Client Briefing

JULY 2013

Post hoc ergo propter hoc

FEDERAL GOVERNMENT CLAIMS CARBON PRICE SUCCESS

On 8 May 2013 the then Minister for Climate Change, the Hon Greg Combet declared that ".... the carbon price mechanism that the Government has implemented is working. It is doing what it was intended to do and that is to cut our greenhouse gas emissions. In fact, the data from the independent agencies demonstrates that emissions in the National Electricity Market fell by 7.7 per cent in the first nine months of carbon pricing".

This is a claim worth investigating, particularly with the coming Australian federal election being, in large part, fought over the best policy to manage the achievement of the greenhouse gas reduction target. In this client briefing, Frontier Economics (Australia) examines whether the Government's claim that the carbon tax resulted in a 7.7% reduction in emissions holds up to scrutiny.

CORRELATION IS NOT CAUSATION

The *post hoc* fallacy (*post hoc ergo propter hoc* / after this, therefore because of this) is based on the erroneous notion that because one event follows another event, the first event was the cause of the subsequent event. In this instance the Hon Greg

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Combet observed that greenhouse gas emissions fell the year the carbon tax was introduced. To most people it would seem more than reasonable for the Minister to conclude that the Government's carbon tax had worked given the aim of the tax was to reduce emissions and that seems to be what followed.

However, estimating the effect of the carbon price on greenhouse gas emissions from the electricity sector is complicated because many factors influence the output of various power stations and it is not possible to control for just the introduction of a carbon price.

The fact that there is a correlation between emissions in the electricity industry falling with the introduction of the carbon tax in FY2013 does not necessarily mean that this fall is caused by the carbon tax. The observed fall in emissions could have been caused by a multitude of other factors, which we explore below.

WHAT ELSE HAPPENED IN THE NEM?

Between FY2012 and FY2013 several changes occurred in the National Electricity Market (NEM) that would contribute to a fall in CO_2 emissions from the electricity sector. This includes:

- Decline in demand for electricity, which reflects an ongoing trend of falling electricity generation and emissions since 2009 (pre-existing the carbon price).
- Plant, equipment and services failures at high emission generators like Yallourn brown coal power station in the Latrobe valley of Victoria. These failures have nothing to do with the carbon tax but have resulted in material reductions in the output of some of the highest emission generators in the NEM.
- Preservation of water by hydro generators in the year before the carbon tax (forcing greater thermal generation) so that they can generate more power in the first year of the higher priced market with the carbon tax (which causes thermal generation to decline compared to the artificially higher level the year before the tax). Since hydro generators cannot make it rain to provide water to sustain this higher production level, hydro generation levels should return to normal levels, and emissions with it.

GENERATING EMISSION TRENDS

Figure 1 shows the recent trend in NEM electricity generation levels. Generation levels have been in decline since 2009/10, years ahead of the carbon tax. Unsurprisingly, this fall in generation is correlated with a decline in demand for electricity.

Some may argue that at least some fall in demand could be attributed to the introduction of the carbon tax. For example, the Kurri Kurri aluminium smelter in the industrial region of the NSW Central Coast closed following the

introduction of the carbon tax. The Kurri Kurri smelter was one of the biggest single loads in the NEM, accounting for around 450MW of demand, day in day out. However, the then Minister for Climate Change, the Hon Greg Combet dismissed the carbon tax playing any role in the plant's closure, citing instead that low aluminium prices combined with the strong Australian dollar as the reasons for decision to shut the plant.[1]

Figure 1: NEM generation (sent out versus as generated, scheduled)

