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National Energy Emissions Audit

June 2018

Providing a comprehensive, up-to-date indication of key greenhouse gas and energy trends in Australia

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Key points

+ Australia's energy emissions decreased in the first quarter of 2018 thanks to the closure of one of Australia's oldest coal-fired power stations

Decreased energy emissions over this three month period were entirely caused by lower electricity generation emissions, resulting from the closure of Hazelwood power station.

+ Improvements in emissions intensity and energy efficiency have contributed to the slower growth in electricity generation emissions since 2009

The long-term trend from 1990 shows a decoupling of energy generation and emissions-intensity since 2009 and the impact of energy efficiency in slowing down the growth in generation since 2011.

+ Major uptake in diesel as the transport fuel of choice – now accounts for half of all petroleum emissions

Diesel consumption continues to grow and while it is helps save drivers money based on fuel efficiency it emits 17 per cent more than petrol by volume and now accounts for half of all petroleum emissions.

+ Expect more vehicles and the lack of national emissions standards to continue to drive up transport emissions

Unless the Australian Government takes action on emissions standards, we will continue to drive up emission in the transport sector with one of the least efficient, highest emission motor vehicle fleets in the world.

+ Expect total fuel combustion emissions to increase from now on

Little if any further reduction in electricity generation emissions, combined with continuing growth in diesel consumption, are likely to cause energy combustion emissions to increase over the next period.

Introduction

Welcome to the June 2018 issue of The Australia Institute's *National Energy Emissions Audit* (the *Emissions Audit*). The *Emissions Audit* tracks Australia's emissions of greenhouse gases from the combustion of fossil fuels every quarter; this issue contains data up to the end of March 2018. The *Emissions Audit* will therefore give readers the most up to date possible advice on how Australia is tracking towards meeting its emissions reduction commitment under the Paris Agreement.

Fossil fuel combustion accounts for the majority of Australia's emissions – 72 per cent in the recently released (and latest) *National Greenhouse Gas Inventory* for financial year 2015-16. Fossil fuel combustion emissions also account for most of the year-on-year change in Australia's emissions.

The *National Energy Emissions Audit* is published on a quarterly basis, in September, December, March and June each year, with data to the end of the preceding quarter. Each month the *Electricity Update* of the *Emissions Audit* is produced, reporting on changes to emissions from electricity generation in the National Electricity Market (NEM), and including commentary on other issues relating to the extraordinarily dramatic changes happening in Australia's electricity supply system.

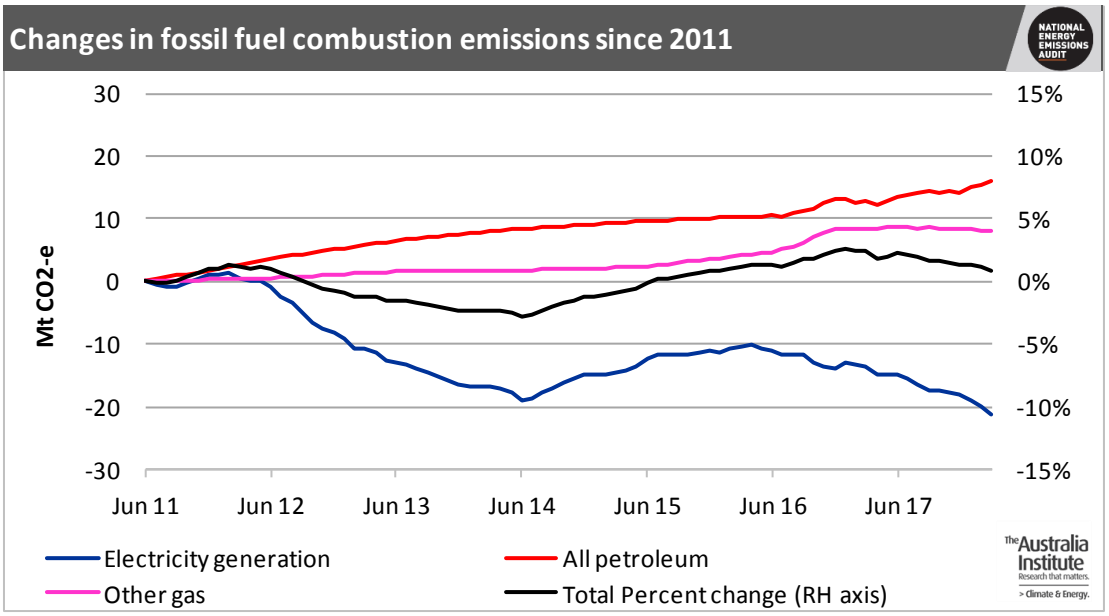
All emissions data are reported as annual moving averages. This approach removes the impact on the reported data of seasonal changes, which particularly influence electricity and gas consumption. Annualised data will show a month on month increase if the most recent monthly quantity is greater than the 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.

