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> Climate & Energy.

NATIONAL ENERGY EMISSIONS AUDIT

National Energy Emissions Audit
Electricity Update

March 2019

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

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Key points

+ Total renewable supply, including rooftop solar, is at 21.2% of generation from all sources across the NEM and growing, though growth has recently slowed because of network constraints changes and changes to marginal loss factors affecting grid scale wind and solar farms.

+ In the last three years there has been no systematic or sustained change in total demand in the NEM.

+ There has been a continuing steady three year decrease in emissions and emissions intensity in the NEM. From early 2016 to early 2018, falling brown coal generation was the main contributory factor, and since then it has been as result of falling gas generation (replaced by cheaper and cleaner renewables).

+ Rooftop solar continues to climb and is now generating about 7.5 TWh per year, equivalent to over 4% of the total electricity used. There is around 6.6 GW of rooftop solar capacity on the NEM, with the lion's share in residential rooftop.

+ Very gradual decline in gas consumption across the manufacturing, commercial and residential sectors, undoubtedly reflecting, at least in part, the effect of higher gas prices on demand for gas.

+ Transport emissions continue unfettered by any constraints and as we have repeatedly noted, unless and until Australia has a set of genuine policies directed at decisively changing the trend of transport energy consumption, transport related emissions will continue their inexorable growth.

+ Continuing growth in use of petroleum fuels for transport also presents supply security challenges.

Introduction

Welcome to the March 2019 issue of the *NEEA Electricity Update*, with data updated to the end of February 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). In this issue we also include information on trends in emissions from consumption of petroleum products and natural gas, thereby giving, in total, very good guidance to changes in Australia's energy combustion emissions as a whole.

Demand for electricity

February 2019 marked three years throughout which there has been no systematic or sustained change in total demand for electrical energy in the NEM (Figures 1 and 2), and in both New South Wales and Victoria. Over the past year, the level of demand has also become stable in Queensland, South Australia and Tasmania. This means that only in the SWIS (South West Interconnected System) of Western Australia is there apparently a continuing decrease in demand.

