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National Energy Emissions Audit Report

May 2020

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

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Key points

- Apart from the achievement of reaching the symbolic 25% share mark, April 2020 was the **twenty eighth successive month in which the renewable generation share of annual generation was larger than in the previous month.**
- Over the whole two months or more since lockdown, however, there seems to be very little difference in electricity consumption this year, compared with 2019 and 2018.
- **In Victoria, over 80% of households are connected to gas supply and most use it for space heating.** Its lower in South Australia (60%), NSW (just under 50%) and small in Queensland (11%). Victoria accounts for a very large share of the total gas consumption, never falling below one third during summer, and increasing to over half in the peak winter months.
- **Gas consumption over the past six months appears to have followed the same trend as in previous years, in the context a very gradual decline,** extending back several years. There is no unambiguous evidence that the economic lockdown has affected gas consumption, except for in Victoria.
- **Victorian gas use in April was higher than in any of the preceding ten years.** This suggests in Victoria working and schooling from home has meant that many more households are using their gas heaters throughout the day.
- The higher consumption in April 2020, compared with 2019, will have increased greenhouse gas emission by about 0.2 Mt CO_2-e.
- **Compared with March 2019, the reduction in aviation fuel supplied to aircraft on international routes in March 2020 reduced by 165 ML or about 33%.** This translates to an emissions drop of over 0.4 Mt CO_2-e.
- **The corresponding reduction from domestic aviation fuel consumption was around 60 ML or 20% which equals about 0.15 Mt CO_2-e drop in emissions.** Note annual emissions from domestic aviation are about 10 Mt CO_2.
- **Diesel consumption appears to have increased sharply during March.** Supply chain security uncertainty is likely to have caused many bulk diesel consumers to fill their tanks as insurance against the risk of future supply disruptions.
- **It remains to be seen how any of this will affect apparent consumption of petrol and diesel in April.** Data should become available in mid June and could be complicated by difficulties of social distancing on public transport which will see an extreme re-bound of road traffic volumes and therefore emissions.
- **There is absolutely no road towards lowering transport emissions** and Electric Vehicles are considered a disruption rather than solution in the Technology Investment Roadmap. Hopefully the forthcoming Electric Vehicle strategy will provide a more useful roadmap to lower transport emissions.

Introduction

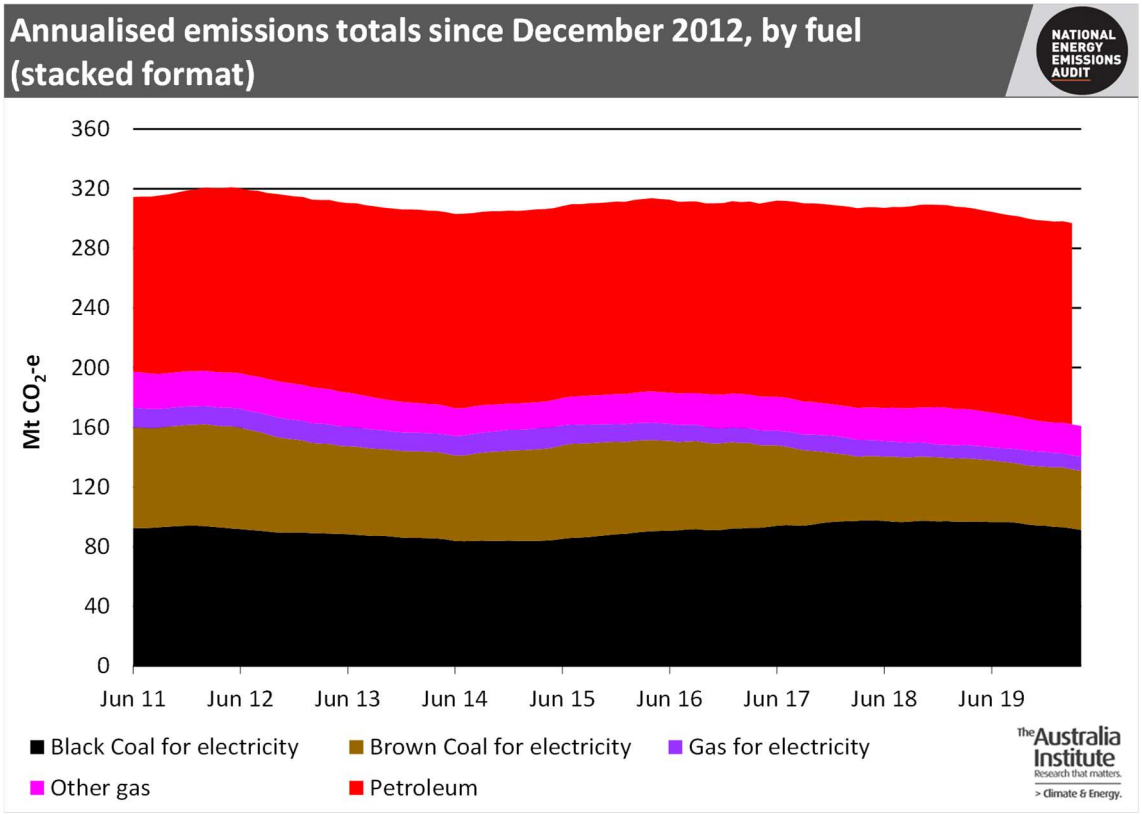
Welcome to the May 2020 issue of the *NEEA Report*, with most data updated to the end of April 2020, and some data for May. Data presented includes greenhouse gas emissions arising from: the generation of electricity in the National Electricity Market (NEM), the consumption of natural gas in eastern Australia (the area covered by the NEM), and the consumption of petroleum fuels throughout Australia.

