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NATIONAL ENERGY EMISSIONS AUDIT

# National Energy Emissions Audit Report

**January 2020**

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

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## Key points

- *Emissions from the National Electricity Market (NEM) continue to fall, as do emissions from non-generation gas consumption in the NEM states. Petroleum emissions fell from a peak in 2018 but in recent months began to rise again. Petroleum emissions are now approaching emissions from the NEM. In the year to December 2012 petroleum emissions were 76% of NEM emissions. In the year to October 2019 the ratio had grown to 93%.*

- *While earlier declines in diesel sales suggested transport emissions might start to fall, this decline has now stopped. At the same time, petrol and auto LPG sales have fallen now for two years, even without transport emissions policy.*

- *Falling emissions from the NEM are driven by more renewable energy and less coal. In the year to the end of December 2019, coal power stations supplied 67% of generation, down from 74% three years ago and 82% ten years ago. This is due to falling brown coal generation in Victoria. Black coal's share of NEM generation fell during the carbon price period, but subsequently rose again and is now still as high as in 2010.*

- *In terms of renewable generation share by state, Queensland saw the fastest growth, however it will need to accelerate to meet Queensland's 50% by 2030 target. If Victoria's growth trend continues it is likely to meet its target. However, growth is now threatened by grid constraints and policy uncertainty.*

- *Gas generation in the NEM is flat and in other sectors (excluding WA) gas use is falling. Growth in gas consumption has been driven by making liquefied natural gas (LNG) for export.*

- *Gas and coal export industries are heavy domestic emitters, including from direct consumption of diesel and gas, electricity consumption and fugitive emissions. Despite being the smaller export, in terms of energy content, LNG is a larger domestic emitter than coal exports and is still rising.*

- *Total emissions linked to gas and coal exports are estimated to have been 71 $MtCO_2$-e in 2016-17, equal to 13% of Australia's total emissions in that year, higher still in later years and higher in the future if exports keep growing. This is almost as large as total emissions from agriculture, and larger than direct energy combustion emissions in manufacturing, other mining, commercial and residential sectors combined.*

# INTRODUCTION

Welcome to the January 2020 issue of the NEEA Report, updated to the end of October 2019, and for electricity to the end of December 2019 emissions. Details on data sources and methods are included in the appendix.

This issue looks first at total energy combustion emissions to the end of October. Petroleum emissions have again begun increasing, approaching the scale of NEM emissions, which continue to fall. The trend of falling diesel consumption seen during the first half of 2019 has now ended, as foreshadowed in the December NEEA Report, however the renewed growth is modest. In addition, there appears to be a more rapid fall in natural gas consumption. The overall consequence is energy emissions are continuing to fall.

This issue then examines the emissions associated with extracting and processing coal and gas for export from Australia. Domestic emissions caused by Australia's large coal and gas exports are estimated to have been 13% of Australia's total emissions in 2016-17. The significant emissions from gas consumed in the Queensland LNG projects are shown in the context of other gas consumption.

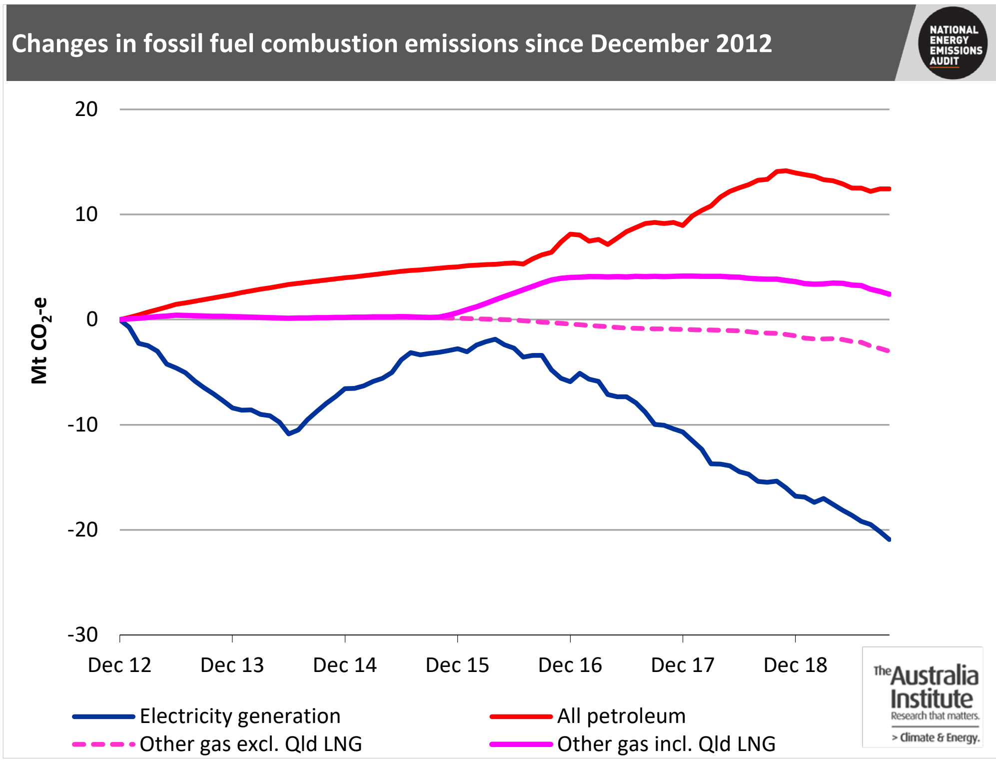
Turning to electricity, data to the end of December 2019 show the continued steady growth in renewable generation and associated fall in emissions. Two new graphs are included, showing the ten-year trend in total renewable generation by state and the consequent renewable share of total generation in each state.  These data allow ready assessment of how states with formal renewable targets are progressing towards their targets, and makes it easy to compare their performance with those of states without targets.