Figure 1

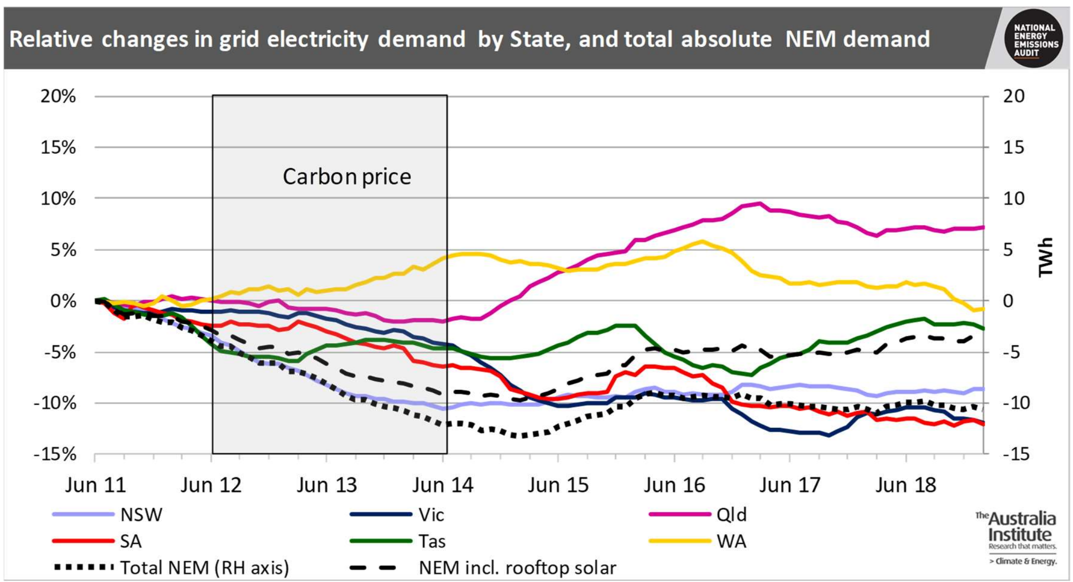
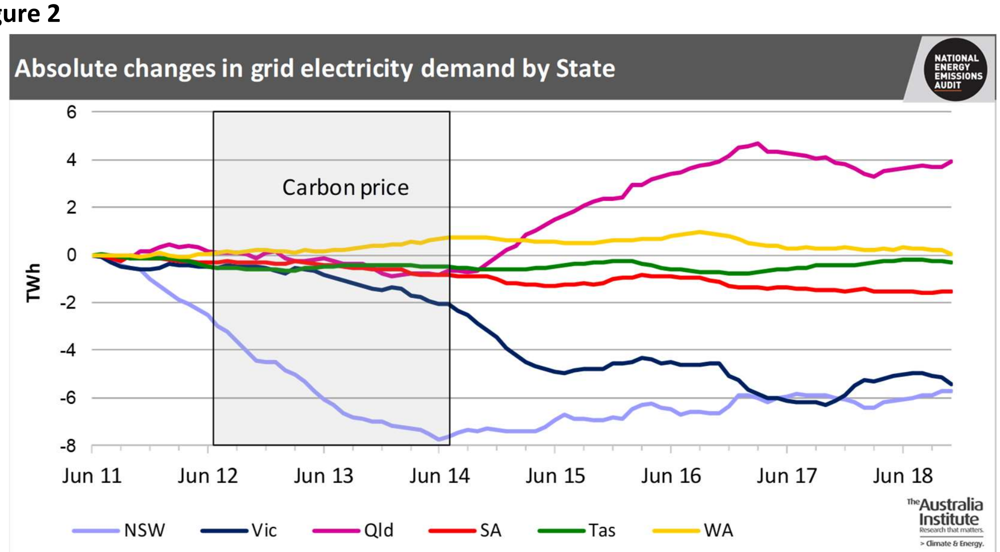
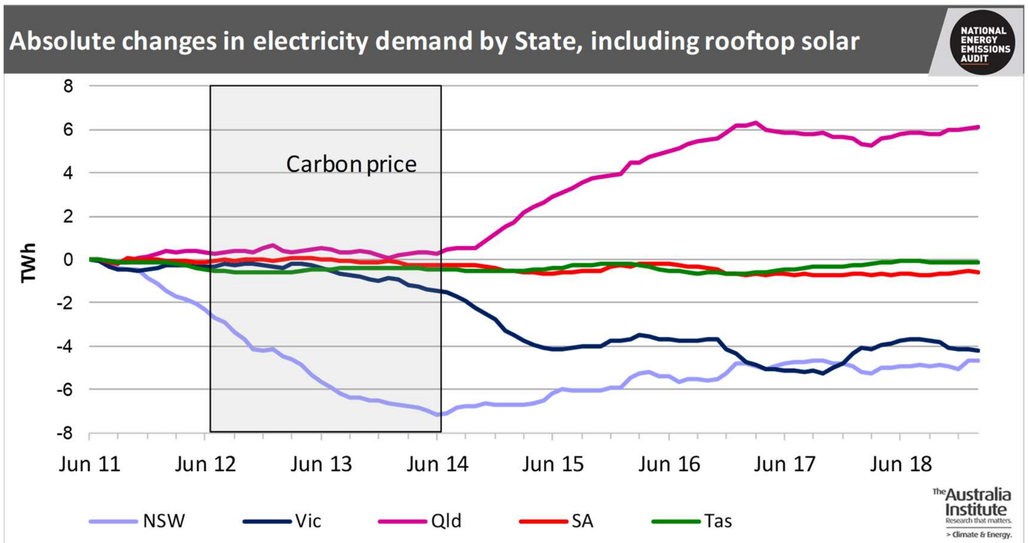


Figure 2



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. This is shown in Figure 3, which is a new graph, not previously presented. Equivalent data on rooftop solar generation in the SWIS are not available for years prior to March 2016. Since then, however, the data indicate that growing rooftop solar generation has offset much of the reduction in grid demand, shown in Figures 1 and 2, though not the sharp fall in demand since last September.

Figure 3



Generation and emissions

Figure 4 shows the corresponding slight increase in electricity supply, inclusive of rooftop solar, and the continuing steady decrease in emissions and emissions intensity seen in previous months. Interestingly, although the fall in emissions has been quite steady for nearly three years, Figure 5 shows that the contributory factors have changed over that period. For nearly two years, from early 2016 to early 2018, falling brown coal generation was the main contributory factor. Since then, falling gas generation has been the main contributor. However, with gas generation at its lowest level for well over a decade, it is possible that continuing growth of wind and solar generation will put pressure back onto coal generators. For example, with the scheduled closure of Liddell just over three years away, AGL could consider seasonal operation of one or more of its increasingly unreliable machines.

