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How will the Hazelwood closure impact the NEM?

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This edition of IES Insiders investigates the impact of the 1,600 MW Hazelwood Power Station withdrawing from the National Electricity Market (NEM). We assessed the market changes in terms of dispatched electricity, greenhouse gas emissions, power flows across interstate transmission lines, and the revenue impacts to each main type of generator. We also examined the changes to regional wholesale spot prices and how this will affect household electricity costs.

1 NEM Modelling with PROPHET

To test the market impact of a Hazelwood closure, IES carried out a simulation of the NEM using its proprietary modelling application, PROPHET. The modelling uses the most up to date input assumptions including forecasts for electricity demand, gas and coal costs, and capital costs for new generator investment. This new entrant capacity is initially expected to be either new wind (driven by the Renewable Energy Target, or RET) or gas turbines.

The PROPHET calculations replicate the Australian Energy Market Operator's (AEMO) bid stack for scheduled electricity generators. AEMO makes the generator merit order calculations in real time and PROPHET uses this approach to produce wholesale spot prices over short, medium and long term forecast periods. Our bidding logic takes account of the ability larger players have to lift the price of their offers when supply is constrained.

We haven't included the Victorian 40% and Queensland 50% renewable targets because the full details of these schemes haven't yet been finalised. In any case neither scheme will be fully in place during the period of our forecasts.

We carried out detailed modelling of the NEM in two scenarios. The first scenario assumed Hazelwood remains in service and the second sees it closed from 31 March 2017. The scenarios are otherwise the same. A comparison between the scenarios provides an indication of how NEM prices, emissions, dispatched generation, and investment will respond as a result of the Hazelwood closure. We ran five year forecasts for this article.

We note that a recent AEMO report assesses the impact of the Hazelwood closure on reliability in the NEM[1]. It found that the NEM will continue to operate reliably, however the supply and demand balance will be tighter during times of peak demand. Our analysis and discussion focuses on impacts other than reliability. This includes a forecast of changes to price, investment, generator revenues, and emissions.

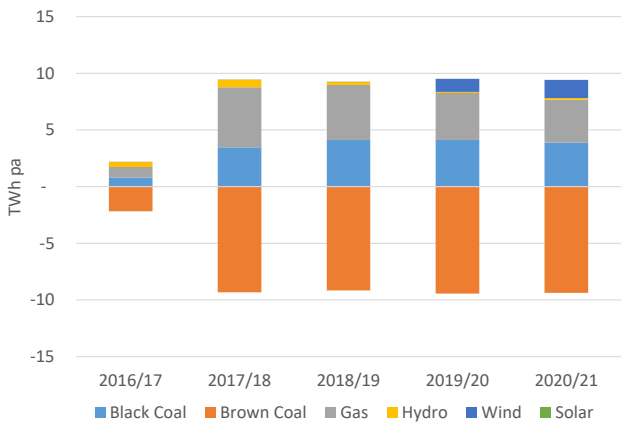
2 Dispatched Generation

The withdrawal of Hazelwood's 1,600 MW generating capacity will change the dispatched energy outcomes across the whole NEM. Victoria currently exports around 7 TWh of electricity each year to other states (or 14% of its total generation output). Hazelwood produces about 10.3 TWh per year and it is expected that the lost supply from the closure will be made up by both Victorian and interstate generation sources. The figure below shows how the overall NEM generation mix is expected to change. The results for

[1] *AEMO Market insight report – Victoria's supply outlook November 2016*

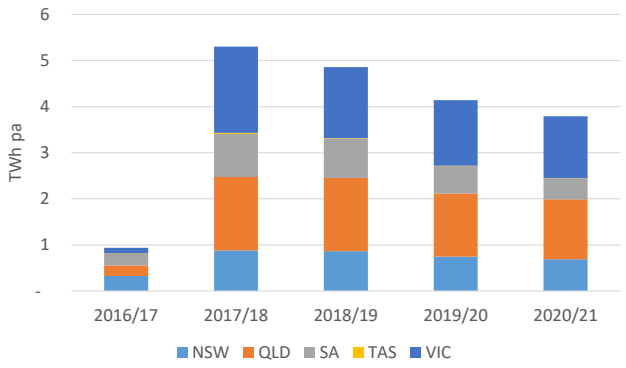
the 2016/17 year are lower than the subsequent years since the Hazelwood closure will only have been in place for three months.

Figure 1 Changes to NEM dispatched energy (by fuel type)



Electricity supplied from Hazelwood is replaced by black coal, gas turbine, and a small amount from hydroelectric sources. More than 75% of this energy is generated outside Victoria. It is projected that gas-fired generation will increase output to supply 48% of the consumption previously met by Hazelwood. This additional gas generation occurs across Victoria, Queensland, South Australia and NSW (as shown in the following chart).