# OVERVIEW OF MAIN TRENDS

Figure 1 shows energy combustion emissions to October 2019. The emissions data are expressed as running annual totals for emissions from the National Electricity Market, all petroleum, and non-electricity gas consumption, excluding Western Australia and the Northern Territory. This gas consumption is shown with and without consumption for LNG production in Queensland.

The NEEA emissions data cover over 80% of Australia's total energy combustion emissions: 82% of the 2016-17 National Greenhouse Gas Inventory total and 81% of the 2018-19 total estimated in the government's most recent Quarterly Update. NEEA covers about 60% of Australia's total net emissions, i.e. including all other sources. As noted above, the NEEA figures do not cover the substantial gas consumption in Western Australia.

**Figure 1**




Key features of the trends over the past few months include the following.

- Total petroleum emissions are no longer falling, but have not reverted to the strong growth experienced up to the end of 2018.
- The previous gradual fall in emissions from non-generation consumption of natural gas appears to have accelerated. Note again these data do not include the large gas consumption in Western Australia.
- The steady decline of emissions from electricity generation is continuing.

- The overall outcome is that total reported emissions fell at a rate of over 2% p.a. during August, September and October 2019.

Figures 2 and 3 show the same data as Figure 1 but as total emissions, rather than changes in emissions relative to a December 2012 base. In Figure 2 each emission category is shown separately, whereas in Figure 3 the data are stacked.

**Figure 2**

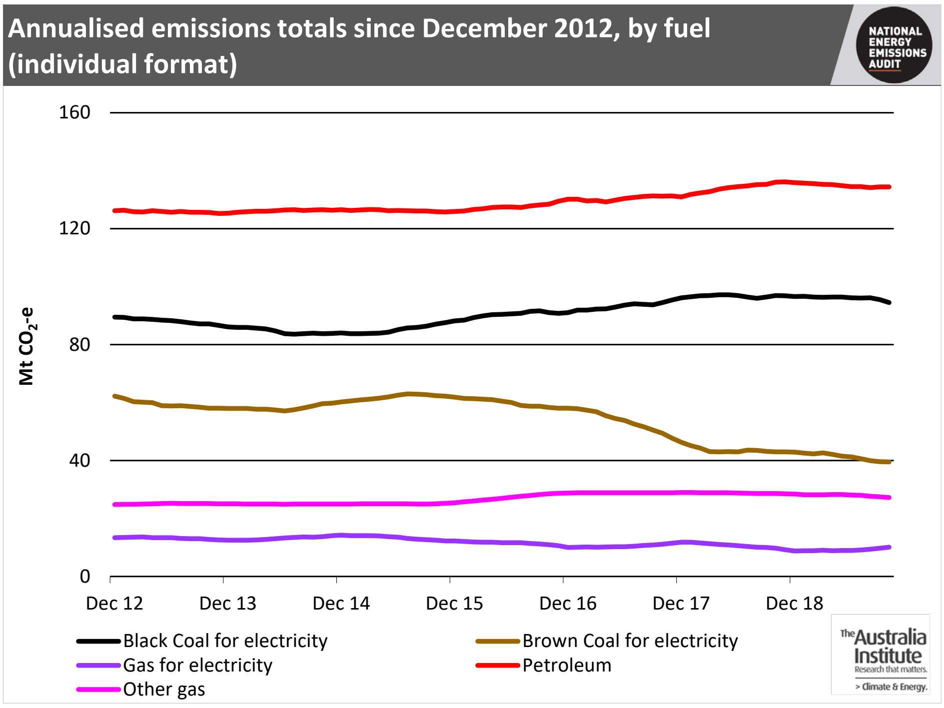
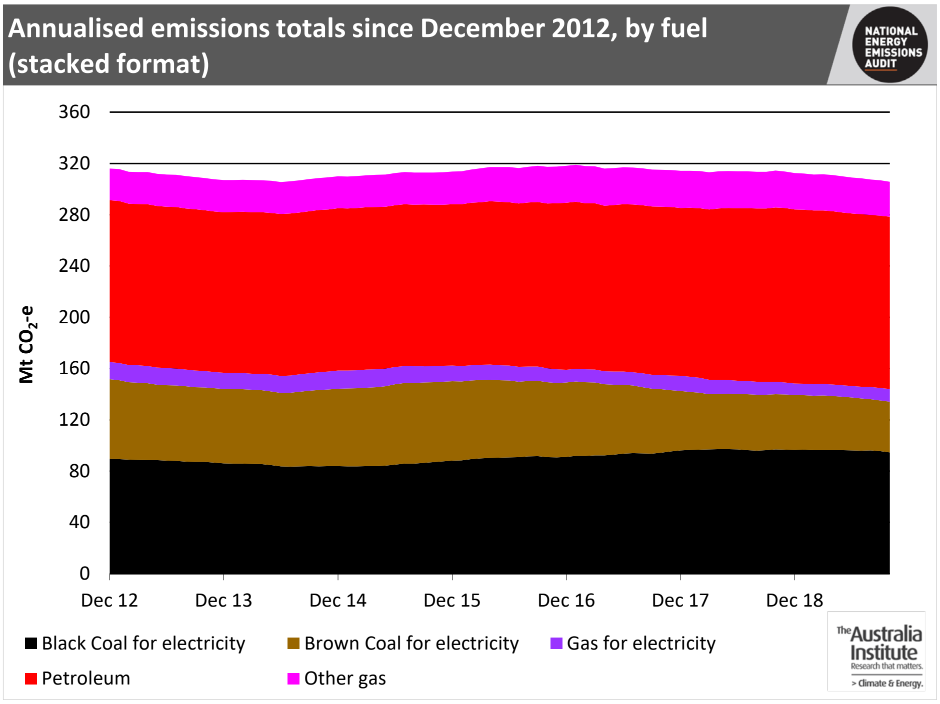