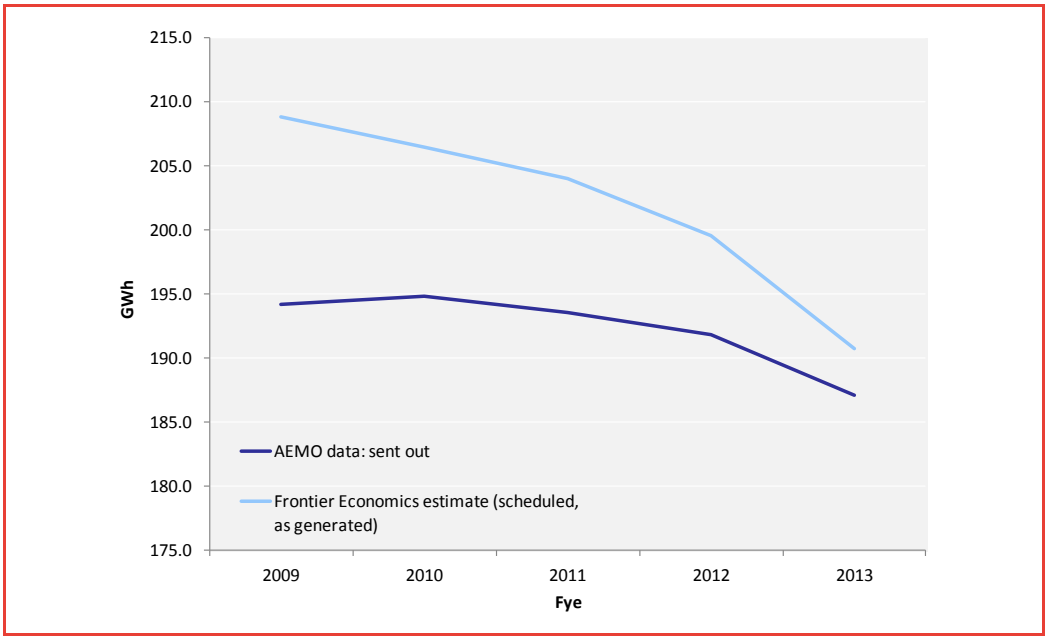


Figure 2 shows the trend in NEM CO_2 emissions since 2009. In line with a general trend downwards in demand since 2009, emissions have also been in decline. The chart shows both the Australian Energy Market Operator's (AEMO) estimate of emissions and Frontier Economics' estimate, which is based on a similar methodology to AEMO and applies a current estimate of emissions intensity by generator multiplied by generator output each year[2]. Although the general trend is a decline, there is a small kink from 2012 (when emissions did not decline as rapidly as the short term trend) and 2013 (when emissions declined more rapidly than the short term trend). On raw figures, this suggests that the reduction in emissions from 2012 to 2013 has accelerated since the carbon tax. This acceleration in the decline in emissions since the carbon tax is exacerbated by a levelling off, or even slight increase, of emissions the year immediately

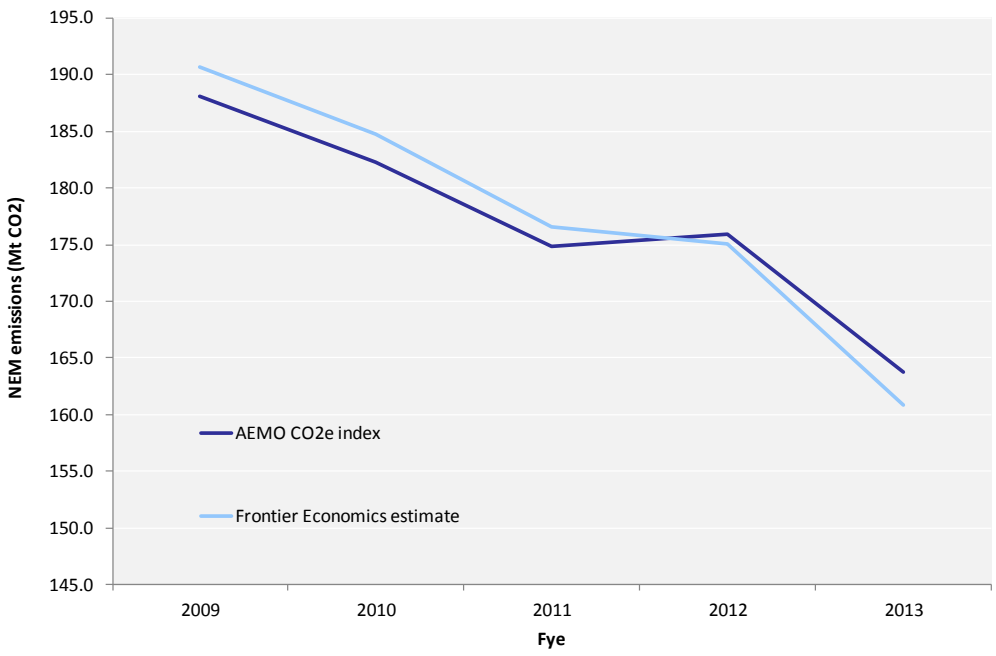
1 For example: http://www.climatechange.gov.au/ministers/hon-greg-combet-am-mp/media-release/kurri-kurri-aluminium-smelter-media-release

2 We have derived our own estimates both as a sense check and because this allows us to consider the underlying sources of CO_2 emissions and annual changes.

before the carbon tax (FY2012) – see Figure 3. The Government has attributed the fall in FY2013 to the operation of the carbon tax because the decline followed the introduction of the tax.

However, on closer inspection of the available data, it appears that this accelerated reduction in emissions is also correlated with an increase in hydro generation. As we have already warned, correlation does not necessarily imply causation. So what's going on?