This issue focusses on examining whether changes in either electricity or fuel consumption resulting from the pandemic response and economic slow-down are as yet apparent.

ENERGY EMISSION TRENDS

Figures 1 and 2 are updates of the graphs which opened last month's *NEEA Report*, showing respectively annual total energy emissions, and changes in those emissions, as estimated and reported by NEEA since 2011. Both graphs show moving annual emissions from electricity generation and gas consumption to the end of April 2020, and emissions from consumption of petroleum products to the end of March, as the petroleum sales data for April are not yet available. These emissions account altogether for roughly 80% of Australia's total fossil fuel energy combustion emissions. Readers interested in a detailed explanation of the changes shown should refer back to last month's NEEA Report.

Figure 1



As pointed out there, the reduction in emissions over the past four years, clearly visible in Figure 2, is entirely attributable to reduced emissions from electricity generation. Figure 2 also shows that during the two year life of the carbon price, emissions from electricity generation were reduced, as is widely recognised, but so too were emissions from natural gas used outside the electricity generation sector. It is often forgotten that these emissions were also subject to the carbon price. All emissions from combustion of petroleum products were exempt, and these actually grew faster while the price was in place than after it was removed.

Figure 2

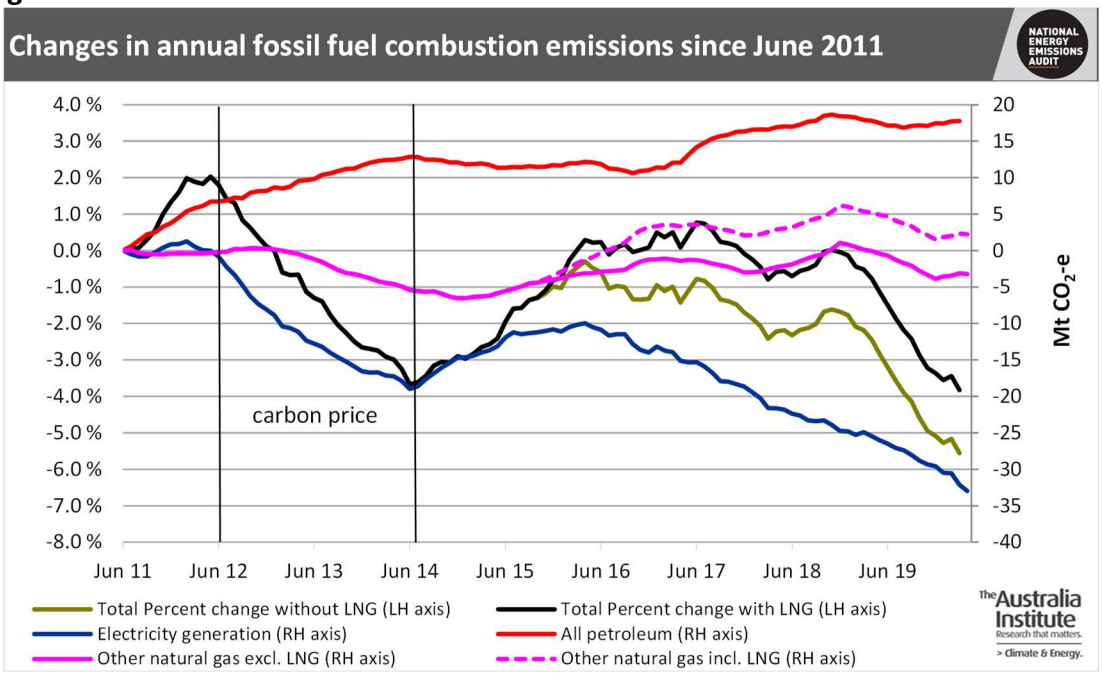


Figure 3

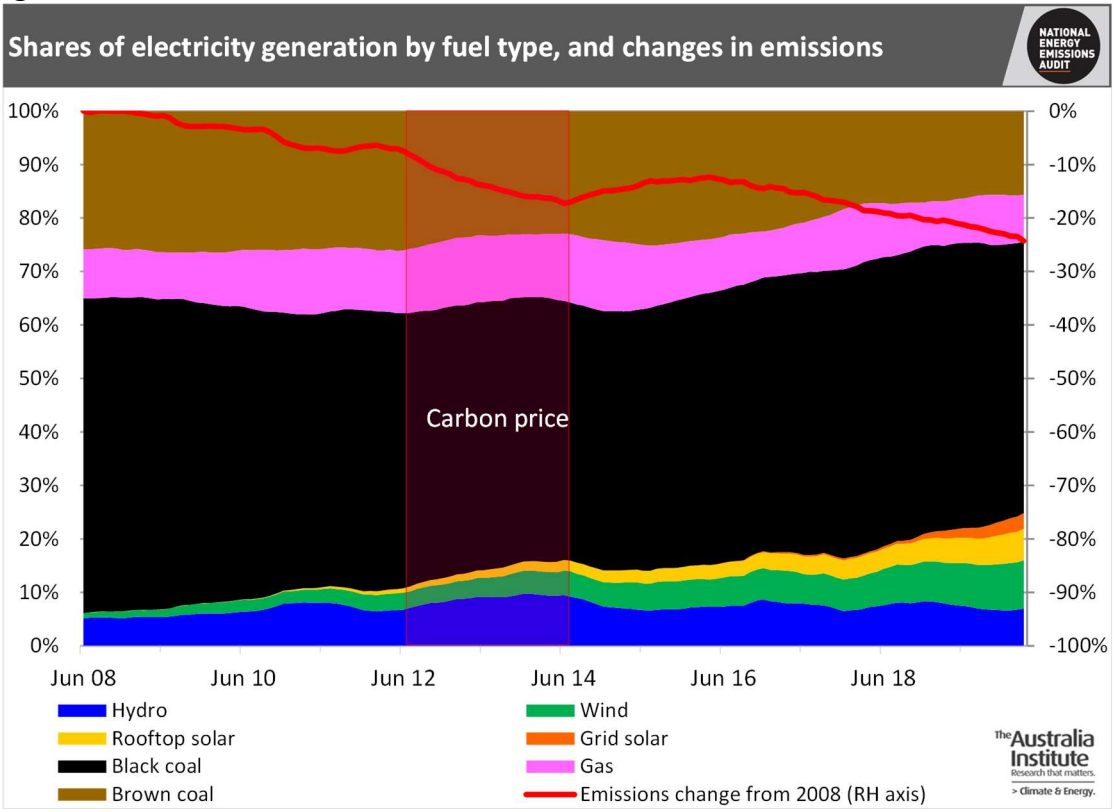
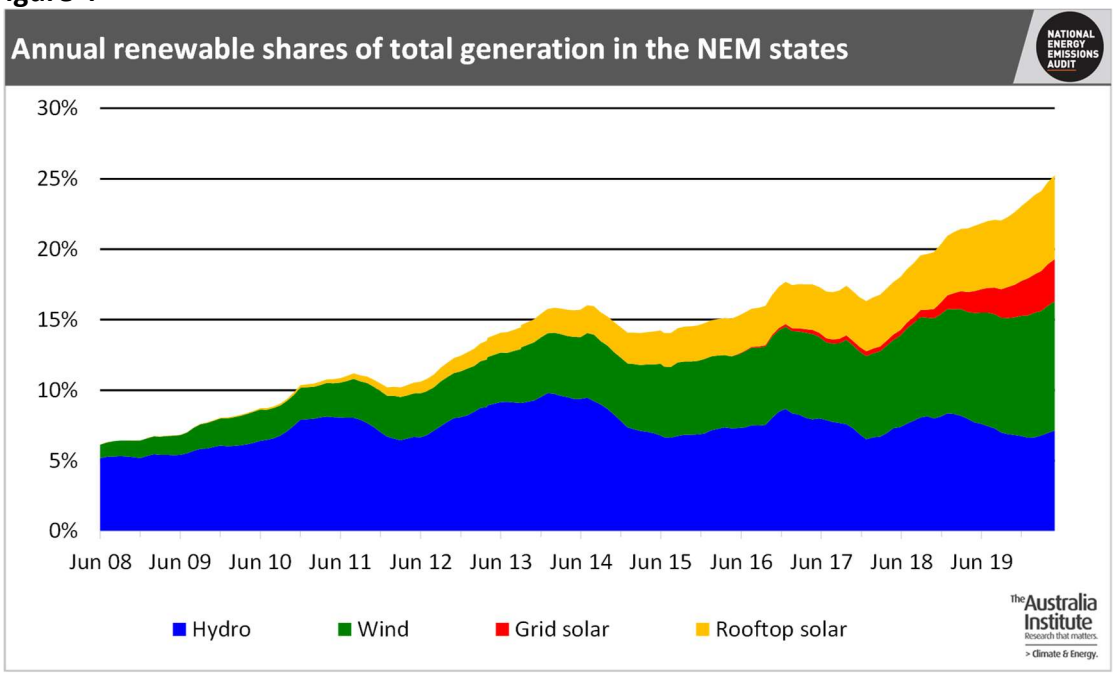