**Figure 3**



The graphs show petroleum emissions rising over the period until very recently and NEM electricity generation emissions falling, mainly because of a drastic reduction in emissions from brown coal generation as a result of the closure of Northern power station in South Australia in May 2016 and Hazelwood in Victoria in March 2018. Petroleum combustion emissions are now approaching emissions from the NEM. In the year to December 2012 petroleum emissions were 76% of NEM emissions. In the year to October 2019 the ratio had grown to 93%.

Public discourse about how to achieve decisive reductions in Australia's emissions is almost exclusively confined to debate about the transition to zero emission electricity generation, and significant emissions reduction policies, such as they are, are similarly narrowly focussed. These data make it quite clear that the debate and policy must include a greater focus on petroleum. New policies and programs are needed to reduce consumption of petroleum fuels, particularly in road transport.

Figures 4 and 5 look in more detail at emissions from use of different petroleum products. The unusually smooth trend up to June 2016 arises from the use of annual *Australian Energy Statistics* figures to chart diesel consumption. After that date, it became mandatory for petroleum refiners, importers and distributors to report monthly sales, with the consequent elimination of inconsistent and incomplete reporting of diesel sales, which had previously plagued *Australia Petroleum Statistics*.

**Figure 4**

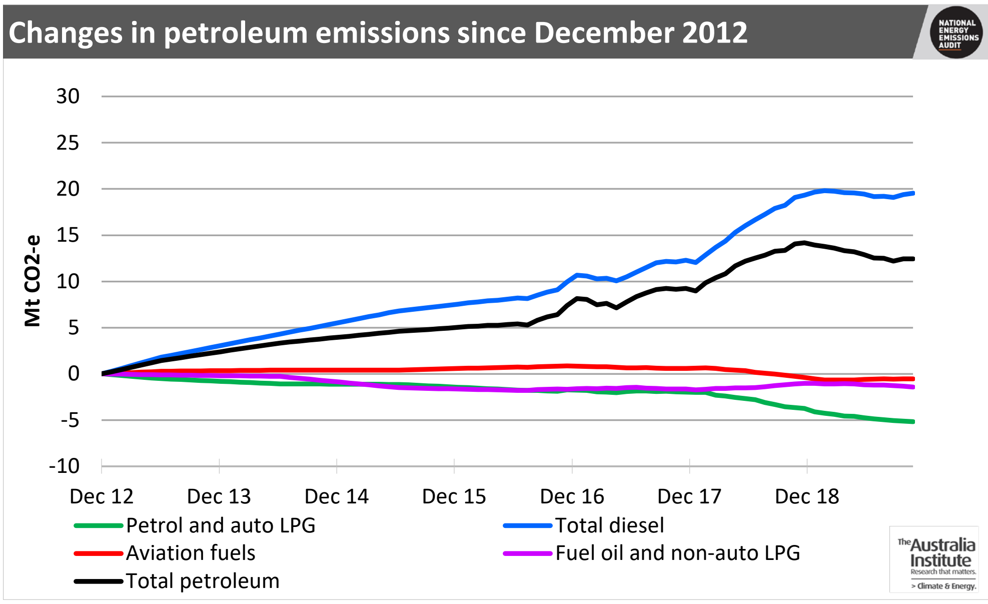
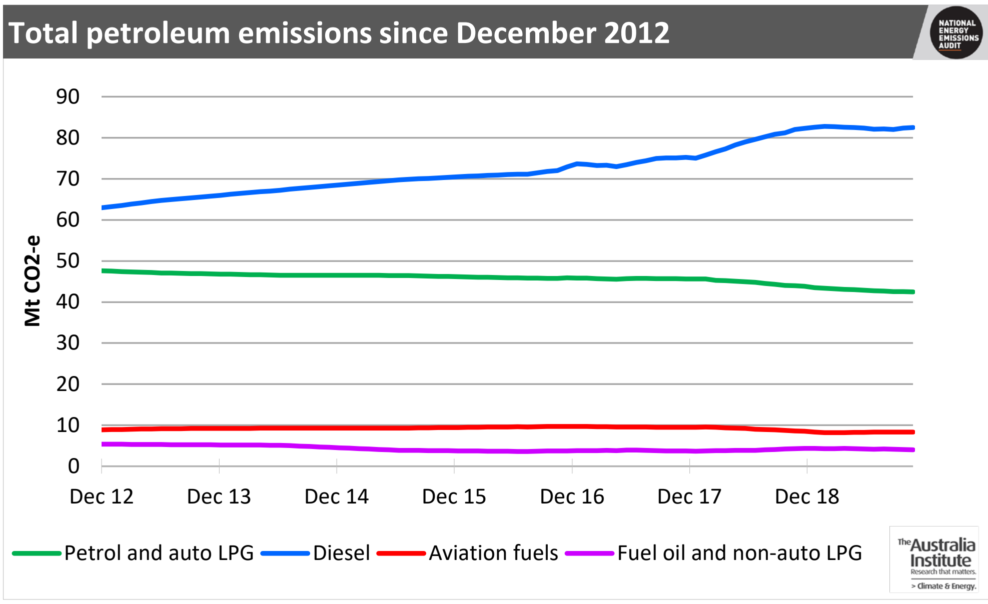


**Figure 5**




Regular readers will recall that the October 2019 NEEA Report examined trends in diesel sales and concluded that the main driver of the slow down in growth was reduced sales for road transport. Figure 4 shows there has also been a clear reduction in sales of petrol and auto LPG. Since these fuels have no significant use other than road transport, it is safe to say that the limited overall slow down in growth of emissions from petroleum fuels as a whole has been caused by reductions in petroleum consumed for road transport.

In addition to falling petroleum use, it has been widely reported that sales of new passenger vehicles fell during the second half of 2019. These changes have occurred without any significant policy aimed at reducing petroleum use. They indicate significant potential for policymakers to launch new policies to reduce petroleum use and redirect Australia's road transport system towards a low emission future. However without policy, sustained long term reductions are very unlikely to occur and further increases in petroleum use cannot be ruled out.

# Electricity update

This section looks at changes in emissions from the NEM. Figure 6 shows changes in total annual generation and emissions up to the end of December 2019. Figure 7 shows changes in the annual shares of each main type of grid generation. Figure 8, a graph which we have not published for many months, shows the changing mix of total annual generation by each of the main generation types supplying electricity to consumers in the NEM.

