cedex®

CARBON EMISSIONS INDEX PLUS

Providing a comprehensive and early indication of key greenhouse gas and energy trends in Australia.

Combining: Full report, data to December 2015 and National Electricity Market update, data to February 2016.

PRESENTED BY

pitt&sherry

The Australia Institute
Research that matters.

Introduction

This CEDEX® *Report* contains data for emissions from all fuels up to the end of December 2015. The *Electricity Update*, at the end of the main report, shows emissions from generators in the National Electricity Market (NEM) up to the end of February 2016.

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. Annualised data reported in CEDEX® 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.

Full reports are published on a quarterly basis; *Electricity Updates* are published monthly.

Full report: total energy emissions to December 2015

Energy combustion emissions covered by CEDEX® include all emissions arising from the generation of electricity in the National Electricity Market (NEM), all emissions from the combustion of petroleum products within Australia, i.e. excluding international ship and aircraft bunkers, and all emissions from the combustion of natural gas by gas consumers (i.e. not including emissions from the gas industry's own use of gas – see below) in NSW, Victoria, SA and Tasmania. All data are reported as moving annual totals, so as to remove seasonal effects on consumption of relevant products, and in terms of the changes since June 2009. The emissions reported by CEDEX® reached their historical maximum in December 2008, i.e. in the calendar year 2008. By June 2009 the annualised total, i.e. total for financial year 2008-09, had fallen by 0.7%. The financial year 2008-09 is also the year in which Australia's total emissions from fossil fuel combustion, as reported in Australia's National Greenhouse Gas Inventory, reached their historic maximum.

More recent changes in the total of these emissions are shown in Figure 1. It shows a continuation of the trend of strongly increasing emissions, described in the last five CEDEX® *Reports*. While electricity generation has been the largest contributor to emissions growth, emissions from the consumption of petroleum products and natural gas are also growing steadily. Annual emissions reported here, which are approximately 56% of Australia's total emissions in 2012-13, have now increased by 12 Mt CO_2-e, or 4.2%, since the year ending June 2014.

Comparing this increase in emissions with Australia's total national emissions from all sources, in the December 2015 CEDEX® *Report* we pointed out that the increase in emissions reported by CEDEX® from June 2014 to September 2015 was equivalent to nearly 2% of Australia's total national emissions, in just 15 months. As at December 2015, the increase had risen to 2.2%, in 18 months. Of course, the CEDEX® *Report* data do not include emissions from electricity generation and natural gas consumption in WA and the NT. Nor do they include emissions from the gas used to convert coal seam gas to LNG at the new LNG plants at Gladstone in Queensland, all three of which are now operating. More detail on gas going to LNG is provided below.

Over the three months between September and December 2015, electricity generation made the largest contribution to the emissions increase, as the pattern of increased coal generation, decreased gas generation, and almost unchanged renewable generation continued. However, the rate of increase was moderated by the shift from brown to black coal generation, described in recent CEDEX® *Electricity Updates*.

But Figure 1 also shows that petroleum emissions continue to grow, though more slowly than they did before 2013, and natural gas emissions also appear to be increasing. As Figure 3 shows, continuing growth in emissions from petroleum is mainly driven by increased consumption of diesel fuel. Diesel consumption has also been regularly examined in previous CEDEX® Reports.