Total energy combustion emissions to March 2018

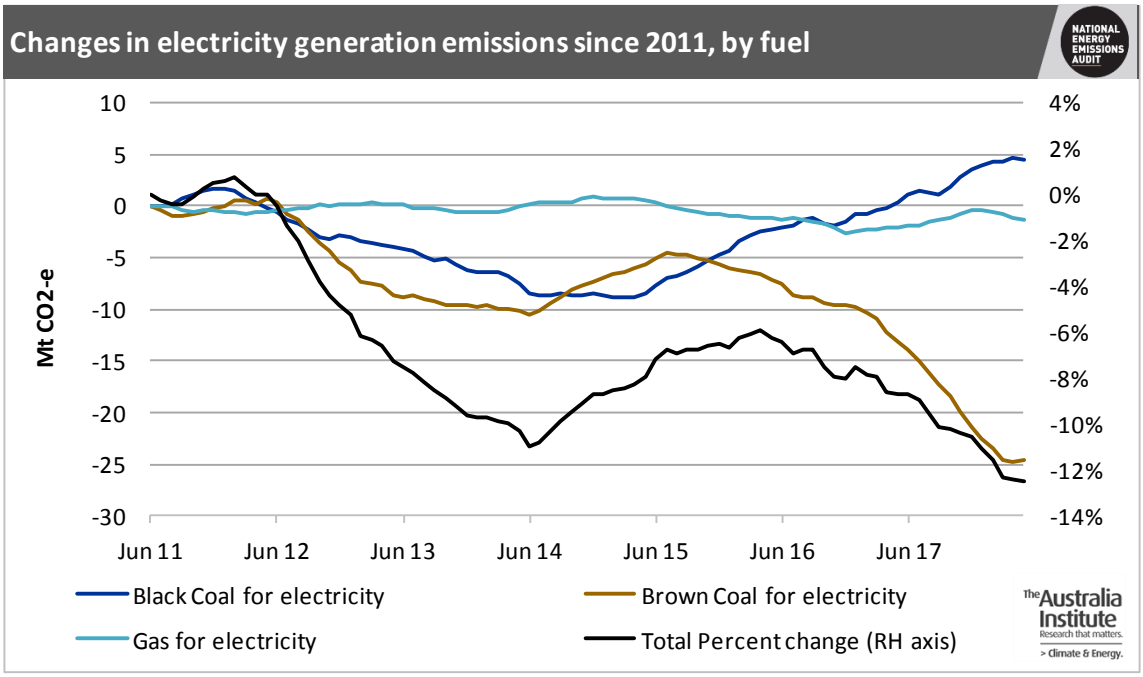
Data to the end of March, in this June 2018 *NEEA Report*, show petroleum emissions continue to rise, while electricity generation emissions decrease. There is little change in trends from those seen in the last Report. Natural gas emissions stay almost unchanged, and hence total energy combustion emissions continue to decrease, but very slowly (Figure 1). The total reduction from March 2017 to March 2018 was about 5 Mt CO_2-e.

Figure 1



However, as can be seen in Figure 2 (extending to the end of May 2018), lower electricity generation emissions were entirely caused by reduced emissions from brown coal generation, caused by the closure of Hazelwood power station at the end of March 2017. The effect of that closure is now fully incorporated into annual emission figures. From now on, therefore, electricity emissions will fall much more slowly (as can be seen in the last two month's data in Figure 2) and total energy combustion emissions may well start to increase, as they were doing up to the beginning of 2017.

Figure 2



Regular readers will note a distinct change in shape of the petroleum emissions line in Figure 1. This change has been caused by a change in the methodology used to calculate these emissions. Until now, the calculations have been entirely based on monthly petroleum product sales data, sourced from *Australian Petroleum Statistics*[1], a publication which has been produced by the Department of the Environment and Energy, and its various predecessors, for over 30 years. For all that time, reporting by industry of petroleum production, sales, imports, exports, and stocks held, was voluntary, meaning that it depended on the goodwill of industry participants. Legislation to make this reporting mandatory came into force on 1 January this year.

In preparing this issue of the *NEEA Report*, emissions data in the most recent *National Greenhouse Gas Inventory*[2], for the year to June 2016, published in April, has been compared with data in the NEEA system, calculated from *Australian Petroleum Statistics*. The comparison strongly indicates that, in earlier years, *Australian Petroleum Statistics* under-reported consumption of petroleum products. This is of course not surprising with a voluntary reporting arrangement. The NEEA system has therefore been changed to use annual total emissions from petroleum product combustion, as reported by the *National Greenhouse Gas Inventory*, to calculate emissions changes between June 2011 and June 2016. Month by month values are approximated, using linear interpolation. The result is the relatively smooth curve of growing emissions from petroleum product combustion, seen in Figure 1.