**Figure 6**

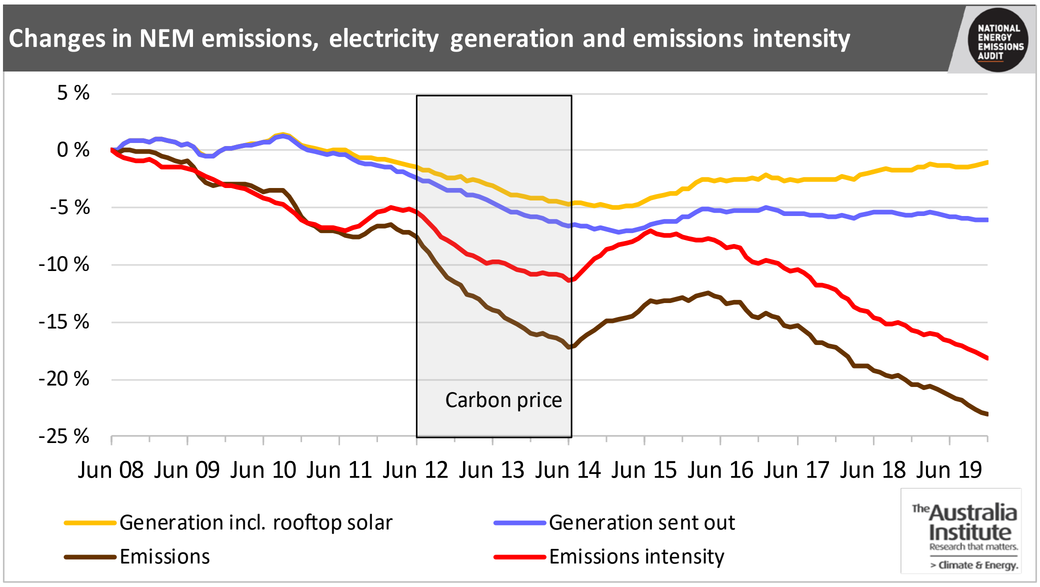



**Figure 7**

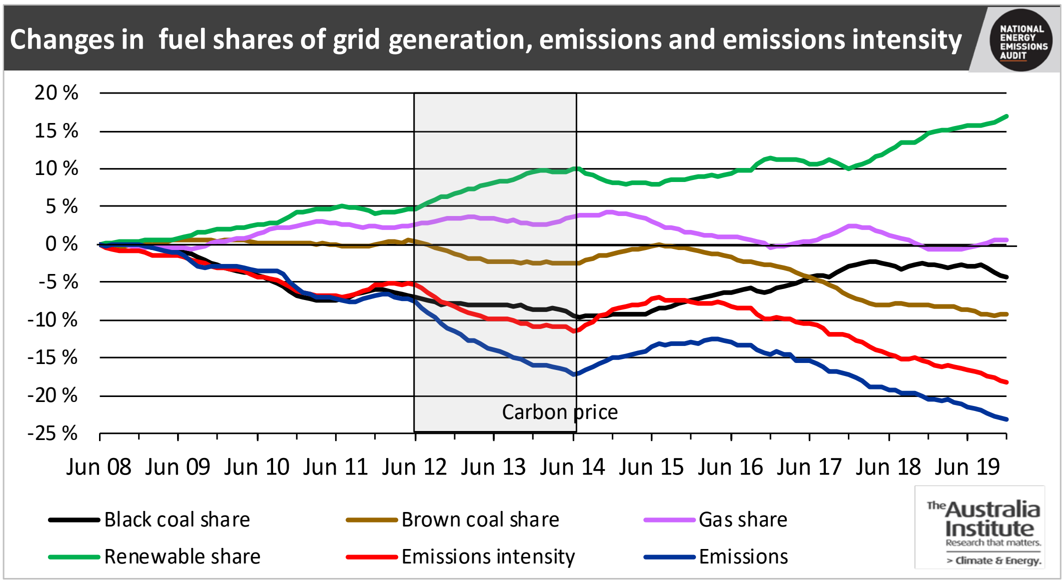
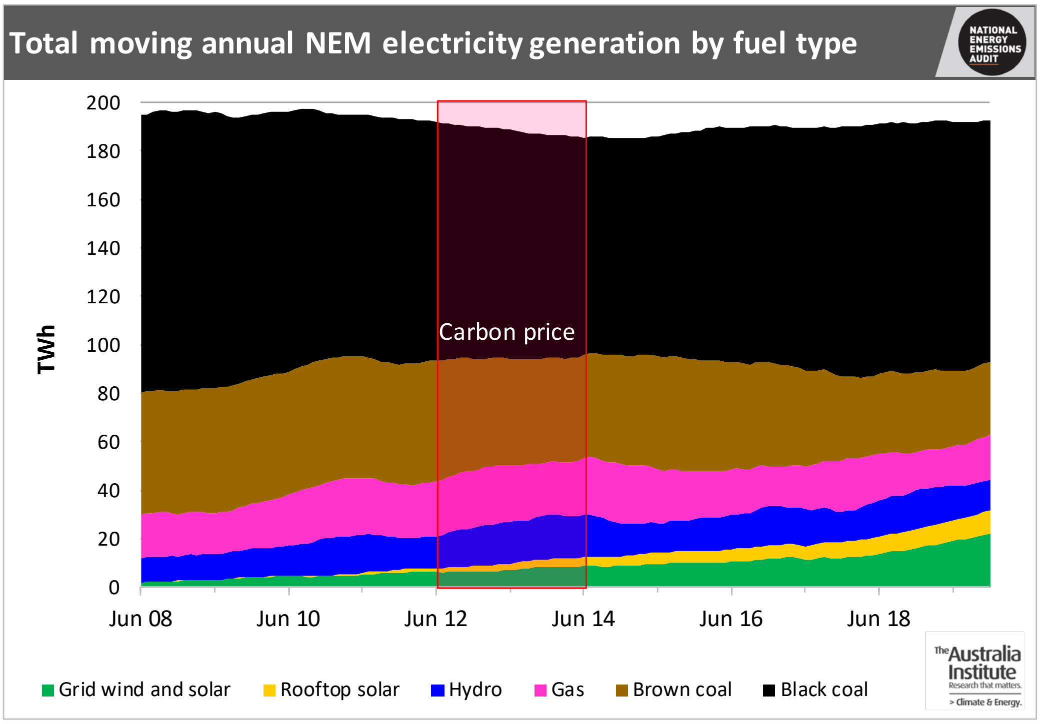


**Figure 8**




NEM emissions continue to fall, driven by increasing renewable energy and declining coal generation. In the year to the end of December 2019, the total share of electricity supplied by coal power stations was 67%, down from 74% three years ago and 82% ten years ago. Figure 7 shows this is due largely to the fall in emissions from brown coal generation, with black coal generation's share of total generation falling only slightly in recent months, remaining as high as levels seen in 2010.