FIGURE 1

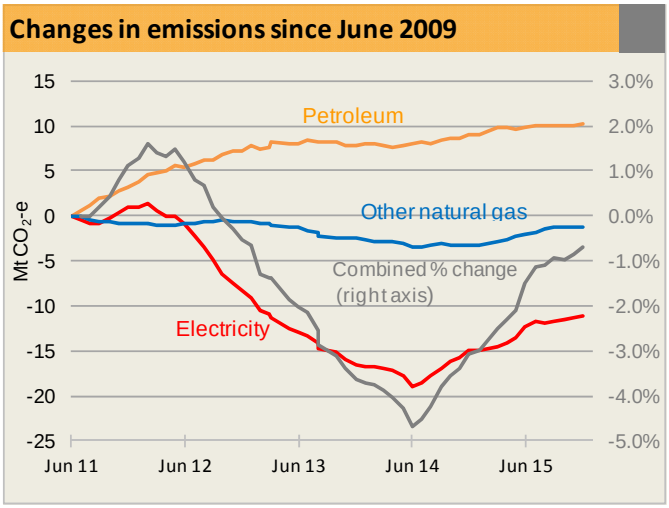
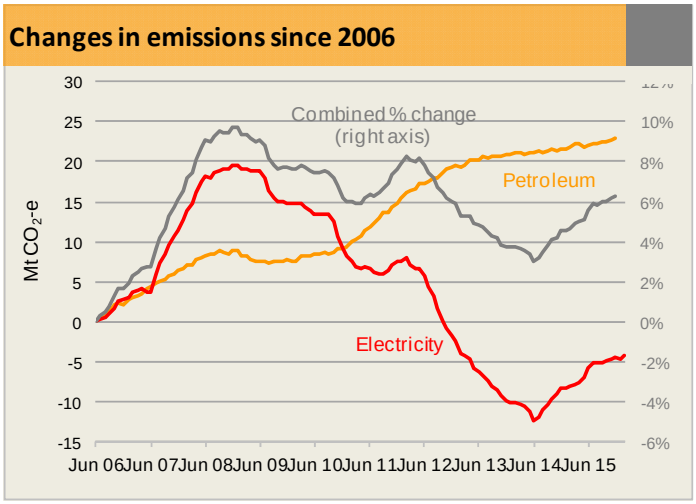


FIGURE 2



Petroleum

As already mentioned, growing diesel consumption has, for many years, been the main driver of growth in emissions from petroleum product consumption, as shown in Figure 3. Figure 4 shows annual consumption of diesel by the economic sectors and activities responsible for the great majority of diesel consumption. This figure, together with Figure 5 below, have been compiled from data contained in the 2015 edition of *Australian Energy Statistics*, compiled and published by the Office of the Chief Economist in the Department of Industry, Innovation and Science. The importance of road transport as a consumer of diesel is easy to see, as is both the importance and rapid growth of consumption by the mining industry. By contrast, consumption by agriculture, another important and long established diesel using sector, has been almost constant.