Figure 3 shows the annual shares of electrical energy supplied by each type of generation in the NEM, including rooftop solar, which supplies electrical energy through local distribution networks, rather than the NEM transmission grid. The graph runs from December 2008, when emissions from generators supplying the NEM

reached their highest ever level, and renewables generators supplied only 6.3% of electricity to April 2020 when the annual share of electricity supplied by renewable generators passed 25% for the first time. Figure 4 shows the growth in renewable generation over the same period.

Figure 4



Shares of generation in the year to December 2008 and the year to April 2020

Year ending	December 2008	April 2020
Black coal	58.6%	53.4%
Brown coal	25.8%	16.8%
Gas	9.2%	9.2%
Hydro	5.3%	7.1%
Wind	1.0%	9.2%
Grid solar	0.0%	3.0%
Rooftop solar	0.0%	5.9%
Biomass (sugar mills)	0.1%	0.1%

Apart from the achievement of reaching the symbolic 25% share mark, April 2020 was the twenty eighth successive month in which the renewable generation share of annual generation was larger than in the previous month.

The renewable share of annual generation grew strongly in every mainland NEM state, as shown in the table below. Note that hydro generation was somewhat below long term average levels in 2008, because of drought.

Growth in the renewable share of annual generation, December 2008 to April 2020

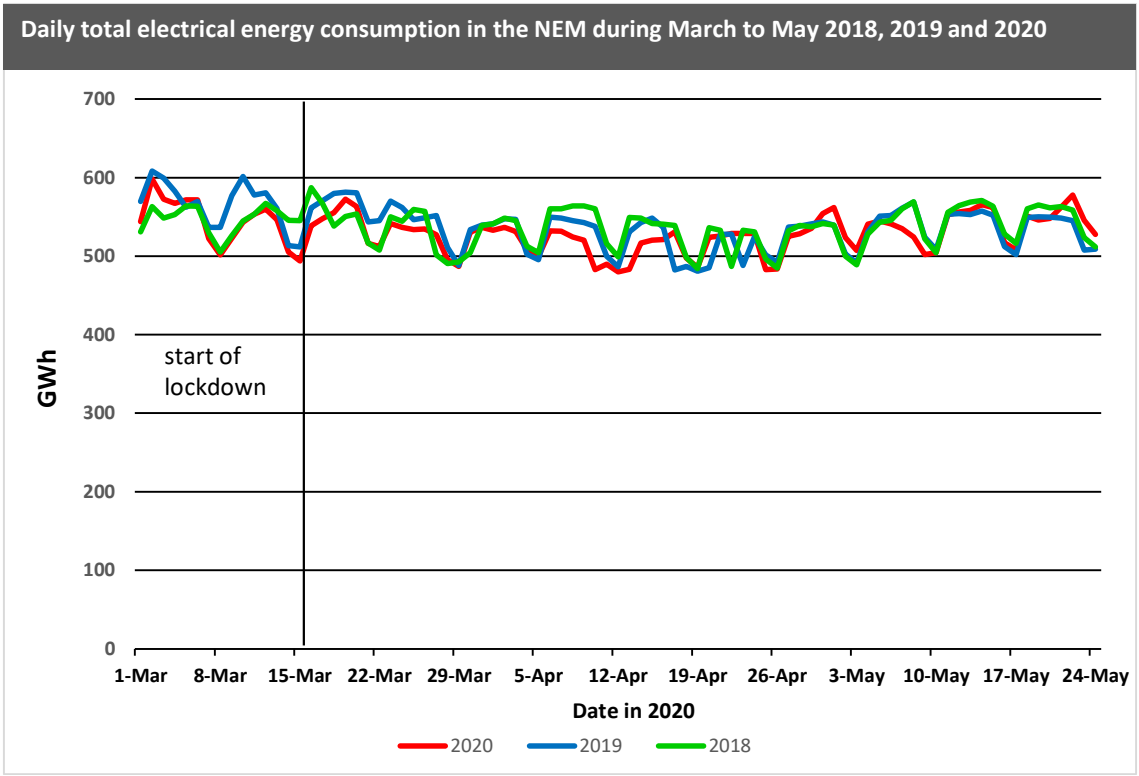
Year ending	December 2008	April 2020
New South Wales	1.3%	16.2%
Queensland	1.8%	14.2%
Victoria	4.0%	24.3%
South Australia	12.8%	56.0%
Tasmania	87.4%	98.3%

Victoria has a legislated target of 25% electricity supplied by renewable generators in 2020. Reaching this target has been affected by the widely discussed delays in new wind and solar farms being allowed to connect to the grid. Nevertheless, present trends suggest that, although the target may not be met by the end of June, it seems certain to be achieved by the end of the calendar year.

PANDEMIC RESPONSE

The last NEEA Report discussed the impact on electricity consumption of the pandemic lockdown and concluded, based on comparing total daily consumption in the NEM this year with consumption on the corresponding days in 2019 and 2018. It was concluded that, on the basis of data up to late April, that consumption was almost unaffected. Figure 4 extends the analysis by a month, but does not affect the previous conclusion. It does, however, make even clearer how sensitive electricity consumption is to extremes of weather, which may be either very hot or very cold days. During March, and first half of April, unusually high consumption occurred on abnormally hot days. Since then that has been reversed, with unusually cold days causing sharp increases in consumption. This year, the weather was cold, windy and heavily overcast across much of eastern Australia on 1 May and 22 May. The graphed data suggest that last year similar weather was experienced on 10 May, and in 2018 there was similar weather on 11 May. Over the whole two months or more since lockdown, however, there seems to be very little difference in consumption this year, compared with 2019 and 2018.