Similarly, gas generation has fallen, post carbon price, to a share of total generation seen a decade ago. At the same time, renewable energy continues to increase its generation share.

## Progress towards renewable generation targets

Victoria, Queensland and South Australia all have formally stated targets for shares of renewable generation in their respective states. This month we have introduced two new graphs, showing progress in each state.

Tasmania is not included in Figure 10, because its renewable share is over 90% at most times, but the NEM total includes Tasmania.

The data include "old" hydro in all states and also a small volume of biomass (bagasse) generation in Queensland, as well as new wind and solar generation. Note that hydro generation in New South Wales and Victoria was abnormally low in 2008 and 2009 because of drought, and much of the growth during the two subsequent years reflects hydro generation in both states returning to long term average levels. Large variations in more recent years are also mainly attributable to varying hydro generation.

It should also be noted that the data for New South Wales, Victoria and South Australia have not been adjusted to allow for the wind generation which has been contracted by the ACT government and is being paid for by electricity consumers in the ACT. In this sense the data for these states in the Figures somewhat overstate their progress towards policy goals, or put differently, have been achieved in part due to ACT government policy. The annual contracted volumes are roughly 1.1 TWh from South Australia, 0.7 TWh from New South Wales and 0.4 TWh from Victoria.

**Figure 9**

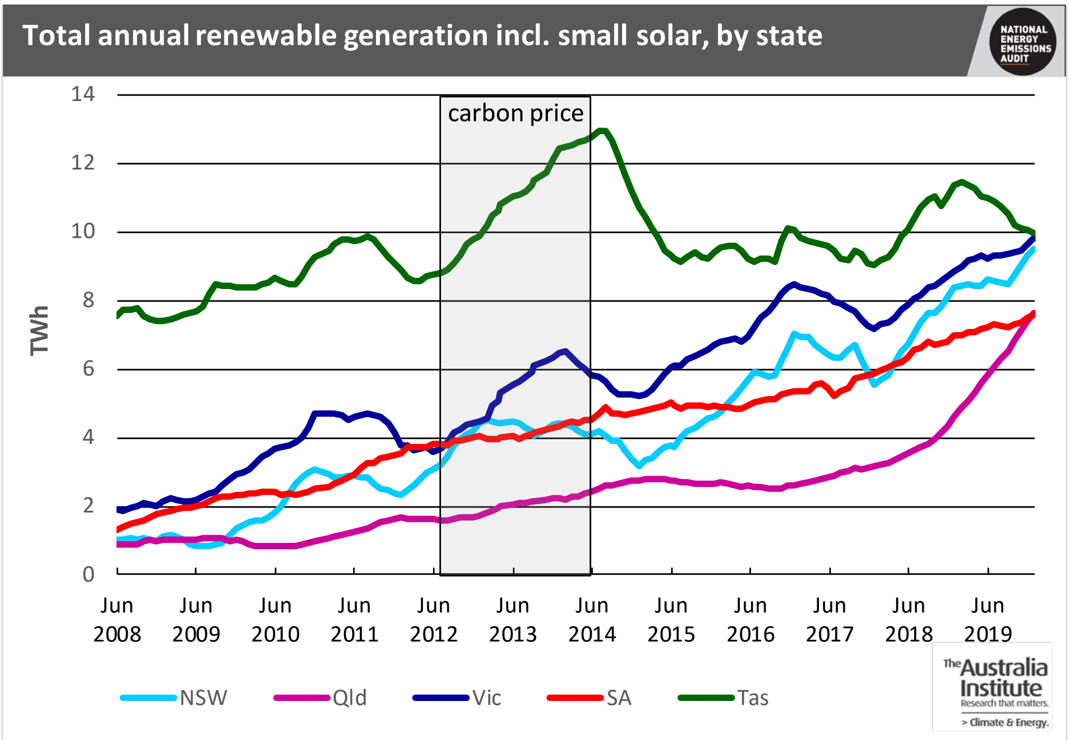
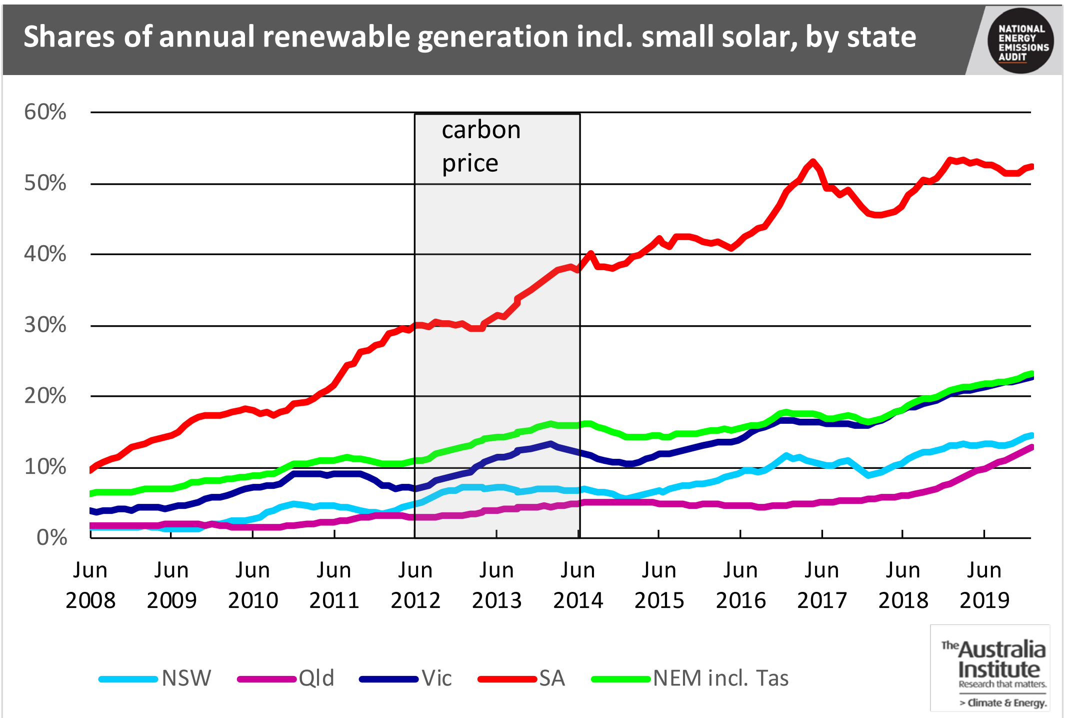