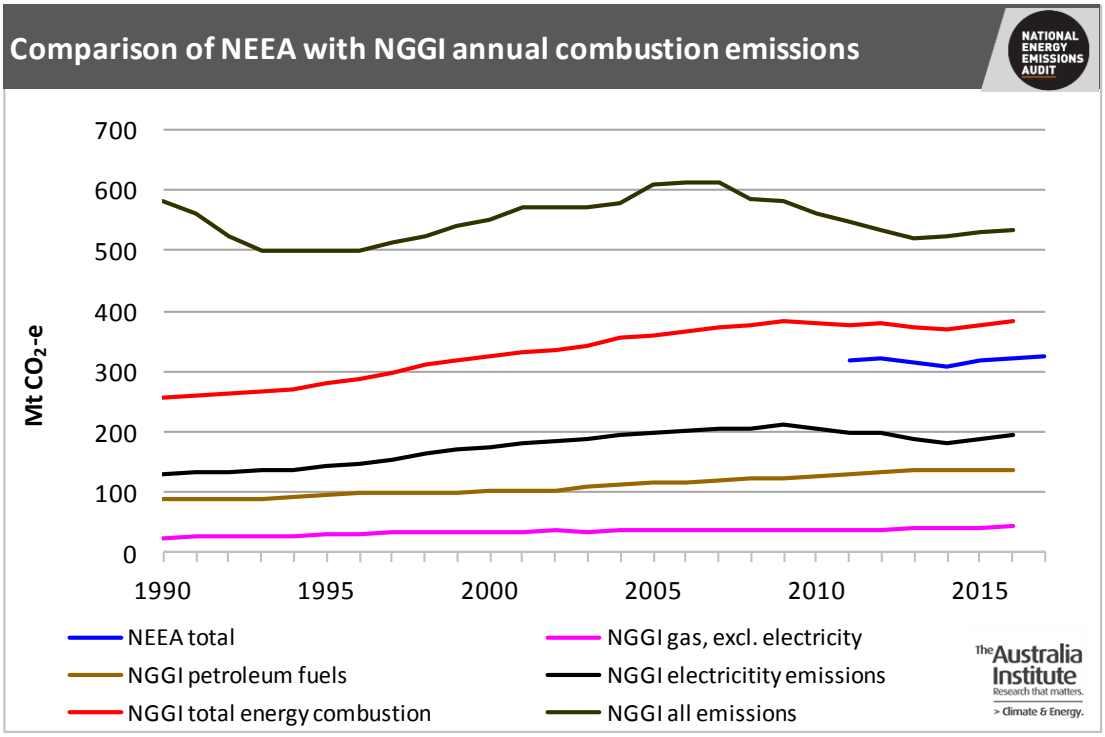
[1] Department of Environment and Energy (2018) *Australian Petroleum Statistics* https://www.energy.gov.au/publications/australian-petroleum-statistics-2018

[2] Department of Environment and Energy (2018) *National Greenhouse Gas Inventory* http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/ageis

For the months since June 2016, the subsequent changes in emissions are calculated for each month by using *Australian Petroleum Statistics*. The results show considerable month to month volatility, probably caused by the fact that the reported data are the volumes sold and physically delivered to consumers by oil companies, not the volumes actually consumed. Sales of petroleum products delivered in bulk into a customer's own fuel tanks can vary month to month because of factors such as numbers of weekends and holidays in the month. However, what is sold is ultimately consumed, so that the general trend is considered to be a reliable estimate of growth in emissions from petroleum consumption.

Release of the *National Greenhouse Gas Inventory* for 2016 allows the relationship between NEEA and the *National Inventory* to be updated. As explained in the Introduction, the NEEA reports only emissions from fossil fuels. In 1990 combustion emissions contributed just 44 per cent of Australia's total emissions. By 2005 the share of energy combustion had reached 59 per cent, and in 2016 it was 72 per cent. These trends are shown in Figure 3. The fact that energy combustion emissions continue to grow, while Australia's other emissions have been falling, reflects poorly on Australia's efforts to reduce emissions. It also demonstrates that from now on climate change policy must focus on reducing energy emissions much faster than emissions from other sectors.