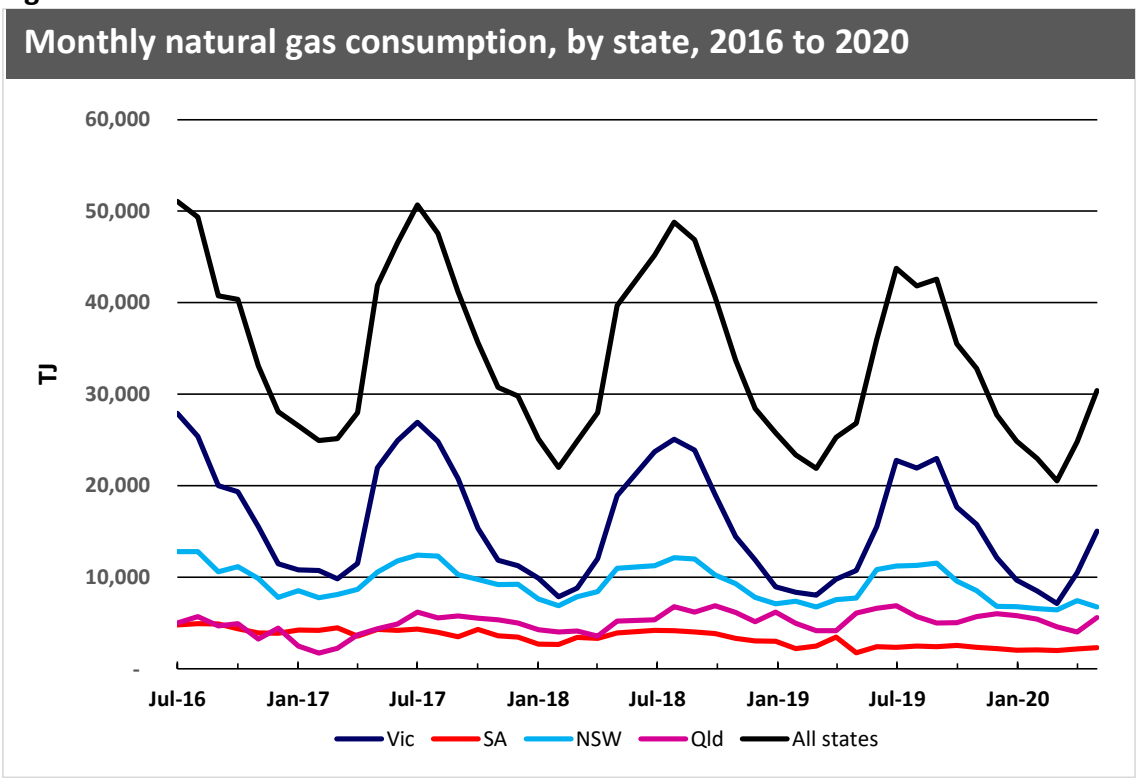
Figure 4



For natural gas, the situation is less clear. Figure 5 shows monthly gas consumption in each of the four mainland states of eastern Australia (gas consumption in Tasmania is extremely small). There are two key features are, firstly, the extreme seasonality of

consumption and, secondly, that Victoria accounts for a very large share of the total, never falling below one third during summer, and increasing to over half in the peak winter months. Seasonality is really a consequence of the dominance of Victorian consumption because, nationally, the total winter space heating requirement is much larger than in any other state and, secondly, most of this requirement is met by burning gas. In Victoria, over 80% of households are connected to gas supply and most use it for space heating. Corresponding fractions are 60% in South Australia, just under 50% in New South Wales, and only 11% in Queensland. Moreover, many households in these latter three states use gas for water heating and cooking, but not for the far more "energy hungry" space heating.