The present moment seems very much like an inflection point in the NEM. The large "pipeline" of new wind and solar farms has slowed because of the problems caused by network constraints and the partly related large changes in marginal loss factors. On the demand side, it is hard not to believe that demand for electrical vehicles must soon begin to grow in earnest, despite the complete vacuum in national policy leadership. In addition, continuing high gas prices are clearly prompting both business and residential consumers to seriously consider switching to electrical equipment, where that option is available. Meanwhile, the seemingly inexorable growth in rooftop solar continues.

Figure 4

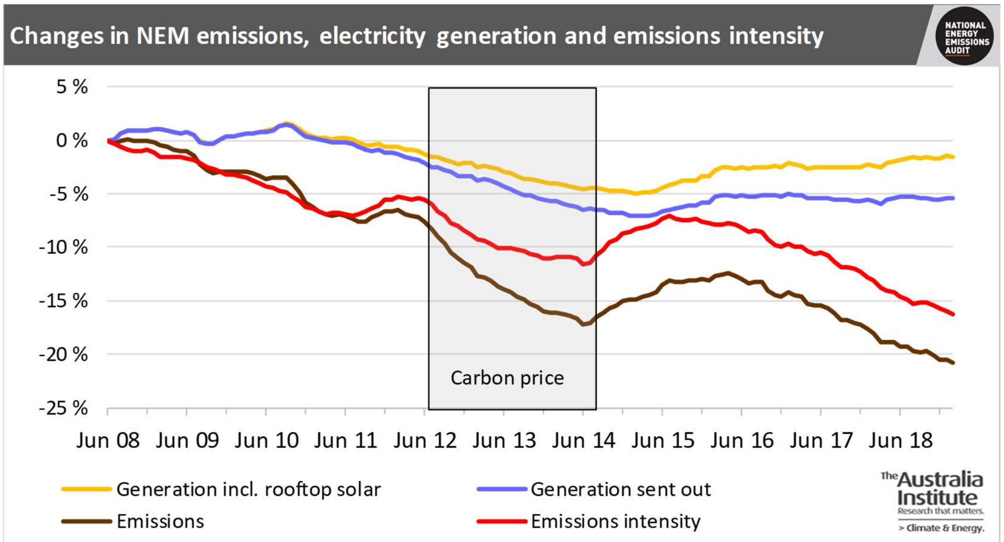
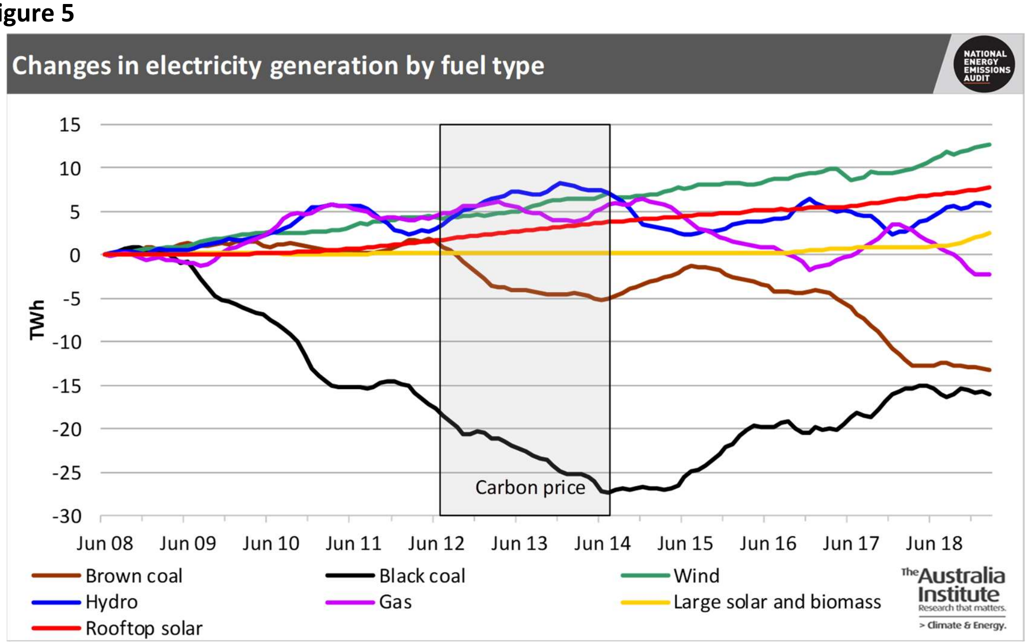