Figure 2 Additional gas generation by NEM region



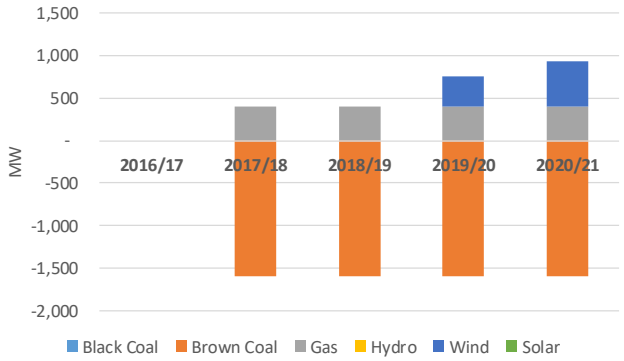
The contribution of gas turbines to the make-up declines over the five year forecast. This is due to the arrival of new generation capacity that displaces more expensive gas fuelled generation sources.

A further 42% of the replaced energy is met by more black coal generation in NSW and Queensland. The remainder is met by additional hydro output from Victoria and Tasmania.

3 New Capacity Investment

Our modelling takes into account the need for additional generation investment over the forecast term by using a least cost approach. This includes capital investment, fuel costs, and any incentives provided by the RET. We forecast that the Hazelwood closure will trigger an additional 760 MW of new entrant capacity over the next five years. The following figure shows these changes. The 1,600 MW of capacity lost from Hazelwood is only partly replaced due to subdued demand forecasts and a current oversupply of generation capacity.

Figure 3 Changes to Generating Capacity in the NEM



The modelling found that the additional wind turbines were installed in Victoria and South Australia. The gas turbine investment occurs in 2018 but we note that some South Australian gas generation may be returned to service ahead of any further investment in this technology.

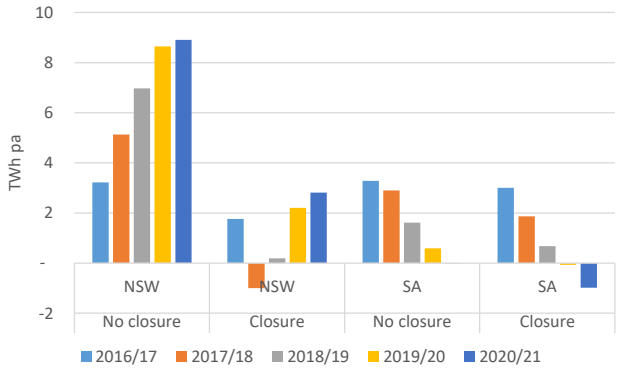
4 Interconnector flows

Victoria is currently a net exporter of electricity to NSW, South Australia, and Tasmania. The closure of Hazelwood means that 10 TWh of energy will be required to be made up from other sources. Figure 4 shows the net energy exports from Victoria under the two modelled scenarios.

The most significant change from the closure is the reduction in net electricity exports from Victoria to NSW. Before the announcement, Victoria was expected to contribute up to 9 TWh to NSW demand in 2021. But

introducing the closure shows that in 2017/18 this trend will be reversed and NSW will briefly become a net exporter to Victoria. New capacity investment in Victoria restores the existing trend after 2017/18 but is still well below the level of the power flows in the base case.

Figure 4 Net Victorian electricity exports for two scenarios



Victorian net exports to South Australia also fall substantially. By 2021 South Australia is expected to export to Victoria on a net flow basis due to additional generation/investment in South Australia combined with subdued market demand. We note that the Victorian 40% renewable scheme was not included in either scenario.

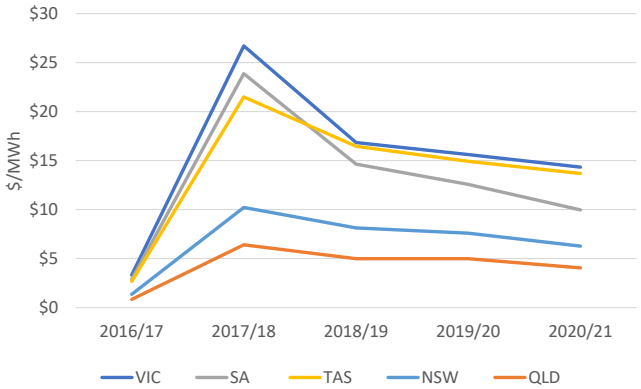
The Victorian net exports to Tasmania also fall by between 100 and 400 GWh over the forecast term. Tasmania will rely more on its own generation sources.

5 Wholesale Prices

The retirement of Hazelwood power station is expected to increase wholesale electricity prices. Brown coal is a cheap source of electricity generation that offers capacity into the market at comparatively low prices. Our analysis showed that the generation replacing Hazelwood will be made up by black coal and gas turbine sources. These power stations have higher marginal running costs than a brown coal generator.

The two PROPHET simulations calculated the wholesale prices in each region over the five year forecast term. The changes between the two scenarios are shown in Figure 5. Annual wholesale prices increase in all regions as a result of the Hazelwood closure. The impact is the greatest in the 2017/18 year before new capacity is anticipated to arrive in Victoria and South Australia. Wholesale price impacts are $27 /MWh in Victoria for this year. South Australia and Tasmania also see wholesale price increases that are of a similar magnitude. Prices in NSW and Queensland increase due to a greater reliance on gas generation.