FIGURE 3

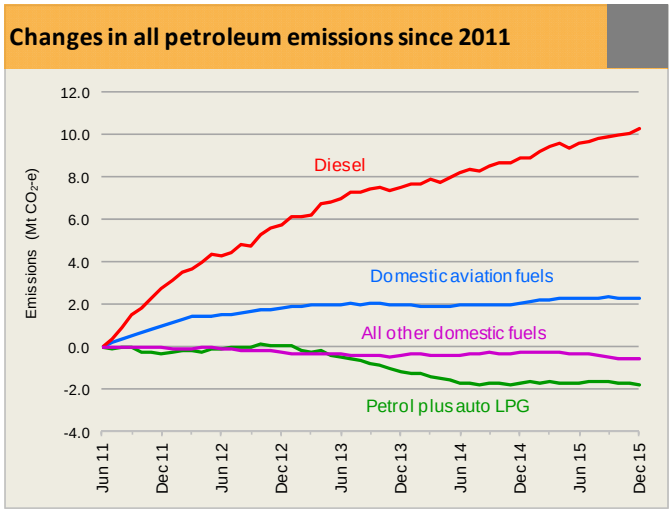


FIGURE 4

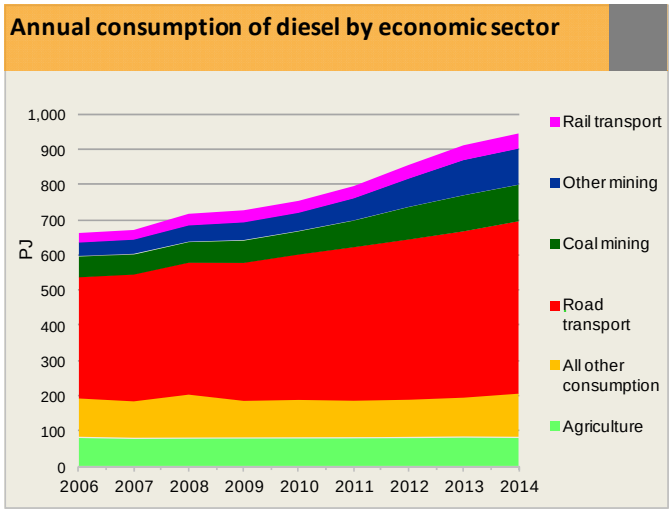


Figure 5 shows changes in sectoral consumption since 2006, thereby covering the same period as Figure 2. It can be seen that road transport has accounted for just over half the total increase in diesel consumption since 2006. As discussed in a number of previous issues of CEDEX® *Report*, this growth has been driven by two main processes.
The first is the steady growth of road freight. According to data published in 2014 by the Bureau of Infrastructure, Transport and Regional Economics, the total Australian road freight task increased at an average compound rate of 2.6% p.a. between 2005-06 and 2012-13. By contrast, road transport diesel consumption shown in Figure 4 grew by an average annual compound rate of 4.6% over the same period. Over this period there has been definitely been an increase in the energy efficiency of road freight transport, through the shift to B-doubles for long haul freight. It has long been recognised that further energy efficiencies could be realised by shifting some part of the freight task from road to rail. Attempts to do so, however, have been largely unsuccessful. Over the longer term, the application of either emissions or fuel efficiency standards to both light and heavy vehicles could have a very large impact on national petroleum fuel consumption and emissions. Australia is currently far behind both the USA and Europe in terms of such standards, in that it has none.

Even if there had been no increase in road freight efficiency over this period, the difference in growth rates between the road freight task and road transport diesel consumption indicates a major role for the second process. This is the shift from petrol to diesel as a fuel for light vehicles (cars). CEDEX® *Report* has been pointing out for some time that the absolute decline in consumption of petrol and LPG can only be explained by this switch. In general, a diesel fuelled vehicle is more fuel and emissions efficient that a petrol fuelled vehicle of the same size (notwithstanding uncertainties created by recent revelations of test cheating in the USA and Europe). It could thus be argued that emissions from petroleum use in private motor vehicles would be even higher, were this switch not occurring. Nevertheless, the inescapable conclusion is that total emissions from both road freight and light motor vehicle use are continuing to climb, with little if any decisive policy action directed towards curbing this growth.

Almost all the remaining 49% of the increase in diesel consumption since 2006 is attributable to the mining industry. The very large increases from coal mining and from other mining (of which iron ore is by far the largest component) are clearly seen in Figure 5. The combined increase in consumption is 125% over eight years, most of which in fact occurred over six years from 2008. The average annual compound rate of increase from 2008 to 2014 was 13%. There is, furthermore, little doubt that consumption has continued to grow at a similar rate during the eighteen months since the most recent *Australia Energy Statistics* annual figures. The continued growth of coal and iron ore exports, albeit at severely reduced profitability, has been widely reported. In addition, the much smaller increase in diesel use by rail transport is almost certainly mining related. All exported iron ore is transported from mine to port in trains hauled by diesel locomotives. The same goes for a major share of coal exports (some lines are electrified). Finally, it is noteworthy that remotely located mines are the main users of diesel for electricity generation in Australia, and it has also increased.

These data from the Department of Industry, Innovation and Science therefore show that, from 2008 to 2014, the increase in annual diesel consumption by mining and associated rail transport was 124 PJ. This equates to an emissions increase of added 8.6 Mt CO_2-e (1.6% of current total emissions) to Australia's emissions.

