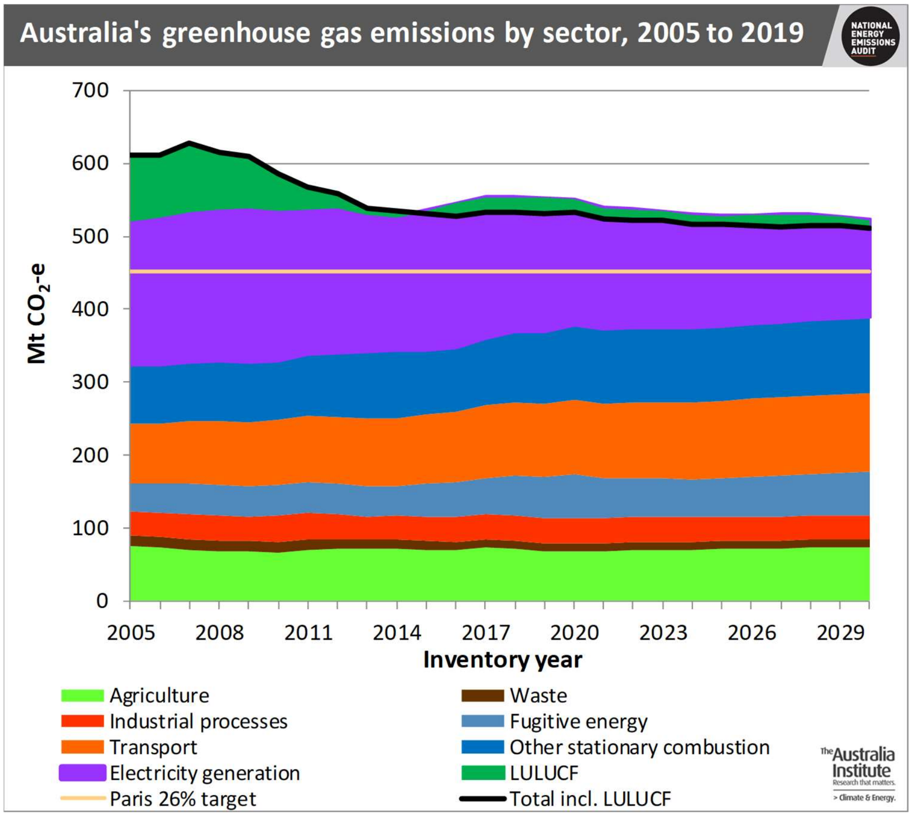


Finally, we note that the first Emissions Reduction Fund grants were made towards the end of calendar year 2014. If this policy were to fulfil the ambitious claims that were made for it, it should by now having some discernible impact on national emissions. In the early rounds, a high proportion of grants went to projects in the land sector (LULUCF) and the waste sector. The data show that waste sector emissions fell by considerably less between 2014 and 2019 than the did between 2008 and 2014, and actually increased in some years, while, as already noted, LULUCF increased strongly from 2014 to 2019. The Emissions Reduction Fund has certainly done much less to reduce emissions than the carbon price did, and it is, in fact, hard to see that it has had any effect at all.