Figure 3



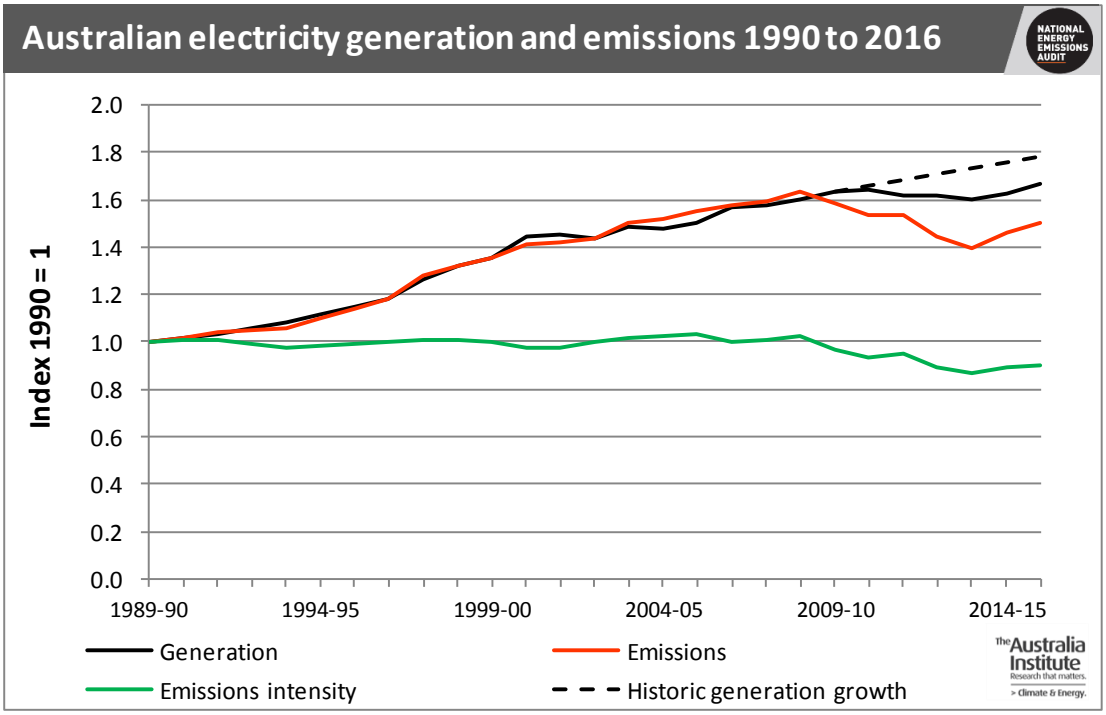
It is because they are so important that the NEEA focuses on energy combustion emissions. Figure 3 shows that for each year between 2011 and 2016, the NEEA estimate of energy combustion emissions closely tracks the *National Inventory*, accounting for between 84 and 85 per cent of the *National Inventory* total. Most of the difference is attributable to emissions sources for which data needed to estimate emission sis not publicly available. These sources

include all gas consumption in Western Australia and the Northern Territory, all coal consumption in Western Australia, and coal consumption in all other states for activities other than electricity generation.

The release of the 2016 *National Inventory* also provides an opportunity to step back from the most recent emission trends, on which the NEEA usually focuses, and look at the overall trend in energy emissions since 1990, the first year for which national emissions were calculated. Figure 4 shows total national electricity generation and total electricity generation emissions since 1990. From then until 2009, emissions and generation grew at almost precisely the same rate, meaning that the emissions intensity of generation remained constant. Then emissions fell, as the emissions intensity of generation decreased, initially because of the displacement of old, inefficient black coal generation by gas, plus the first significant wind generation.

Two years later generation also stopped growing, as increased energy use efficiency began to have an impact. As can be seen, from 2014 to 2016 inclusive, the last three years for which complete national data are available, reduced electricity consumption and lower generation emissions intensity contributed roughly equal shares to the overall reduction in emissions from electricity generation. As explained in the *Electricity Update* April/May 2018, decline in net electricity consumption by consumers drawing from the grid is also due to the rise in solar PV, which supplies electricity to consumers behind the meter.[3]