FIGURE 5

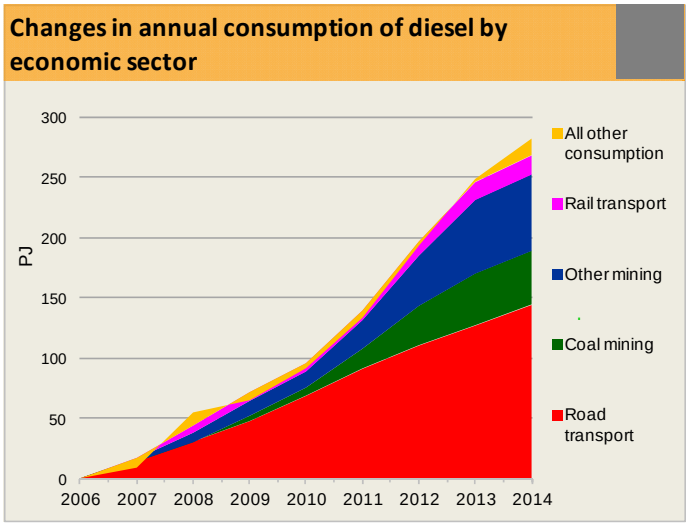
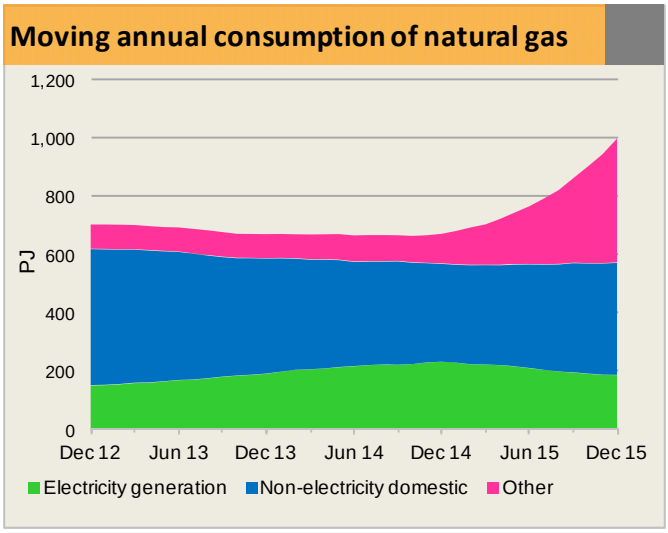


FIGURE 6



Natural gas

Figure 1 shows that the modest increase in natural gas consumption discussed in the last *Report* appears now to have ended. Figure 6 provides a broader picture of gas use in eastern Australia, placing gas used by domestic consumers, other than electricity generation, in a wider context. The "Other" category includes gas used in Queensland for purposes other than electricity generation. As can be seen, for nearly two years from the year ending December 2012, this was almost unchanged. Most non-electricity gas consumption in Queensland is used for industrial purposes, such as the manufacture of ammonium nitrate blasting explosive and urea fertiliser. Relatively little gas is used by residential and small business consumers. Note that none of the three categories includes gas used by the gas production industry itself, to process raw gas to pipeline quality, before it enters a pipeline. It is very difficult to obtain consistent and comprehensive data on this consumption, but it could amount to another 30 PJ, or more, per year, almost all at conventional natural gas processing facilities (coal seam gas generally requires much less processing).

From late 2014 onward the "Other" category also includes gas going to the LNG plants at Gladstone, for conversion to LNG and subsequent export. Most of this gas will ultimately be consumed in the countries to which it is exported, but a significant fraction is used in the LNG plants themselves, where gas is the only significant source of energy. Note that all three plants generate their own electricity requirements, using gas turbines, and do not draw on the Queensland electricity grid.. All three plants use the Bechtel LNG process. This process is also used at the older Darwin LNG plant, operated by Conoco Phillips. Data reported by this company indicate that roughly 12% of the gas entering the plant is used in the plant. The energy requirements of the Gladstone plants will be less, because coal seam gas needs less processing prior to liquefaction than does conventional natural gas used by Darwin LNG, and because they are more modern. Assuming that 8% of the input gas will be used in the plant, then for each 100 PJ of gas entering the plants, about 0.4 Mt CO_2-e will be emitted. Thus from now on the Gladstone LNG plants will be an important new and growing source of emissions.