Figure 2: NEM emissions



Source: AEMO Carbon Dioxide Equivalent Intensity Index, Frontier Economics estimates

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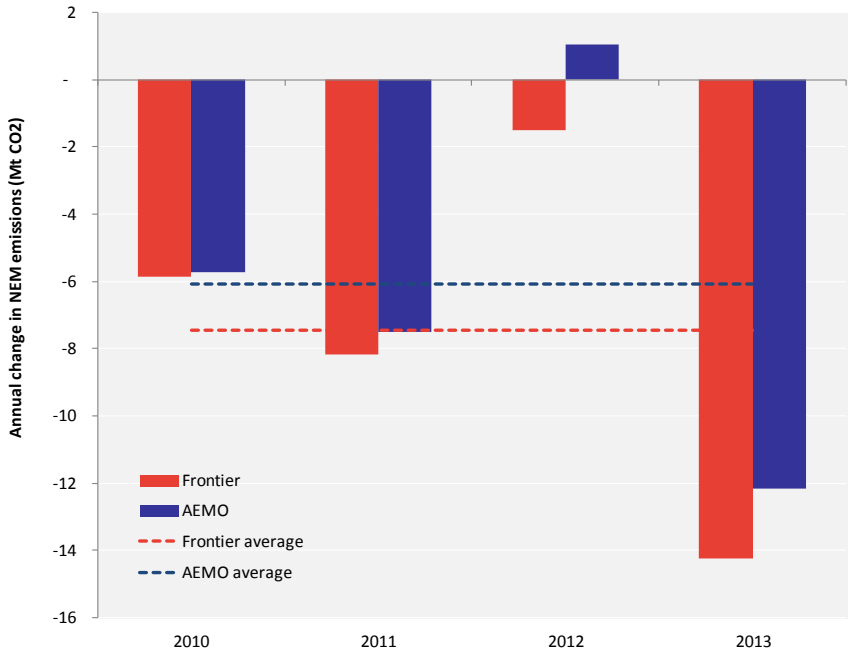
Figure 3: Annual change in NEM emissions (versus prior financial year)



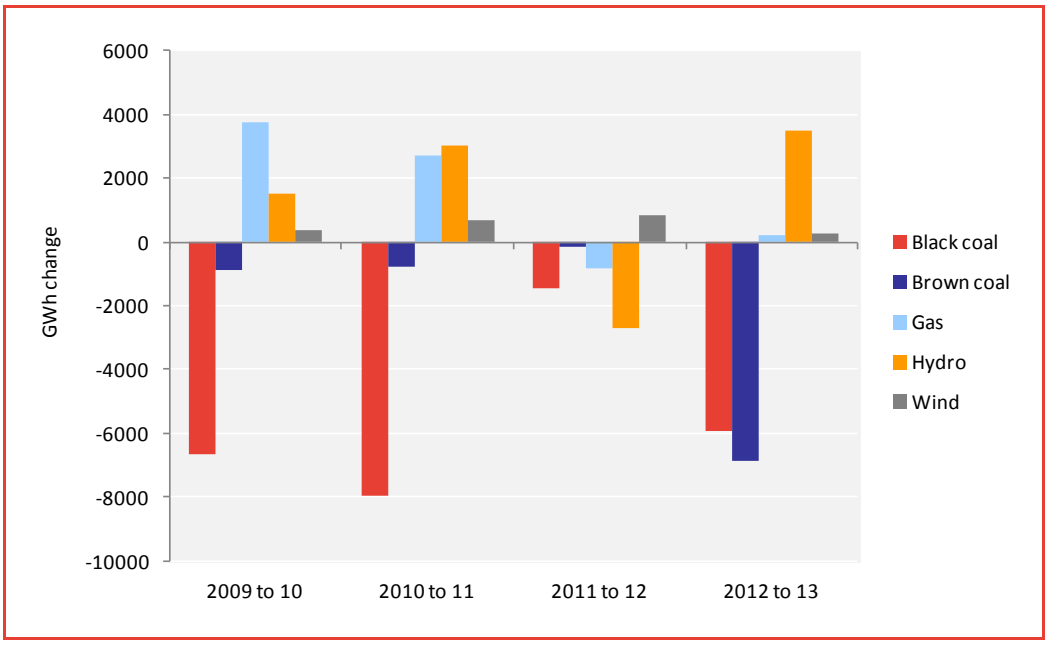
Source: AEMO Carbon Dioxide Equivalent Intensity Index, Frontier Economics estimates

TAX TURNING WATER INTO MONEY

Figure 4 shows the annual change in NEM generation by fuel type from 2009/10 to 2012/13. This figure indicates that black coal output has generally been in decline since before the carbon price was introduced.

The other interesting feature of this graph is the decline in hydro output in 2012, the year before the introduction of the carbon tax, which was followed by an increase in hydro out in the first year of operation of the carbon tax.

Figure 4: Annual change in NEM generation, by type (as generated)



One possible explanation for this pattern of production is that water storages were low due to reduced rainfall in 2012, while increased rainfall in 2013 resulted in a recovery in production. Detailed water storage data is available for Hydro Tasmania, Australia's largest hydro producer to test this theory

Figure 5 shows Hydro Tasmania's energy in storage over recent years. The dashed line reflects the average over the period and the blue line shows the introduction of the carbon price. The chart shows a steady upward trend from 2007-2012, with a sharp decline after the introduction of the carbon price.