Figure 4

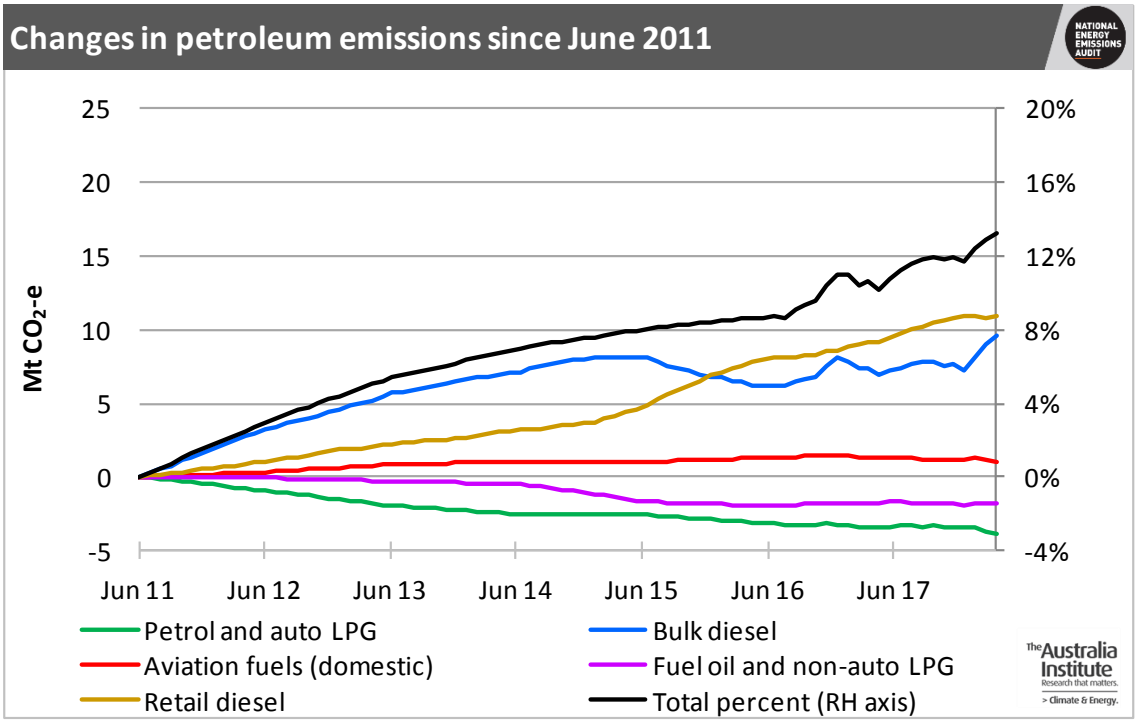


[3] Saddler, Hugh (2018) *National Energy Emissions Audit Electricity Update April/May 2018*, The Australia Institute, http://www.tai.org.au/sites/defualt/files/NEEA%20Electricity%20Update%20May%202018%20FINAL.pdf, p.5 and Figure 4 p.7

Petroleum emissions

Diesel consumption and resulting emissions continue to climb as showing in Figure 5 and now account for well over half the total emissions arising from combustion of petroleum products. Figure 5 shows changes in emissions since 2011 from the four main groups of petroleum products: total petrol plus auto LPG; diesel; aviation fuels; and fuel oil and non-auto LPG. Diesel consumption is further separated into retail sales and bulk sales. As the *NEEA Report* has been showing for a long time, decreased consumption of petrol, LPG, and fuel oil more than offsets, in terms of emissions, modest growth in consumption of aviation fuel. Thus diesel is responsible for all the continuing growth in emissions from petroleum fuel consumption.

Figure 5



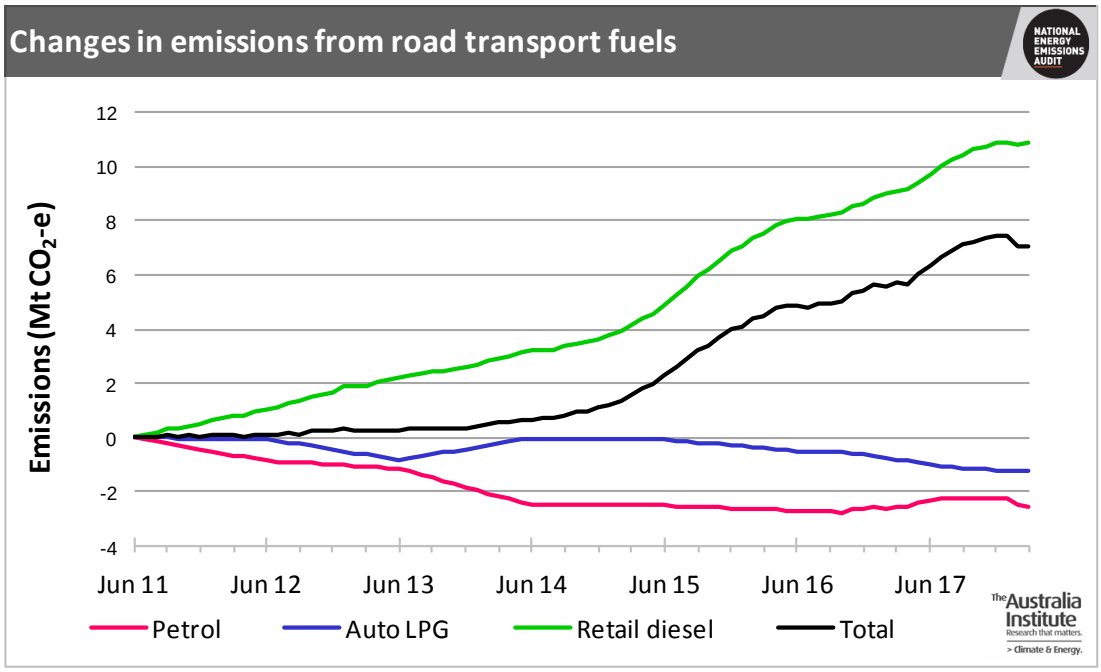
As explained above, the apparent month by month variation in emissions from consumption of bulk diesel is essentially an artefact of the use of sales data as a proxy for consumption by large users of diesel fuel. Sales data is the only source of information related to use of petroleum products which is available with minimal delay. The *National Greenhouse Gas Inventory*, by contrast, uses actual consumption data as reported annually by businesses through the National Greenhouse and Energy Reporting Scheme (NGERS), but the information does not become available until about a year after the end of the year to which it relates.