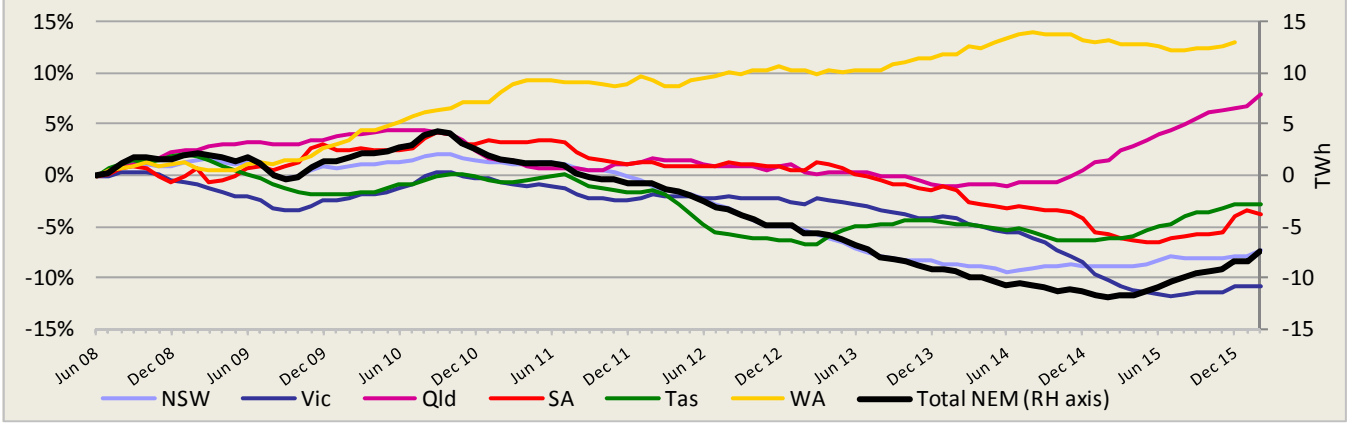
National Electricity Market update to February 2016

Continuing demand growth, especially in Queensland; brown coal generation keeps going down

NEM data to the end of February 2016 show a continuation of trends reported over the last few months: strong demand growth in Queensland driven by electricity use to drive pumps and compressors supporting the growth in coal seam gas production (as seen in Figure 6), and little if any growth in other states. At this time of year month on month changes in demand are particularly affected by the occurrence, or otherwise, of heat waves. That was the case in NSW, where a heatwave during the last week of February caused total annualised demand to tick up. Demand in Tasmania was flat, which is consistent with the fact that to date the government has responded to the supply crisis described in the last CEDEX® *Electricity Update* by using supply side measures only. These have included operating the state's two gas-fired generators continuously at full capacity and, more recently, bringing in a large number of containerised diesel generation sets. Media reports indicate that discussions have been held with the handful of large industrial users, which consume more than half the state's total electricity consumption, about partial curtailment of operation. To date, unlike responses in other countries faced with similar emergencies, no effort has been made to encourage household and smaller business consumers to increase the efficiency with which they use electricity.

FIGURE 7

Relative changes in electricity demand by State, and total absolute NEM demand



On the NEM supply side, the strong growth in black coal generation, and off-setting fall in brown coal generation continued (Figure 8). Hydro generation increased with higher output from Snowy Hydro to both NSW and Victoria. Failure of Basslink meant that a much needed reduction in hydro output in Tasmania was not possible; hydro generation was almost unchanged on an annualised basis. Gas generation continued to decline in all states except Tasmania (where in a national context it is very small). Wind generation was essentially unchanged.

The total share of coal generation in the year to February 2016 was 76.0%, a level which has scarcely changed over the past four months. The renewable share continued to grow slowly, reaching 13.1%. In historic terms, this is a high value, exceeded only during the carbon price years, when the total was strongly influenced by the short term increase in hydro generation. The current level reflects the steady growth, until recently, of wind generation. With no new windfarms due to come on line for a year or so, it is likely that the renewable share will fall, and emissions rise, once Basslink is repaired and Hydro Tasmania is able to wind back its output.

Total emissions from electricity generation in the year to February 2016 showed a slight uptick from the relatively slow growth seen over the past few months (Figure 9). This matched the small uptick in demand seen in NSW and Queensland. The total was the highest since the year to February 2013, i.e. the highest for three years.