Figure 5



Growth in renewable generation in the NEM

This month, in place of a graph showing month by month shares of grid level electricity supply from grid renewable generators, Figure 6 shows the shares of total supply, including rooftop solar. The graph only runs from April 2015, because there are no reliable monthly data on total rooftop solar generation prior to that date. Figure 7 shows the same shares, but on a moving annual basis. This total renewable share of generation, calculated on an individual state basis, is an important parameter, because both Victoria and Queensland use it to define their respective renewable generation targets. For reference, the annual shares in each state in the year ending February 2019 were:

total NEM	21.2%,
New South Wales	12.0%
Queensland	8.4%
Victoria	20.8%
South Australia	52.8%
Tasmania	97.1%

Figure 6

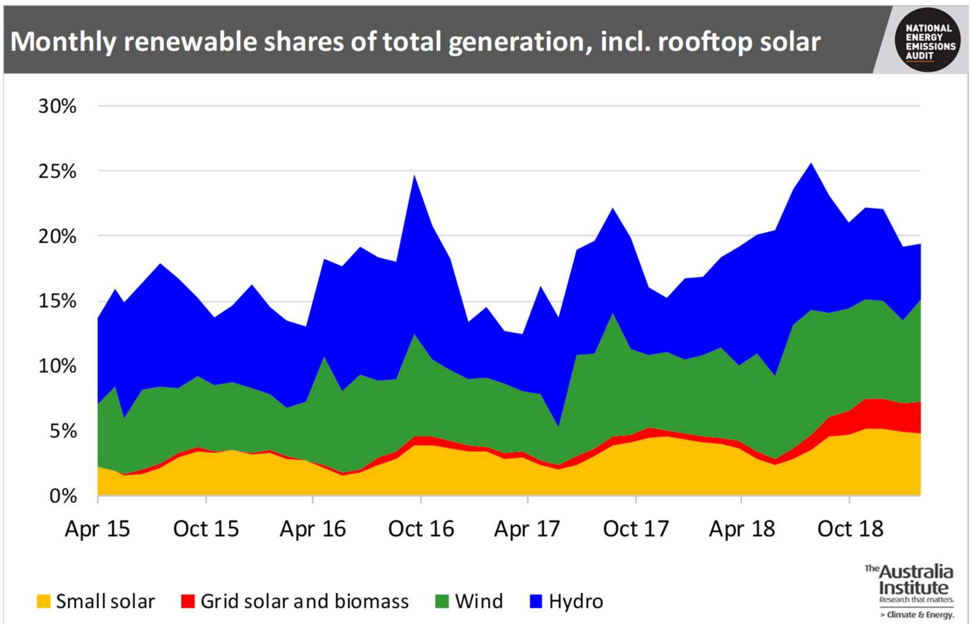
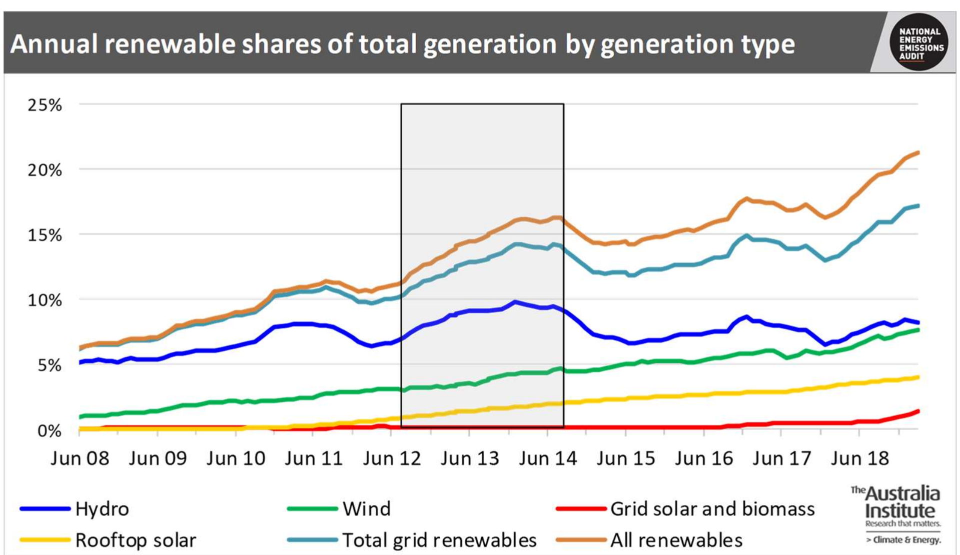


Figure 7



Readers will find more information about how these graphs were prepared and how they should be interpreted in the February 2019 issue of *NEEA Electricity Update*.