Figure 5 Net increase to annual regional wholesale prices due to the Hazelwood closure (2016 $)

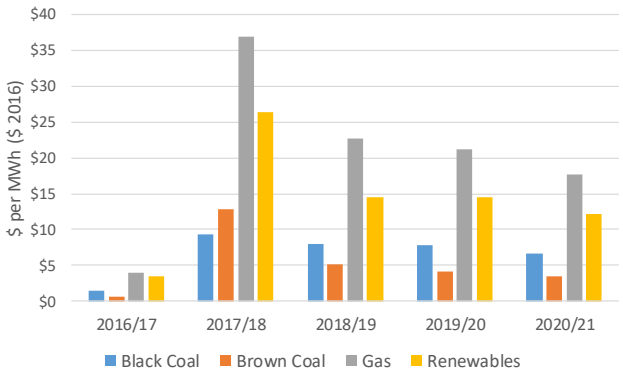


The Hazelwood closure impacts Queensland prices due to a flow on effect from reduced electricity exports from Victoria to NSW.

6 Generator Revenue

We quantified the revenue impacts for each generator type as a result of the increases in wholesale prices. To calculate these impacts, we focused on the half-hourly wholesale spot price and have ignored any power purchase or hedging contracts that exist between retailers and generators.

Table 1 Additional spot revenue per MWh generated



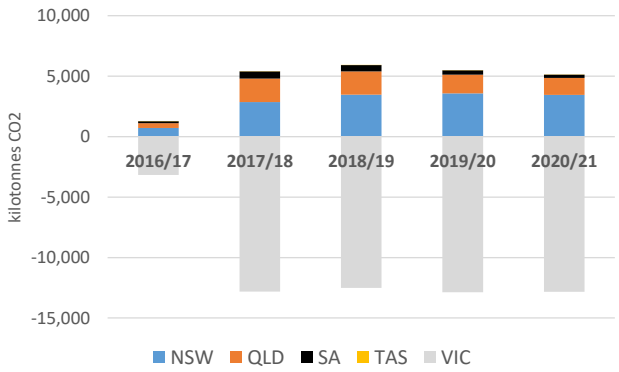
Gas generators are assessed to benefit the most as each MWh they generate will achieve a $37 /MWh premium (price increase relative to the base case) in 2017/18. Renewables (mostly wind turbines and some hydro) will achieve a $26 /MWh premium. However, black coal would

receive the most spot market revenue at $1.0 billion in 2017/18 because it generates more MWh than the other types of generation. Gas fuelled generation sees an extra $0.9 billion, renewables $0.7 billion, and the remaining brown coal sources $0.5 billion. These values fall in the remaining years of the forecast.

7 CO_2 Emissions

The Hazelwood closure does not mean that Australia's annual total emissions will be reduced by the total amount of that power station's emissions. This is because its generated energy will be mostly replaced by black coal and natural gas. However, the lower emission intensities of these substitutes ensures that some gains will be made. The following figure shows the net impacts to emissions in each state as a result of the Hazelwood closure.

Figure 6 Net changes to NEM emissions by state from the Hazelwood closure



For the first full financial year of the closure total NEM emissions fall by 7.4 million tonnes (which is about half of the annual Hazelwood emissions).

8 Conclusion

Our modelling examined the potential market impacts from the closure of Hazelwood Power Station in March 2017. The results provide an illustration of possible changes to various market outcomes such as wholesale prices. Price increases are expected to be the largest in Victoria, South Australia and Tasmania. In the modelling the average Victorian wholesale price increases by $27 /MWh in the 2017/18 financial year. This translates to a $2.50 per week or 11% increase for the average Victorian household[2]. The impact to large business customers will be relatively larger given that the wholesale component contributes more to the total electricity costs for these customers.

South Australia and Tasmania see price increases of a similar magnitude to Victoria due to the reduction in electricity imports for these states. They will be required to source more electricity locally. Gas generation in South Australia will need to increase production by almost 1 TWh or 18% to replace the reduced flows across the interstate transmission links. These price impacts should ease after 2017/18 as more investment is introduced in the NEM. This investment partly replaces the retired Hazelwood capacity.

The results also show that interconnector flows from Victoria to NSW will fall substantially. This will see more gas and black coal generation dispatched in NSW and Queensland (with corresponding higher prices).

Our analysis of generator revenues showed that the outlook for the remaining NEM generators is significantly improved as a result of the Hazelwood closure. Coal fuelled generators in the NEM are forecast to receive an extra $1.5 billion in wholesale market revenue in 2017/18. This means that the decision to close other coal plant is likely to be delayed. It may also explain why Hazelwood's owner (Engie) has announced it intends to sell its other brown coal fired power station, Loy Yang B.

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[2] Assumes a 5 MWh market offer customer in metropolitan Melbourne.