FIGURE 8

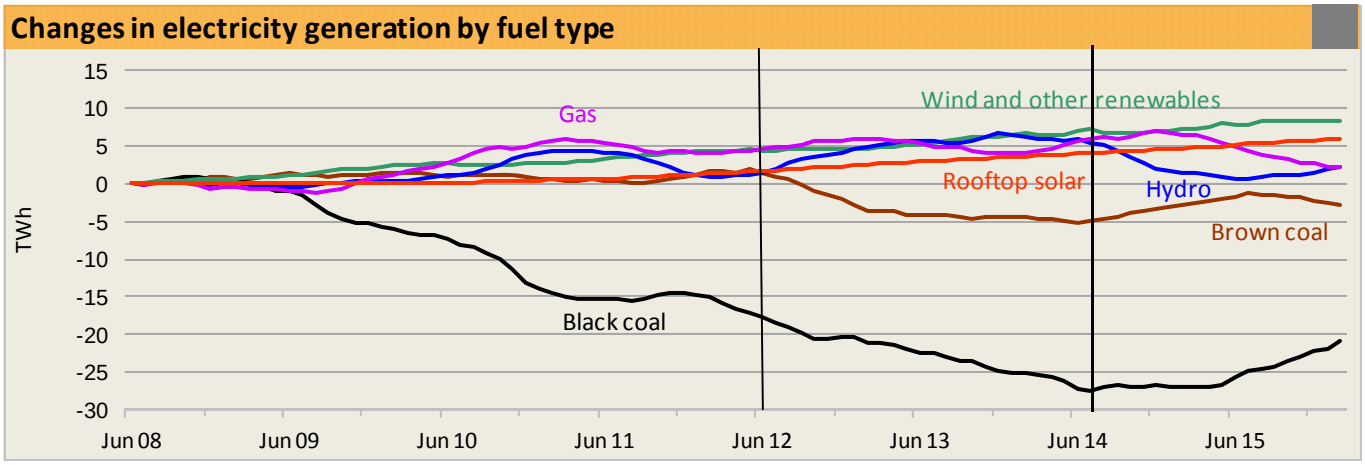
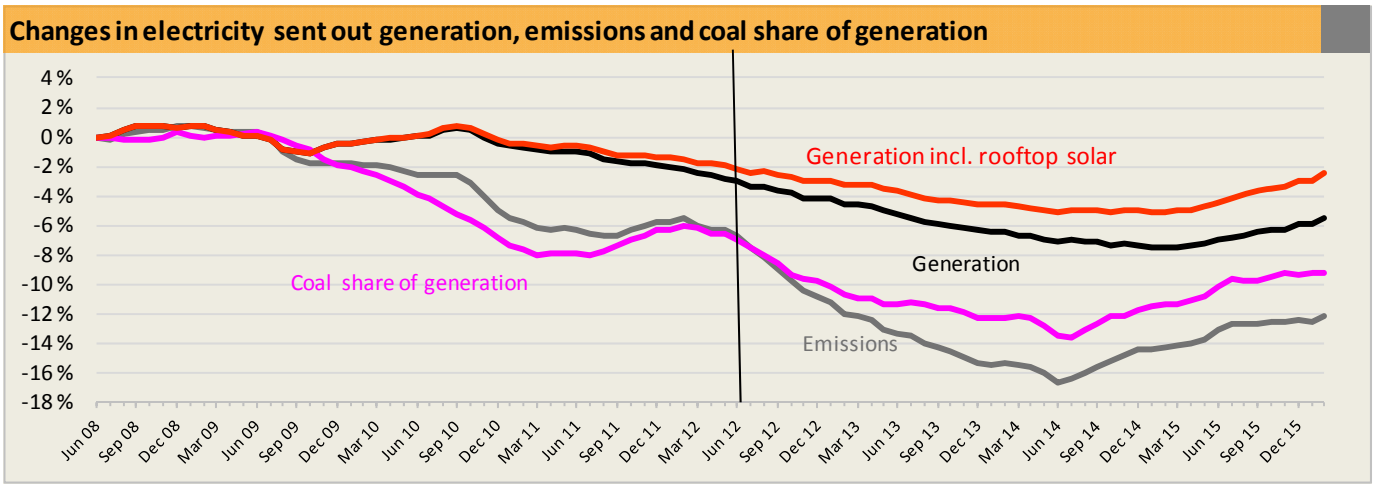