Figure 8 shows the growth in capacity of wind farms and solar farms which are connected and supplying to the NEM. As noted over the last. couple of months, the widely publicised slow-down in new connections, mainly because of inadequate transmission capacity, is clearly evident.

Figure 8

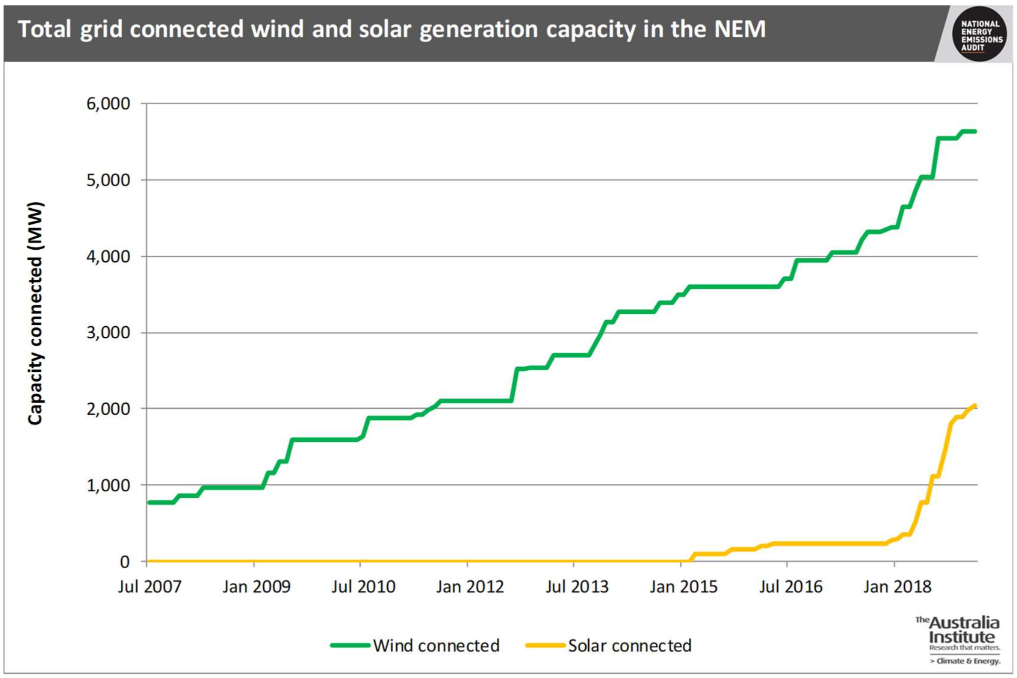
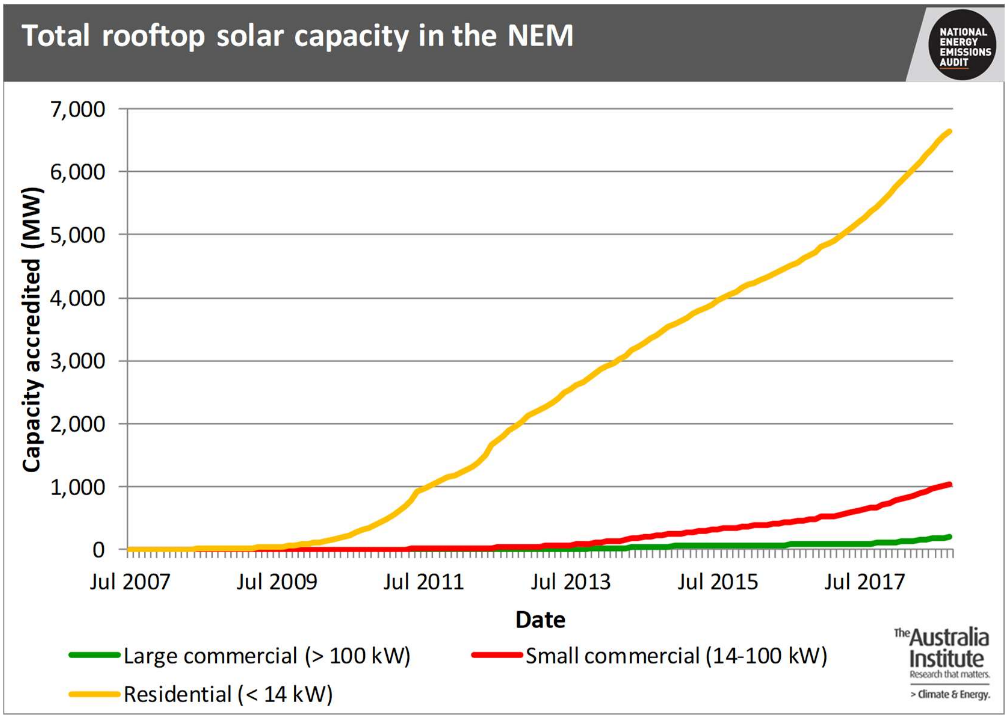