Figure 5

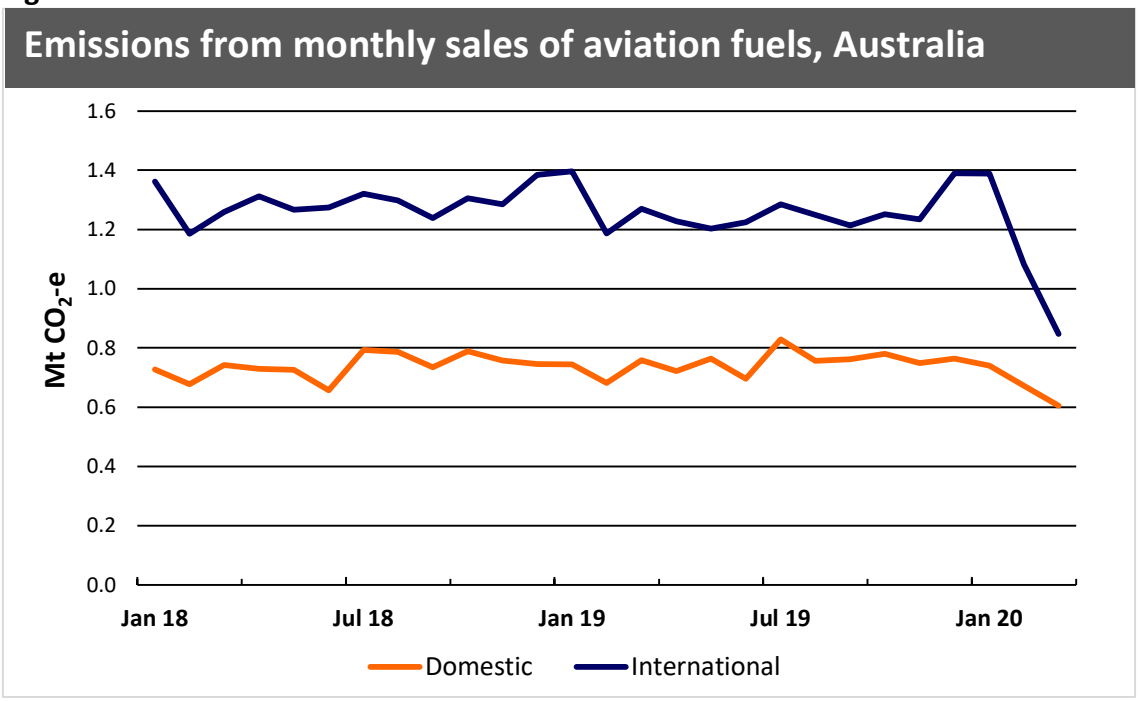


With the exception of Victoria, gas consumption over the past six months appears to have followed the same general trend as in previous years, in the context a very gradual decline, extending back several years. For New South Wales, South Australia and Queensland there is no unambiguous evidence that the economic lockdown has affected gas consumption. Monthly consumption in 2020 was lower than in both 2019 and 2018 during January, February and March in all states. Consumption in April 2020 was also lower than in April 2019 and 2018 in New South Wales, South Australia and Queensland. In Victoria, however, it was higher than in any of the preceding ten years. This comparison certainly does suggest that in Victoria working and schooling from home has meant that many more households are using their gas heaters throughout

the day. If this hypothesis is correct, gas consumption will also be higher than average during May, but less so in June, with the re-opening of schools. The higher consumption in April 2020, compared with 2019, will have increased greenhouse gas emission by about 200 kt CO_2-e.

Turning finally to petroleum products, the effects of the economic lockdown are much clearer. Figure 6 shows monthly emissions from aviation fuels supplied in Australia up to March. Consumption will presumably fall further again in April. Compared with March 2019, the reduction in aviation fuel supplied to aircraft on international routes reduced by 165 ML or about 33%. This translates to an emissions drop of over 400 kt CO_2-e. The corresponding reduction from domestic aviation fuel consumption was around 60 ML or 20% which equals about 150 kt CO_2-e drop in emissions.