Figure 6 shows the annual change in Hydro Tasmania's storages from the start to end of each financial year. This shows that energy in storage tended to increase around 1TWh/year until 2012, then declined around 3TWh in FY2013.

Given rainfall has not been unusually low over the catchments of the main hydro electricity at these times this variation in hydro storages is more likely to be driven by the financial incentives created by the carbon tax to change Hydro Tasmania's pattern of production. Hydro Tasmania is able to store water when prices are relatively low and release to produce electricity when prices are higher due to the carbon price. This capacity for inter-temporal generation shifting is, however, limited by the need to maintain environmental flows of rivers they dam and by the size of their water storages.

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Figure 5: Hydro Tasmania – energy in storage

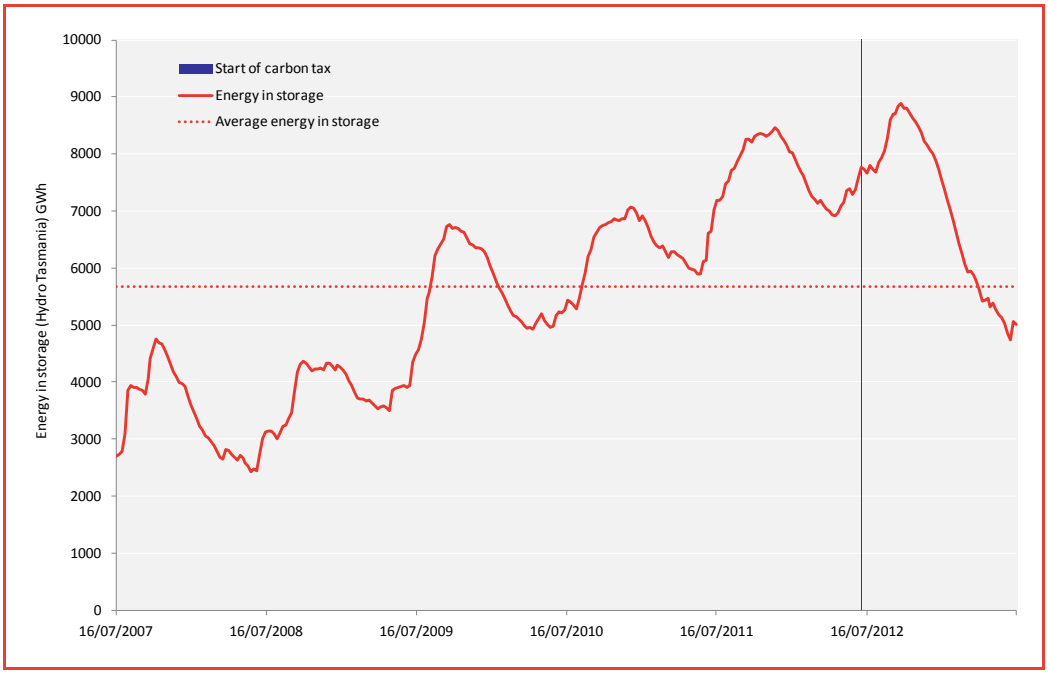
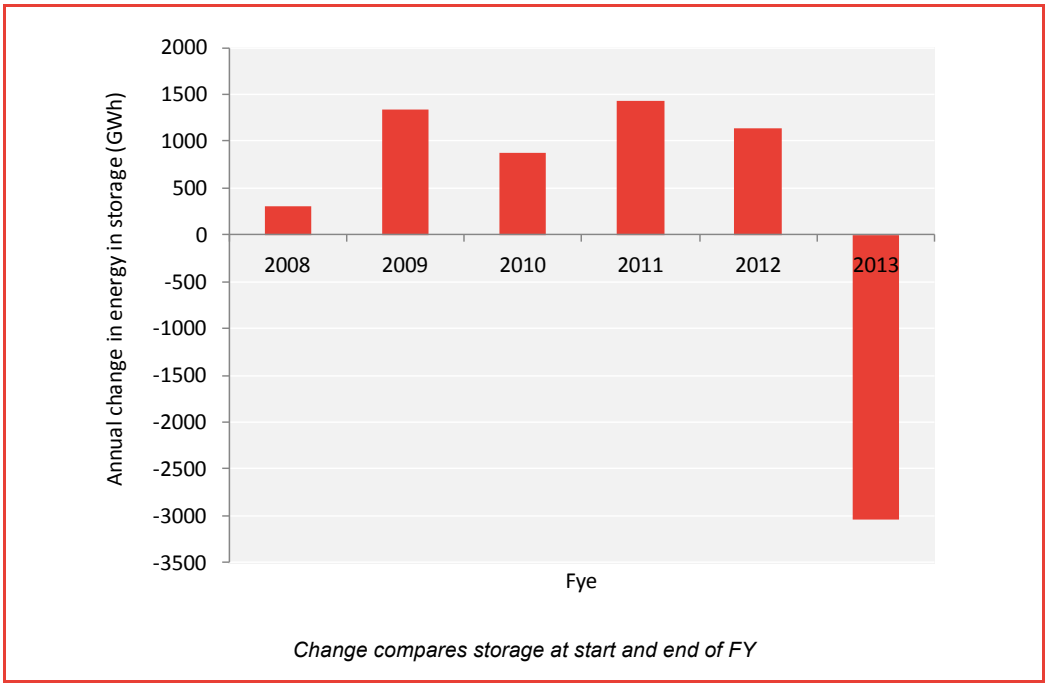