Figure 9 is a new graph, included for the first time in this issue. It uses mainly data extracted from the excellent pv-map website of the Australian Photovoltaic Institute (APVI), which provides monthly data on installed capacity of new photovoltaic systems, sorted into nine separate capacity ranges and disaggregated by postcode. For the purpose of this analysis, it has been assumed that all installations of less than 14 kW are made on residential buildings, while all installations of between 14 and 100 kW capacity are made on commercial buildings. These are plotted as, respectively, residential and small commercial installations in Figure 9. Large commercial installations are systems large than 100 kW and smaller than 5 MW, the data for which is extracted from the Clean Energy Regulator's list of new solar installations accredited under the Large Renewable Energy Target (LRET). These data were explained and graphed in the February 2019 *Electricity Update*.

Perhaps the most important feature of Figure 9 is the clear evidence of an acceleration in the rates of installation of commercial scale solar systems during the past year and a half. The February Electricity Update included a discussion of the significance of this trend.

Figure 9



Total rooftop solar capacity in the NEM
NATIONAL ENERGY EMISSIONS AUDIT
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Capacity accredited (MW)
Jul 2007
Jul 2009
Jul 2011
Jul 2013
Jul 2015
Jul 2017
Date
Large commercial (> 100 kW)
Small commercial (14-100 kW)
Residential (< 14 kW)
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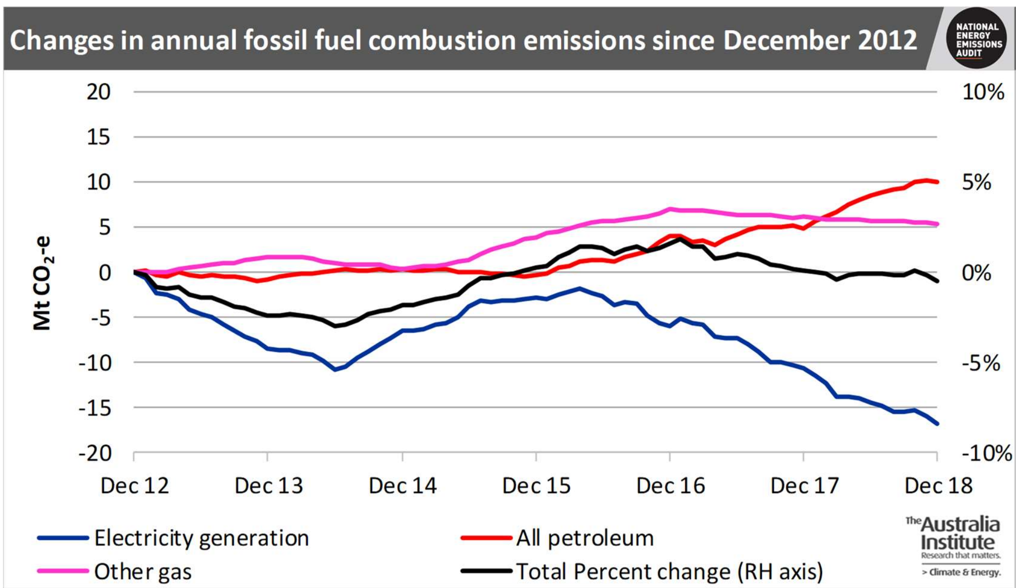
TOTAL ENERGY EMISSIONS TO DECEMBER 2018

Over the three months between September and December 2018, combustion emissions from all fossil fuel sources covered by the NEEA decreased slightly, as shown in Figure 10. This was caused by a faster rate of reduction in electricity emissions over the three month period, coinciding with a slower rate of growth in emissions from use of petroleum fuels. It is important to note that this result does not mean that Australia's combustion emissions have changed direction – a change for three months does not demonstrate that a three year trend has changed. With all three LNG plants in eastern Australia continuing to operate steadily, the trend in emissions from gas reflects a very gradual decline in gas consumption across the manufacturing, commercial and residential sectors, undoubtedly reflecting, at least in part, the effect of higher gas prices on demand for gas

Figure 10



The large contribution which the LNG industry makes to emissions from the combustion of gas in Australia was briefly mentioned in the December 2018 *NEEA Report*, and discussed at greater length in the February 2019 report. This effect is shown explicitly in Figure 11. Note, however, that NEEA does not have access to regular up to date data on gas consumption in Western Australia and the Northern Territory, which together host seven LNG plants. Hence the contribution of these plants to Australia's emissions is not included in the data shown in Figure 11. The results show that, when consumption for electricity generation and the production of LNG is excluded, gas consumption in eastern Australia is now at almost exactly the same level as it was six years ago.