**Figure 10**




The two Figures show that South Australia, with its much smaller total generation, is well ahead in terms of renewable share, but in absolute terms is similar to the other states, though it does not, of course, have the hydro "legacy" of the other states. In absolute terms, Victoria and NSW are now just behind Tasmania. In terms of renewable shares, New South Wales and Queensland clearly trail the other states, but the trend is upwards, in particular in Queensland.

The Victorian targets for renewable generation share are 25% of total generation by 2020, 40% by 2025 and 50% by 2030. The data shown in Figure 9 suggest that these will all be achievable if growth in wind and solar generation continues at the same average rate as has been achieved over the past five years. Queensland has a target of 50% renewable generation by 2030. If this is to be achieved, renewable generation will have to grow even faster than has been achieved over the past eighteen months. This will almost certainly require more decisive action by the state government, such as the reverse auctions conducted by the Victorian government. New South Wales has no formal target other than an aspirational net zero emissions by 2050. South Australia also has no formal target, but expects to reach 75% by 2025.

Unfortunately, however, several published analyses of the most recent data on planned new renewable generation investments have suggested that has been a distinct slowdown, for which two main factors have been blamed. The first factor is the continuing lack of clear national policy directed towards reducing electricity generation emissions. The second factor is the delay in approving and undertaking new transmission investment, which is itself ultimately attributable to the lack of policy direction over recent years. Substantial new investment is needed to allow new wind and solar generators to connect to the NEM grid without compromising the overall security of the grid as a whole. This situation is causing AEMO to impose long delays in granting approvals for new generators to start supplying into the NEM, and, when they do start, imposing large discounts to the generation volumes for which they are paid, in order to meet the costs of transmission losses.

Sustaining renewables investment requires policy certainty and substantial grid planning. While a clear national policy framework would be preferable, in its absence, state level policy is essential.

## Emissions in Australia from coal and gas export industries

This section estimates domestic emissions from coal and gas export industries.

Australia is the world's third largest fossil fuel exporter, by $CO_2$ potential on combustion of exported fuel. These emissions are more than double Australia's domestic emissions, but occur outside of Australia's territory, and so outside of the NGGI. Yet the coal and gas export industries themselves cause substantial emissions within Australia. LNG production for export has been a major driver of recent increases in national emissions. Coal mining is also highly emissions intensive.