(One exception to this generalisation is emissions from consumption of diesel for electricity generation in the NEM, which *NEEA Electricity Update* estimates from AEMO electricity generation data. Diesel generation is nearly always very small. It tends to be somewhat higher during summer months, when it is sometimes required to meet peak demand on heatwave days. Complete data are available since summer 2007-08 and show that last

summer diesel consumption was the second lowest on record, behind summer 2011-12, despite the closure of about 3,000 MW of coal fired generation capacity since then. Diesel generators accounted for just 0.1 per cent of total electricity generated in the NEM last summer.)

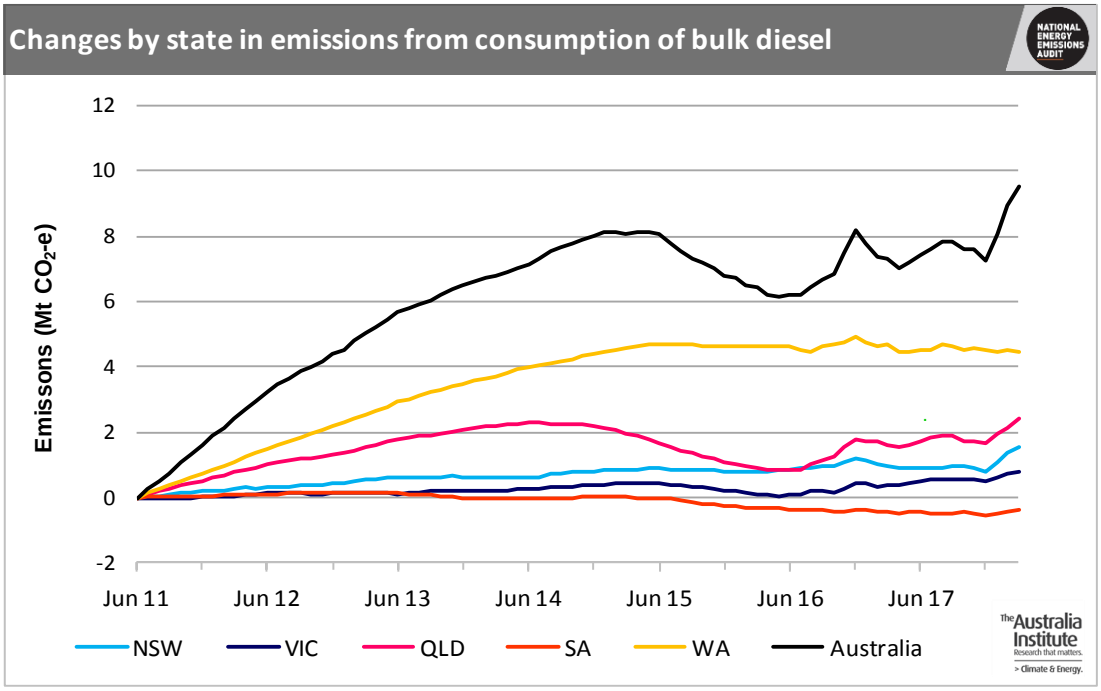
Figure 6 shows, in more detail, trends in emissions from the main fuels used for road transport. As explained in previous issues of *NEEA Report*, this data is not a complete representation of road transport fuel consumption, since some of the diesel sold in bulk is also used in road vehicles, mainly those operated as parts of fleets.

Figure 6



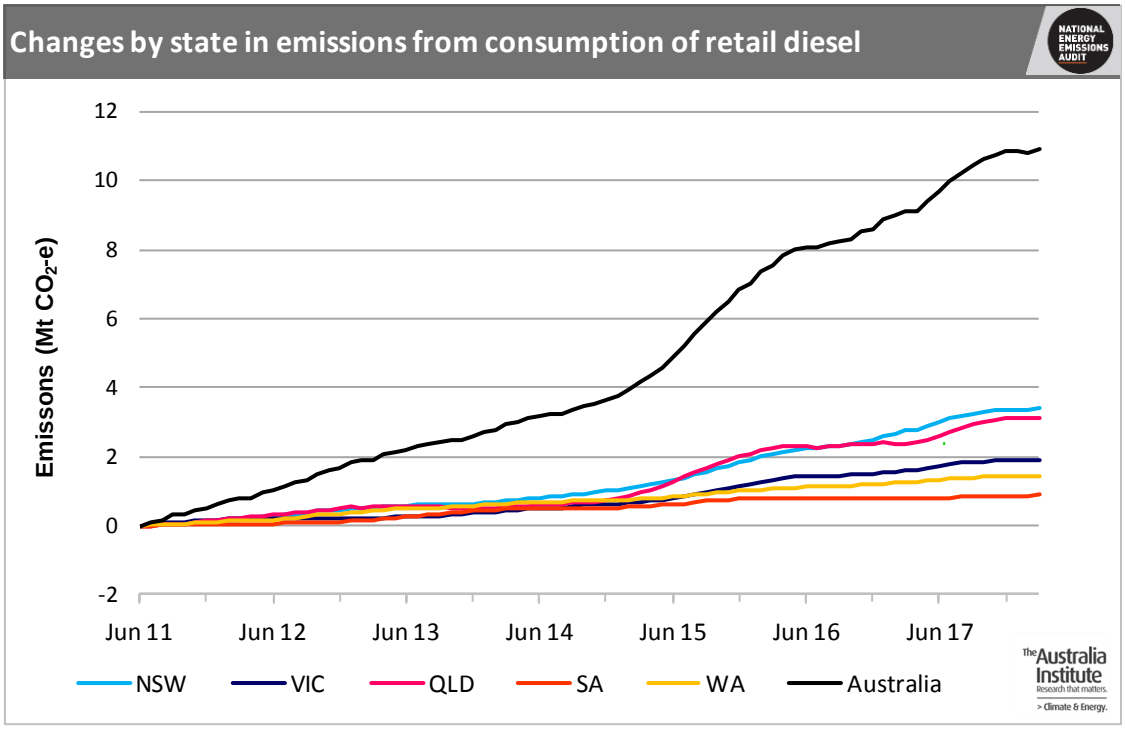
State level changes in emissions from bulk diesel are shown Figure 7 for the five largest consuming states. It can be seen that well over half the increased consumption of bulk diesel since 2011 has occurred in Western Australia, but also that consumption growth in that state has virtually ceased since 2015. Indeed, from 2015 until late last year there was no growth anywhere in bulk diesel consumption. Coming months will show whether the apparent uptick during the few months up to March represents a sustained further consumption increase, or just an expression of volatility in the source data.