Figure 12 shows changes in emissions from combustion of the separate petroleum products. It shows that the small reduction in total petroleum emissions over the three months from September to December can be explained by somewhat slower growth in consumption of diesel, combined with a somewhat faster reduction in consumption of petrol, and a continuing gradual reduction in domestic consumption of aviation fuel. As stated above, this may well be just a temporary halt to the previously inexorable growth in petroleum emissions, and certainly cannot be interpreted as a decisive change in trend.

Figure 11

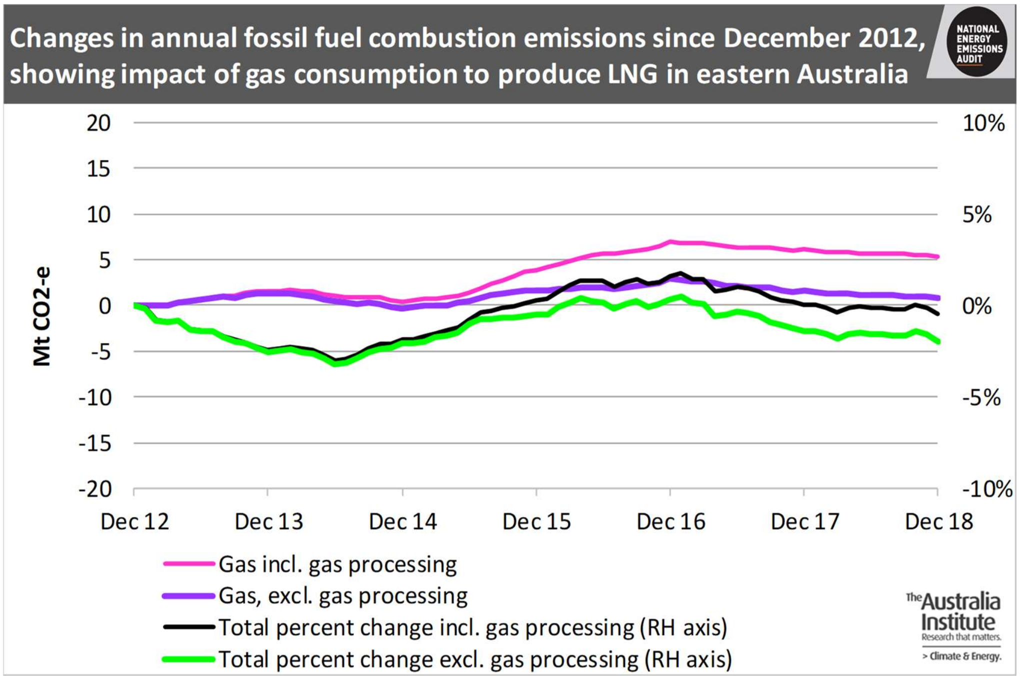
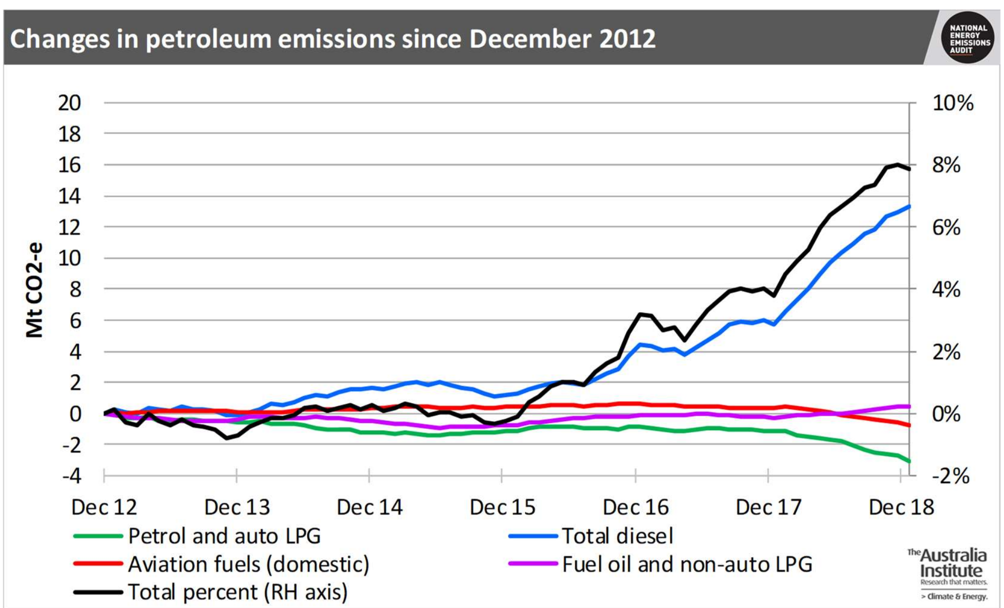