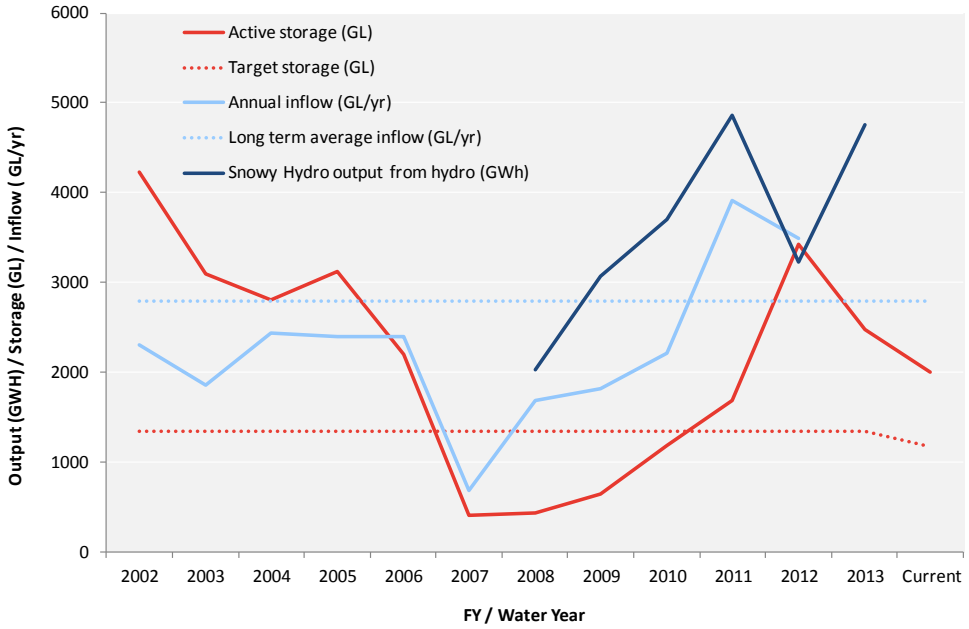
Figure 6: Hydro Tasmania – annual change in energy in storage



Data from Snowy Hydro (Australia's second largest hydro producer) is less clear. Figure 7 shows approximate inflows, active water storage and output, compared with long-term averages for inflows and target active storage. In general, inflows

and storage fell substantially around 2006/7 (though inflows were below the long-term average for several years before this due to drought). Since 2007, inflows, storage and output have risen strongly. This is due to rainfall rather than carbon. There is a kink evident in FYe2012 where hydro output fell though storages continued to rise (even though levels of storage were well above target levels. Storage levels have fallen sharply since as output has increased. Part of this dip in output in 2012 may be attributable to the fall in inflow, but given the level of storages before and after carbon it appears that a reasonable explanation may be some shifting of output to maximise value once carbon was introduced. Either way, total output (and emissions) will be driven by rainfall, However, this shifting of hydro output from 2012 to 2013 (whether due to strategic reasons or rainfall patterns) will tend to overstate emissions reductions in 2013.

Figure 7: Snowy Hydro – water flows, active storage and hydro output estimates



Output FY ends June 30. Water year ends April 30, so the data does not entirely overlap. Water flow data obtained from Snowy Hydro Water Operations reports. Hydro output obtained from AEMO.

Hydro Tasmania and Snowy Hydro would prefer to preserve limited water to generate at times when it is most valuable. Indeed, this is *modus operandi* for hydro generation faced with limited ability to generate electricity. The carbon tax created a strong financial incentive for Hydro Tasmania and Snowy Hydro to withhold water in the lead up to the time before the carbon tax when electricity prices are comparatively low so that they can generate in a market where the price has been boosted by the carbon tax. These businesses are behaving in an entirely reasonable fashion given the incentives created by the carbon tax.

Post hoc ergo propter hoc

For similar reasons we predict that hydro generators will again change their behaviour in response to the most recently announced change to the Government's carbon pricing scheme. That is, the opening the carbon market to the European price a year earlier than originally planned. Faced with either this likelihood or the likelihood that after the Federal election a Coalition Government wins power and abolishes the current carbon pricing arrangements, hydro generators will likely generate as much as they can at the higher priced carbon tax. This behaviour will put further downward pressure on emissions in FY2014, but it would be expected that emissions will rebound in FY2015 as more thermal generation is required from FY2014 onwards to allow the hydro generators to replenish their water storages.