Figure 7



Changes in emissions arising from retail sales of diesel, shown in Figure 8, have a similar general form in all states. In absolute terms, the increases appear have been considerably larger in New South Wales and Queensland than in other states.

Figure 8



Finally, Figure 9 shows the trends in consumption of petroleum products and the average emissions intensity of petroleum consumed. In contrast with electricity, as shown in Figure 4,

there is little evidence of a lasting change in trend. It is certainly the case that the shift from petrol to diesel as the preferred fuel for passenger and light commercial vehicles has been a significant change, and that diesel engines are inherently more efficient than petrol, meaning that they deliver more useful energy per unit of energy used. This is offset, however, by the fact that emissions per unit of energy consumed are higher for diesel than for petrol, because diesel fuel has a higher ratio of carbon to hydrogen than does petrol. When compared on a volumetric, i.e. per litre, basis, combustion of diesel emits 17 per cent more greenhouse emissions per than combustion of petrol. Hence, a diesel engine will have to be 17 per cent more efficient than a petrol engine, on a fuel volume basis, to avoid emitting more greenhouse gases.

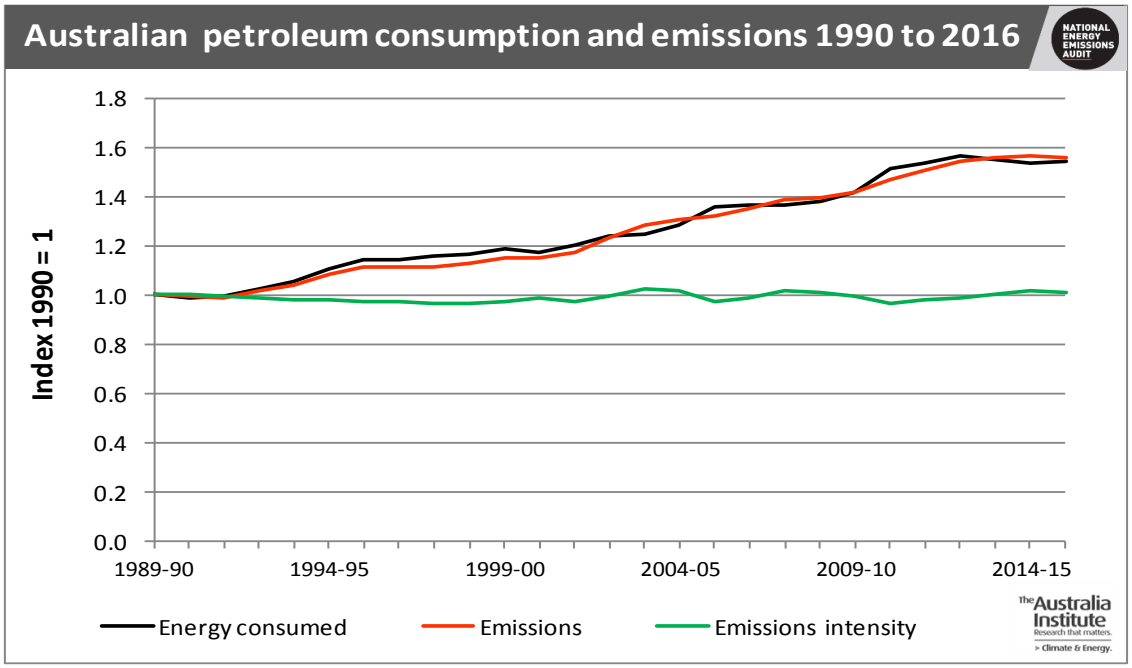
Thus replacing a petrol engine car with a diesel, will probably result in lower fuel consumption on a volumetric basis, and may also result in lower fuel costs. However, it is unlikely to result in much, if any, reduction in greenhouse gas emissions. As we have previously observed in the *NEEA Report*, petroleum emissions will not start to decline until there is either a real and decisive improvement in the average efficiency of motor vehicles, or a reduction in the vehicle kilometres travelled by petroleum fuelled vehicles, or, preferably, both.