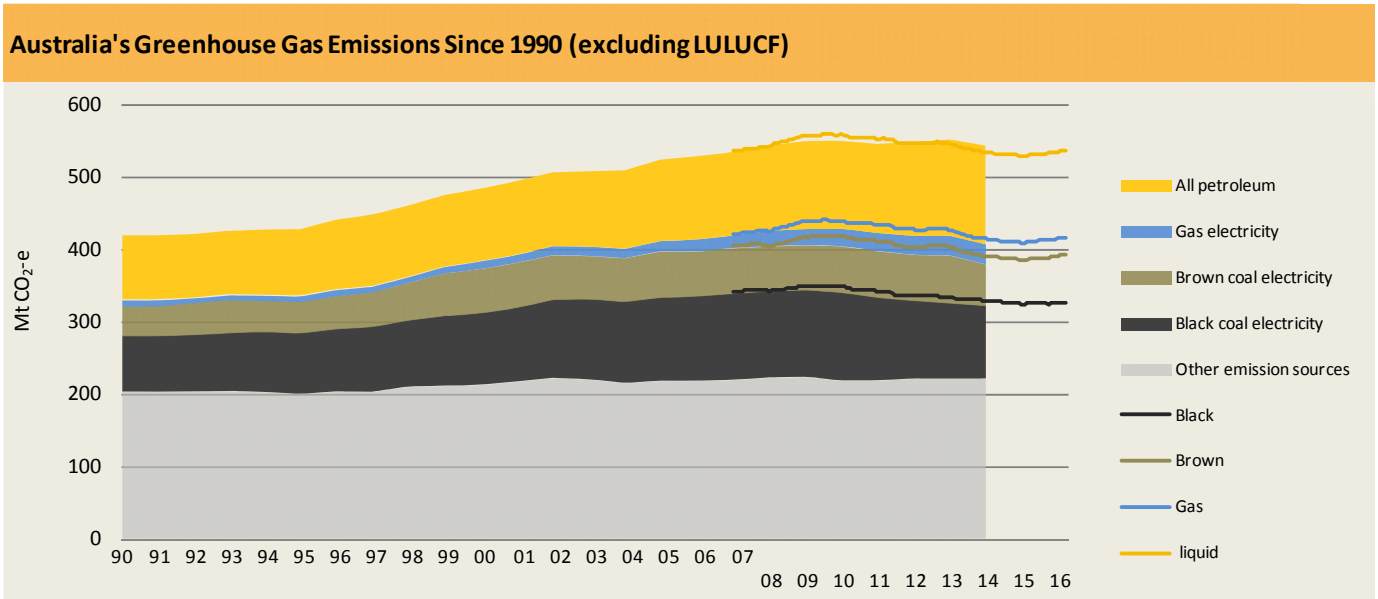
FIGURE 9



About carbon emissions index CEDEX®

The Energy Sector is the largest source of Australia's greenhouse gas emissions. The energy use covered by the CEDEX® accounted in 2012-13 for about 85% of Australia's total energy combustion emissions, and 58% of total emissions (excluding land use change and forestry), as reported in the National Greenhouse Gas Inventory. Figure 13 below illustrates the growth in energy sector emissions, with the lines at the right showing the period and emission sources covered in the CEDEX®.

FIGURE 10



Data sourced from Department of the Environment and CEDEX®.

Between 1990 and 2013 Australia's total emissions, excluding land use change and forestry, Increased by 113.6 Mt CO_2-e, while energy combustion emissions increased by 116.0 Mt CO_2-e, i.e. 2 % more than the total net increase. Hence trends in energy emissions are the key indicator of Australia's ability to achieve significant reductions in total emissions.

The CEDEX® is calculated monthly from three industry resources:

1 Emissions from coal, petroleum and natural gas consumed at all fossil fuel fired power stations in the National Electricity Market (NEM): Data on sent out electricity is sourced from the Australian Energy Market Operator (AEMO), using the service provided by NEM-Review. Sent out electricity data is multiplied by the emission factor (combustion emissions per MWh sent out) for the power station, sourced from a report published by AEMO.

2 Emissions from total national sales of petroleum products: Data on petroleum sales are available from the Department of Industry and Science. Emission factors are from the Department of the Environment.

3 Emissions from natural gas from the National Gas Market (south eastern states). These data were not available prior to 2009.

The main sources not covered, which account for about 19% of other energy combustion emissions, are:

- Consumption of natural gas in WA and NT
- Consumption of fossil fuels for electricity generation in WA and the NT
- Consumption of coal in uses other than electricity generation (such as in steel, cement and alumina production)
- Petroleum products used as fuel at oil refineries
- Combustion related emissions of CH_4 and N_2O, other than from NEM power stations.

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NEM-Review, www.nem-review.info

Data analysis, text and graphs:
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