This all makes logical sense and the data supports the hypothesis that hydro generators have been shifting their use of water to maximise their profits, but what does this mean for emissions and the Government's claims that the carbon tax has resulted in a reduction in emissions?

WATERED DOWN EMISSION REDUCTION

For a given demand, a reduction in hydro generation in one year means that existing power stations (i.e. emission producing thermal generators) have to increase their output to compensate for the loss of normal levels of hydro electricity. This means that coal output will tend to be higher in 2012 thereby increasing emissions, all other things being equal. Or, if demand is falling, an increase in coal output as a share of total output would tend to cause a levelling out of emissions in 2012. And indeed this is the outcome seen in Figure 2.

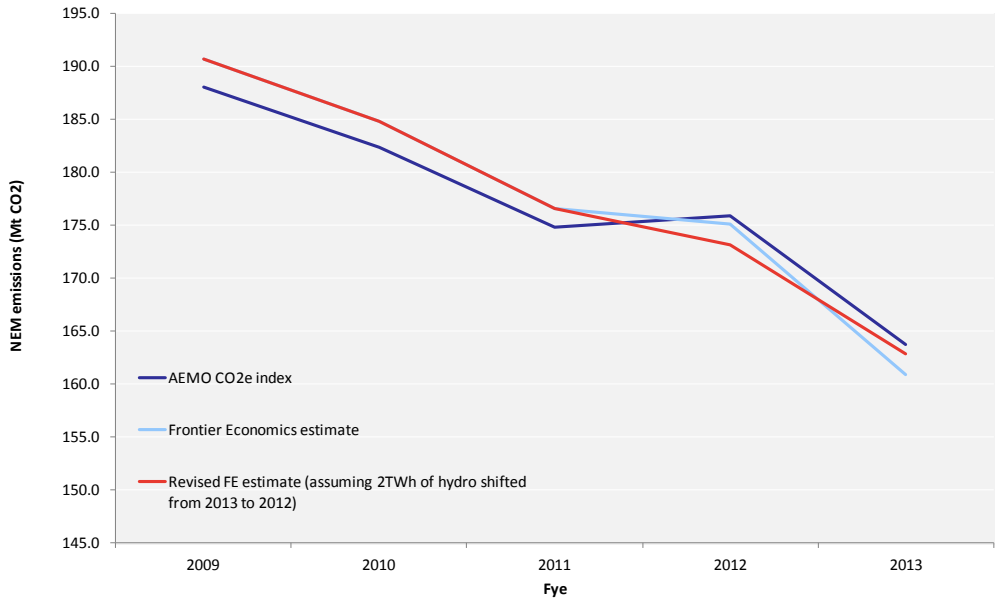
In the year the carbon tax is introduced (FY2013), hydro generators release their banked water to generate unusually high quantities of electricity to sell more into a higher priced market. This output displaces thermal generation and causes emissions to fall. This effect is exacerbated by the fact that the year before the emissions levels were artificially inflated by hydro generators holding back their generation and forcing more thermal generation into the market. This temporary generation switch is clearly seen in Figure 4.

In an attempt to determine how much the carbon tax has affected generation output, we have accounted for the artificial and temporary hydro generation switch by 'normalising' hydro output so that its share of output remains at a more representative level in the lead up to and transition into a market with a carbon tax.

Figure 8 shows the same chart of NEM emissions as before, but with the addition of the normalised emissions curve (red). This normalised curve assumes that 2TWh of hydro output was not artificially shifted from 2012 to 2013. This is based on the assumption that each MWh is worth 1tCO2/MWh of emissions (given that the hydro output would displace brown or black coal, this is a reasonable approximation). With this adjustment, the downward trend in

emissions since 2009 is largely continued (as compared to stalled or slightly increased in 2012 followed by an accelerated decline). This suggests that the carbon price has not discernibly changed this trend and therefore is unlikely to have played a major role in driving additional abatement. Total emissions under the red and the light blue lines are the same across the whole period, but the light blue line would suggest much higher emissions abatement from 2012 to 2013 simply because of the shifting of hydro output (and emissions) between 2012 and 2013.

Figure 8: NEM emissions



Source: AEMO Carbon Dioxide Equivalent Intensity Index, Frontier Economics estimates

EMISSION RAIN CHECK

In the month before the carbon tax was introduced heavy rains caused flooding in the Morwell River that passes over the Yallourn power station mine site in the Latrobe Valley of Victoria. The flooding caused the recently repaired river banks to break and this diverted the river into the coal mine, causing an immediate and significant curtailment in output from one of the highest greenhouse gas emitting generators in Australia.

The result of this prolonged outage of Yallourn was that average availability in FY2013 (the first year of the carbon tax) fell by 344MW compared to FY2012 (see Figure 9). This reduction in capacity is equivalent to, on average, one Yallourn unit. In turn this is equivalent to around 3TWh of generation for the year or around 4Mt of emissions.