One of the most striking energy and emissions policy failures of successive Australian governments, over many years, has been the lack of action on mandatory motor vehicle fuel efficiency standards. Australia is unusual in the developed world in not having mandatory emissions or fuel economy standards. The United States, Canada, the EU, Japan and Korea all have mandatory standards. China and India also have mandatory standards, and both have more efficient passenger vehicle fleets than Australia. Greenhouse gas emissions from cars and light commercial vehicles have been growing at an annual rate of 2 per cent, or more. Strong fuel efficiency standards, if introduced ten or fifteen years ago, could have had the same effect on vehicle fuel consumption as the appliance efficiency standards have had on electricity consumption. If introduced in 2018 (as the Climate Change Authority recommended[4]), at a standard that would bring Australia into line with the United States (and still behind the European Union), it would avoid 59 million tonnes of greenhouse gas emissions over the period to 2030, equivalent to the current annual emissions of all light vehicles.

However to make the major reductions to transport emissions, any emissions standard must be combined with policies to drive rapid adoption of electric vehicles (EVs), fuelled by zero emissions electricity. Anything less would be too little, too late.

[4] Climate Change Authority (2014) *Light vehicle emissions standards for Australia* http://climatechangeauthority.gov.au/reviews/light-vehicle-emissions-standards-australia

Figure 9


Australian petroleum consumption and emissions 1990 to 2016
NATIONAL ENERGY EMISSIONS AUDIT
Index 1990 = 1
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1989-90
1994-95
1999-00
2004-05
2009-10
2014-15
Energy consumed
Emissions
Emissions intensity
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Appendix: Notes on methodology

The quarterly NEEA Report ("the Audit") reports greenhouse gas emissions arising from the use of fossil fuels to provide useful energy. The format in which data are presented in the Audit is determined by the data sources available. This means that the Audit has three major components: electricity generation, consumption of petroleum products and consumption of gas for purposes other than electricity generation.

For electricity generation, the data are those presented monthly in the NEEA Electricity Update. This means that they include all emissions from electricity generators supplying electricity within the National Electricity Market (NEM). The Audit does not include emissions arising from off-grid generation located in the five eastern states. It also excludes all emissions from electricity generation, both grid and off-grid, in Western Australia and the Northern Territory.

For emissions from consumption of petroleum products, the key data source is the monthly government publication, Australian Petroleum Statistics. The specific figures used are monthly sales of petroleum products, published in Tables 3A and 3B. This means that the emissions cover the whole of Australia, not just the eastern states. The emissions calculated are adjusted to net out emissions arising from the small quantities of diesel used at power stations supplying the NEM. In 2017 the Department of Environment and Energy applied a rigorous quality audit and upgrade process to *Australian Petroleum Statistics*. The outcome was changes to some previously published, i e. "historic", data and a new starting date of July 2010 for the improved data series. This new starting date is one reason that many graphs start with annual emissions for the year to June 2011. However, this upgrade was unable to correct under-reporting in past years, under the voluntary reporting arrangements then applying. For this reason, emissions calculated from *Australian Petroleum Statistics* sales data have been replaced by the *National Greenhouse Gas Inventory* emissions data for the years 2011 to 2016 inclusive.

The estimates of emissions from natural gas are, like electricity emissions, confined to the eastern states. Two separate sources are used. For the period to June 2016, annual gas consumption data by industry and state (Table f) of Australian Energy Statistics is used to provide total gas consumption, net of gas used to generate electricity, in the five eastern states. Linear interpolation is used to estimate moving annual gas consumption for each intermediate month. From July 2016 onward the source data are constructed from the pipeline gas flow data published in the weekly Gas Market Report of the Australian Energy Regulator (AER). The NEEA estimates of emissions from gas used for electricity generation in the NEM are subtracted from these totals. The Gas Market Report explains that some gas consumption may not show up in its reported pipeline flow data, i.e. that these data may somewhat underestimate total gas consumption. Comparison with the Australian Energy Statistics data confirms that to be the case, which is why the latter data have been used for all periods up to June 2016.

All data are reported as annual moving averages. This approach removes the impact of seasonal changes on the reported data. Annualised data reported in the quarterly NEEA Report ("the Audit") 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.