Domestic emissions from fossil fuel export industries arise from two main sources. The first is energy combustion emissions, both direct and indirect (scope 2) associated with electricity generation. Direct emissions arise from the use of diesel to mine coal in New South Wales and Queensland, and to extract and process raw gas, and convert it to LNG, in Western Australia, the Northern Territory and Queensland. Scope 2 emissions arise from electricity, also used to mine coal in both New South Wales and Queensland, and to extract coal seam gas in Queensland. The second source of emissions is fugitive emissions, which arise from both coal mining and from various stages in the extraction and processing of gas to LNG.

While all companies producing LNG and most companies mining coal for export are required to report their emissions under National Greenhouse and Energy Reporting Scheme (NGERS), the publicly reported data is highly aggregated and does not show export coal mining and LNG activities separately from other activities.

We have used the most recent (2016-17) National Greenhouse Gas Inventory and Australian Energy Statistics data for the same year to make an estimate of these totals. The major components are as follows.

- For coal:
  - Energy combustion emissions arising directly from consumption of diesel and indirectly from consumption of electricity to mine coal in Queensland and New South Wales.
  - Fugitive methane emissions from coal mining.
  - Both combustion and fugitive emissions are pro-rated by the share of exports in total black coal production.
- For LNG
  - Energy combustion emissions arising from gas consumed in what is termed Oil and gas extraction in the energy statistics in Queensland, Western Australia and the Northern Territory, net of estimated shares of this consumption attributable to domestic gas consumption.
  - Energy combustion emissions from the gas used at LNG plants for self-generation of electricity (this is reported under Electricity generation, not Oil and gas production, in the energy statistics).
  - Indirect energy combustion emissions from electricity used to power pumps and compressors in the Queensland coal seam gasfields.
  - The estimated share of fugitive emissions from oil and gas production and processing in the three states attributable to gas production for export.

The resultant total estimates for 2016-17 are as follows.

| | | |
|---|---|---|
| Export coal mining: | energy combustion | 11 Mt $CO_2$-e |
| | fugitive | 22 Mt $CO_2$-e |
| | Total | 33 Mt $CO_2$-e |
| LNG: | energy combustion | 25 Mt $CO_2$-e |
| | fugitive | 22 Mt $CO_2$-e |
| | Total | 38 Mt $CO_2$-e |

The combined total of 71 Mt $CO_2$-e equals 13% of Australia's total emissions in 2016-17. This is almost as large as total emissions from agricultural activities, and larger than the direct emissions from all energy used in the manufacturing, other mining, commercial and residential sectors combined.

Note these calculations are based on data from 2016-17. The 2019 Australian government emissions projections include estimated future emissions associated with LNG. The projections are 42 Mt in 2020, falling to 34 Mt in 2025 and then increasing again to 39 Mt in 2030, due to increasing production and the early spike in fugitives as new projects begin. However, none of these figures include the indirect emissions associated with electricity used in the Queensland coal seam gasfields, which we estimate to be about 3 Mt CO2-e.

Ignoring the increase in coal exports since 2017, these figures would suggest that total emissions from coal and LNG exports will increase to at least 78 Mt $CO_2$-e in 2020, which would equate to about 15% of total 2018-19 emissions.

The official emissions projections assume no new LNG projects. There is now an active proposal by Woodside Petroleum to develop the Browse project in Western Australia. The Browse reservoir has a very high share of $CO_2$ which the project will vent. Woodside plans to offset only 4% project emissions totalling 7.7 Mt per year. It is proceeds, this project will cause a significant further increase in both Australia's total emissions and the share which is caused by fossil fuel export industries.

All LNG plants in Australia use some of the gas coming into the plants to provide the energy needed to liquefy the remainder of the gas. On average, a modern LNG plant, such as the three at Gladstone, consumes about 8% of the incoming gas to power the plant. At the Gladstone plants, and also at the other six currently operating in Western Australia and the Northern Territory (and also the Prelude floating LNG plants 450 km off the coast of Western Australia), gas is used in two separate sets of gas turbines. One set is used to directly drive the compressors which do the actual liquefaction. The second set drive generators to provide all the electricity needed to operate all other components of the plant. Waste heat from the gas turbines is also used in the liquefaction process. This plant configuration means that all the LNG plants are completely independent of external electricity supply.

As it happens, none of the existing plants are located directly adjacent to connection points to a major electricity grid. However, Curtis Island, where the three Queensland plants are located, is only a few kilometres offshore from Gladstone, which is a major node in the Queensland grid. Connecting Curtis Island to the grid would allow the LNG producers to reduce their consumption of gas, by doing away with self-generation of electricity. There have been media reports that the Queensland government is seeking financial support from the Commonwealth to fund the required transmission link, arguing that this would make more gas available for the domestic market. It should be noted that with domestic prices set by export markets, without policy there is no guarantee as to how much 'saved' gas would be used domestically rather than exported. Further, unless the LNG plant operators choose to enter into power purchase agreements with renewable generators supplying the Queensland grid, drawing supply form the gird, dominated as it is by coal generation, is likely to increase, rather than decrease, emissions associated with LNG production.

# 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.