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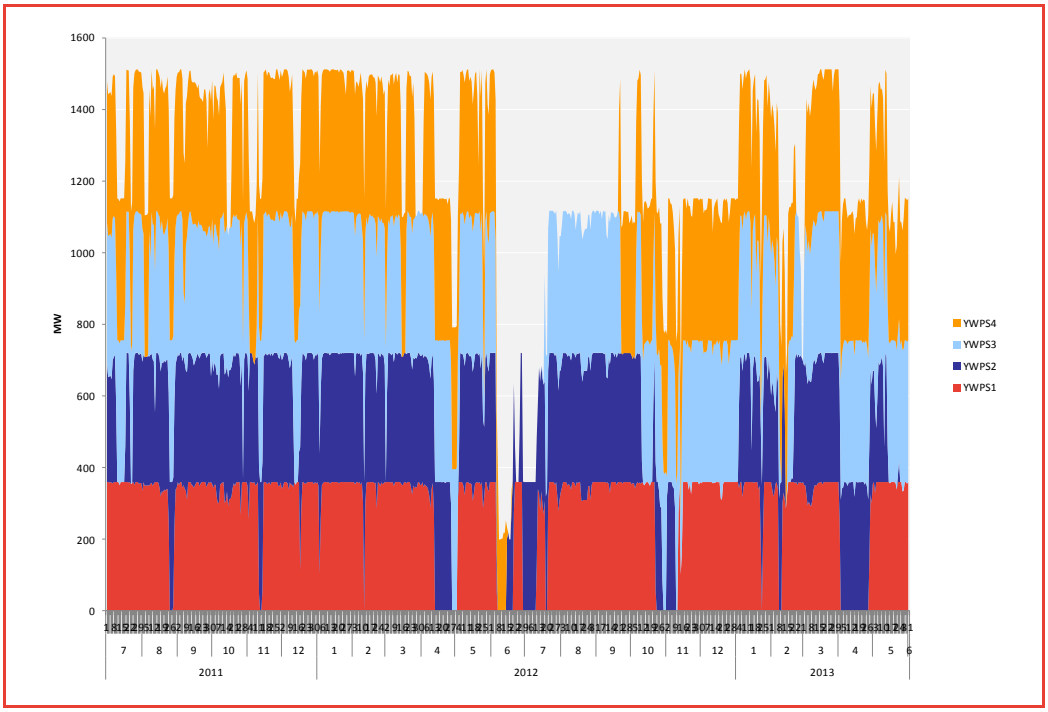
Figure 9: Availability: Yallourn



PLANT FAILURE, CARBON SUCCESS?

In addition to the failure of Yallourn other major coal fired generators have experienced significant reductions in availability (a sign that the plant has experienced a technical failure or is on extended maintenance).

For example, the black coal generator in NSW, Liddell, experienced an availability fall of around 290MW (equivalent to around 2.6Mt of emissions) between FY2012 and FY2013, which is not caused by the carbon tax.

IDLE PLANTS

With the continuing decline in electricity demand (a trend that preceded the carbon tax) a number of older, less economically efficient coal fired generators have shut down some idle capacity rather than continuing to run them inefficiently. For example, Tarong and Wallerawang have closed/mothballed units, reducing *average* availability by around 160MW and 133MW respectively (worth approximately 1.4Mt and 1.1Mt of emissions) – see Figure 10 for the most notable changes to average plant availability.

It is possible that the carbon tax was the final straw that induced these plant owners to mothball some units. However the reduction in output and emissions from these older coal fired plants have been made up in large part by increases in the output of other generators (e.g. Mortlake, Vales Point, Millmerran and Kogan Creek).

The approximate reduction in emissions related to the lower availability of these plant are shown in Figure 11.

Figure 10: Change in availability (FY2012-2013)