Projections of Australia's greenhouse gas emissions to 2030

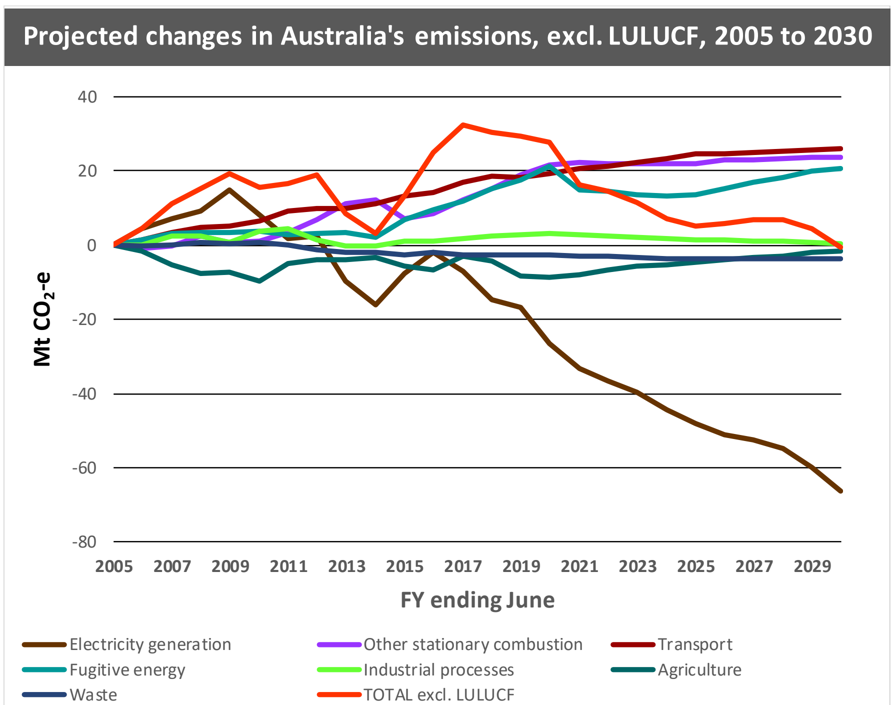
Another end of year government release was the official projections of Australia's emissions from now until 2030. Figure 16 extends the past emissions shown in Figure 12 out to 2030, by adding the official projections for each of the main sectors.

Figure 16



It can be seen that the government expects a very modest reduction of just 4 per cent in total emissions between now and 2030. Note that LULUCF emissions became negative after 2014, as vegetation growth sequestered more than was released through land use changes. This is reflected by the black Total line crossing over below the green LULUCF segment in 2014-2015. LULUCF will remain a relatively small source of CO_2 removals. Electricity emissions are projected to fall by 27 per cent between 2019 and 2030, as the electricity system transitions towards a future dominated by wind and solar generation. However, emissions from the other major sources of fossil fuel combustion emissions will continue to increase. The absence of significant policies to support more efficient consumption of petroleum fuels in transport will see emissions increase by 8 per cent, having already increased by 22 per cent since 2005. The similar lack of policies and measures to encourage either more efficient use or fuel switching away from gas in buildings, and from both gas and coal in manufacturing activities, will see other stationary combustion emissions increase by a further 5 per cent, having already increased by 23 per cent since 2005. Fugitive emissions from increased production of coal, particularly coking coal, and LNG are also expected to increase. There are no expectations of policies which would require new production of LNG from fields, such as Browse, with a high raw gas CO_2 content, to capture and sequester the CO_2, or of policies which would require more stringent abatement of methane emissions from gassy underground coal mines or continuing methane leakage from old, abandoned mines. In the industrial process sector, reduced synthetic gas emissions, as use of hydrofluorocarbons is steadily phased out, will offset continued increases in other subsector emissions.

Figure 17



The overall result is that Australia's total emission in 2030 are projected to be 13 per cent above the promised 26 per cent reduction below the 2005 level. Expressing the emissions target in this way is in fact an over-simplification, because the Paris Agreement is framed in terms of cumulative emissions over the whole period from 2021 to 2030. These projections are for cumulative emission over this period to total 5,169 Mt CO_2-e, which is 395 Mt higher than the cumulative total required to meet the 26 per cent reduction target, and 462 Mt above the cumulative total with a 28 per cent target. However, the report states that its "overachievement" with respect to Kyoto Protocol targets, for the periods 2008 to 2012 and 2013 to 2020, totals 411 Mt CO_2-e. Use of this as an offset will therefore ensure, on the basis of these projections, that the

26 per cent target will be achieved, without any further change in policy settings. However research by Climate Analytics, commissioned by the Australia Institute, found there is no legal basis and certainly main moral objections to using assigned units carried over from the Kyoto Protocol.[1]

Continuation of this current policy approach will mean that in 2030 Australia will be quite unprepared to move forward with any further emissions reductions, other than the electricity sector changes already in train. Australia's situation at that time will therefore be completely incompatible with the changes need globally to achieve a 2 degree, let alone 1.5 degree cap on global temperature increases.

[1] Climate Analytics (2019) *Kyoto carryover in Madrid* https://www.tai.org.au/content/no-legal-basis-australia-s-use-kyoto-credits

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.