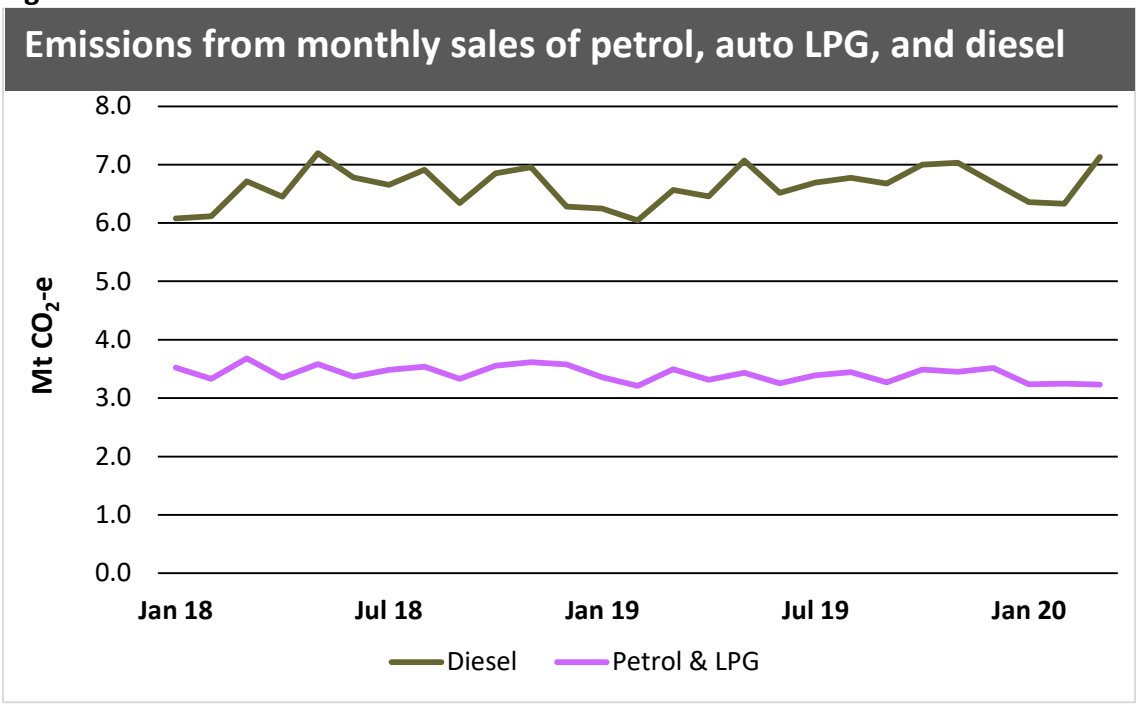
Figure 5



The corresponding trends in monthly emission from petrol, auto LPG and diesel fuel are shown in Figure 6. Emissions are calculated from data on volumes of fuel supplied at wholesale, as reported to the government by petroleum companies, including both refiners and importers. As the NEEA Report has explained in the past, most petrol and auto LPG is supplied to final consumers through retail outlets. By contrast, a large proportion of diesel is supplied in bulk to industrial consumers. It is likely that these supply chain differences explains why diesel consumption appears to have increased sharply during March. Just as uncertainty about supplies caused many households to stockpile toilet rolls during the first few weeks of lock down, supply chain security uncertainty is likely to have caused many bulk diesel consumers to fill their tanks as

insurance against the risk of future supply disruptions. The relatively good autumn rains across most areas of the Australian wheat belt are also likely to have seen farmers increase consumption for ploughing (by those who still plough) and planting wheat, barley and other winter crops.

Figure 6



It remains to be seen how any of this will affect apparent consumption of petrol and diesel in April. Data should become available in mid June. Casual observation of roads in any of our major cities during April and May would suggest that there will be a sharp fall in petrol consumption, and also a fall, though probably much smaller, in diesel consumption. However such any such consumption reductions will almost certainly short-lived. Indeed, state and local authorities have expressed concern that, as schools re-open, the extreme difficulty of social distancing on public transport will see an extreme re-bound of road traffic volumes.

Most public comment on the recently released *Technology Investment Roadmap Discussion Paper* has focussed on electricity generation technology. From an emissions perspective, however, electricity generation in Australia is on a road towards lower emissions as *NEEA Report* demonstrates each month. Certainly that road is full of potholes and attempted roadblocks, but it remains headed in the right direction. By contrast, there is absolutely no road towards lowering transport emissions, which continue heading towards ever higher emissions. It is therefore deeply disappointing to read in the *Discussion Paper* statements (on p. 60) such as

> "Many of the technological challenges facing the transport sector will arise from the need to manage disruptions from increasing use of electric vehicles"

and

> "A host of technologies are close to commercial readiness but not being deployed at scale. For example, the latest engine and hybrid technologies (energy management technologies and electric vehicles, among others) are not reaching the Australian market in significant volumes."

Ten years ago there was a wide variety of possible low emission technologies to power low emission road transport and no certainty as to which would be the best. Now there is absolutely no doubt that battery electric vehicles are the best for passenger and light commercial vehicles, and most major manufacturers have committed to convert their production lines from internal combustion to electric vehicles.

One reason for the equivocation, so obvious in the quotations above, may be the expectation that a national electric vehicle strategy, announced in February last year, may be "forthcoming". If and when it is released, this strategy will be a test, scarcely less important than electricity industry policy, of the how seriously the government is committed to reducing Australia's greenhouse gas emissions.

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.