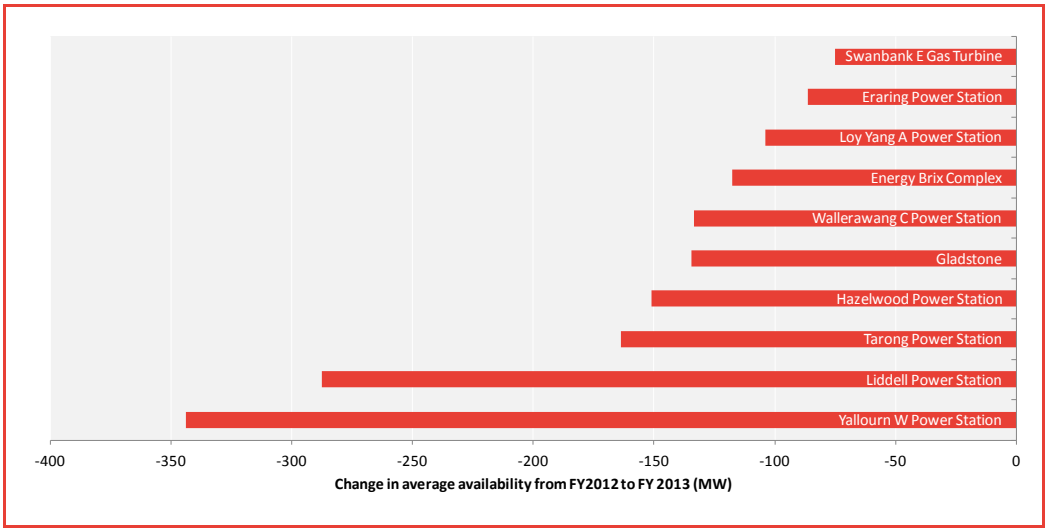
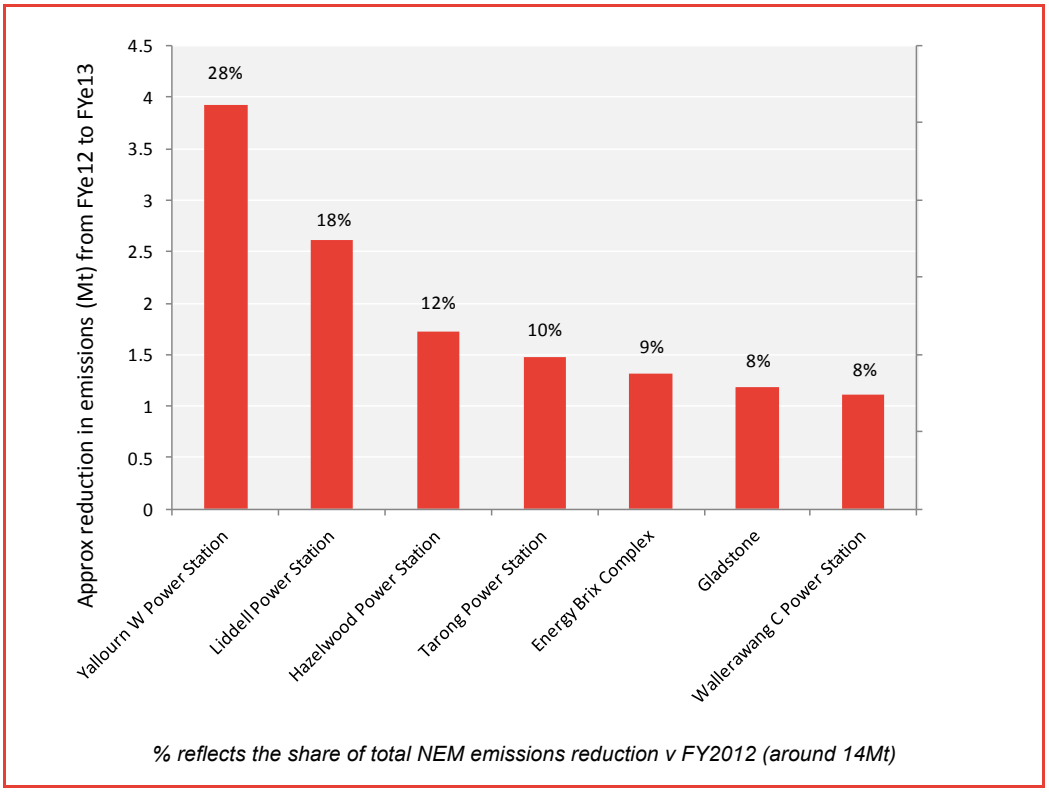


Figure 11: Approximate change in emissions (FYe2012-2013)



CONCLUSION

There is no doubt that there has been a reduction in CO_2 emissions from the NEM since the introduction of the carbon tax. Unfortunately it is unlikely that the carbon tax has directly caused this reduction, at least so far. The more likely explanation is the combined effect of:

- Decline in demand for electricity, which reflects an ongoing trend of falling electricity generation and emissions since 2009 (pre-existing the carbon price);
- Plant, equipment and services failures at high emission generators like Yallourn brown coal power station in the Latrobe valley of Victoria. These failures have nothing to do with the carbon tax but have resulted in material reductions in the output of some of the highest emission generators in the NEM; and
- Preservation of water by hydro generators in the year before the carbon tax (forcing greater thermal generation) so that they can generate more power in the first year of the higher priced market with the carbon tax (which causes thermal generation to decline compared to the artificially higher level the year before the tax). Since hydro generators can't make it rain to provide water to sustain this higher production level, hydro generation levels will return to normal levels, and emissions with it.

Once the Australian carbon scheme is linked to the European scheme, at current European prices, there is little chance that at such low prices (less than $10/tonne) any material abatement activity will occur in the electricity sector in Australia due to the carbon price. At the relative costs of coal and gas prices, a carbon price of $35/tonne or more is required to switch production from existing coal to gas (or considerably higher with rising gas prices). Instead, it is likely that Australia will rely on permit imports, abatement driven by the Renewable Energy Target and slow electricity demand growth to meet the emissions reduction target.

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