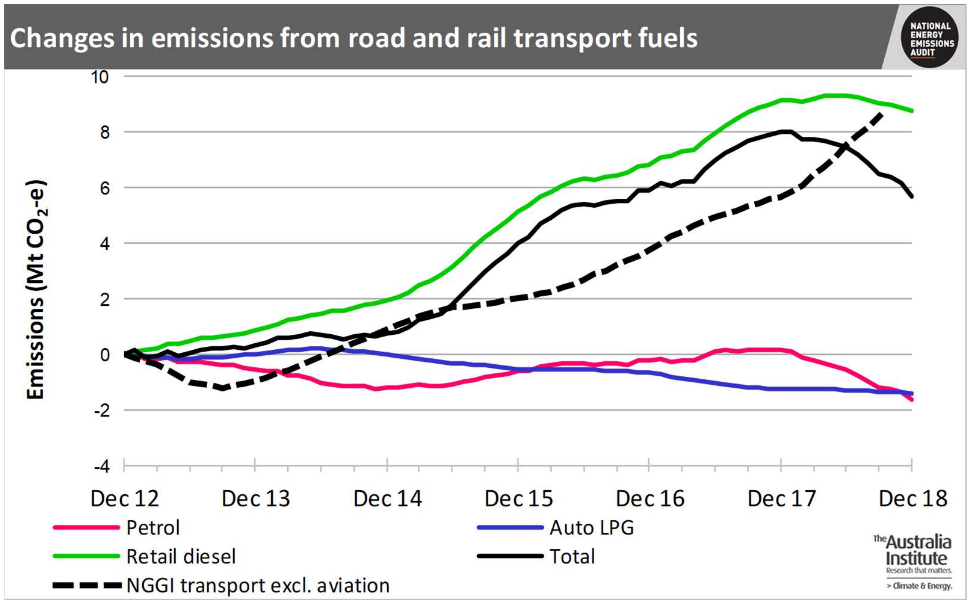
Figure 12



In fact, the best available evidence, taken from the most recently issued *Quarterly Update of Australia's National Greenhouse Gas Inventory*, starkly illustrates the comprehensive failure to curb the growth in transport related emissions in Australia. These data are graphed in Figure

13. The NGGI trend has been calculated by subtracting from the NGGI transport emission totals the NEEA estimates of emissions from domestic sales of aviation fuels. Thus the figures include emissions from use of diesel for rail as well as road transport, plus the small and declining volume of emissions from coastal shipping. In the 2015-16 NGGI (the most recent published), road transport accounted for all but about 5% of the emissions shown in Figure 13.

Figure 13



The government's NGGI figures show transport emissions continuing to grow during 2018, while NEEA data suggest a downturn over the past year. The most likely explanation for this difference is that transport related consumption of diesel supplied in bulk, including all use of diesel for rail transport and significant use for road freight (and also bus transport) has continued to grow strongly. NEEA estimates show continuing very strong growth in bulk diesel consumption, but this is not included in Figure 13, because much of it is used for electricity generation and other non-transport applications.

As we have repeatedly noted, unless and until Australia has a set of genuine policies directed at decisively changing the trend of transport energy consumption, transport related emissions will continue their inexorable growth.

Continuing growth in use of petroleum fuels for transport also presents supply security challenges. In 2017-18, imported crude oil and petroleum products supplied 97% of Australia's total consumption of petroleum products, expressed in terms of simple volumes. When account is taken of exports from Australia, dependence on imports falls to 71% in net terms. However, about half of the exports are condensate (very light hydrocarbons), which cannot be used to any significant extent by Australian oil refineries to produce transport fuels. It follows that Australia's petroleum import dependence is well over 80% in "true" net terms.

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.