

Coal cost projections

Approach to coal cost projections

July 2019





Background and Objectives

Coal cost projections

The Australian Energy Market Operator (AEMO) is responsible for operating Australia's largest gas and electricity markets and power systems, including the National Electricity Market (NEM), the interconnected power system in Australia's eastern and south-eastern seaboard; and Wholesale Electricity Market (WEM).

AEMO's planning functions rely on an underlying set of input assumptions that govern the behaviour of existing generation assets, and the economics/location of future investment and retirement decisions.

The dataset includes projections of fuel costs for both existing and emerging generation technologies. Updated coal cost projections are required for upcoming market simulation studies that will be conducted by AEMO. To this end, AEMO engaged Wood Mackenzie to provide delivered cost of coal for both existing and upcoming power projects.

Wood Mackenzie has provided a separate excel document including the coal cost projections under different scenarios, and a high level approach and risks to the coal cost projections in this document.



1. Approach

2. Scenario development

3. Results



We adopted a stepped approach for the projections – Step 1 involved identifying the type of contracts and supply options for the power stations.

Scope

Step 1: Identify the type of contracts and other supply options

Key issues/assumptions

- » **Approach for the existing power stations:**
 - » **We identified the type of coal procurement arrangements for the existing power plants based on the Wood Mackenzie research and the publicly available data:**
 - » Contracted vs Uncontracted coal supply arrangements
 - » Commercial terms under the contracts
 - » **We also identified possible future mine to power plant coal flows in case of uncontracted volume or as existing contracts expire. This is based on**
 - » coal qualities at existing mines and upcoming projects, distance from power plant, production profile over 2018/19 to 2040/41,
 - » remaining reserves, etc.
 - » **The following details related to the existing power stations were provided by AEMO:**
 - » Capacity
 - » Station heat rates
 - » Plant load factors
 - » Plant life
- » **Approach for new (Upcoming) power projects:**
 - » We identified the coal sourcing options for the following locations based on the resource potential of upcoming coal projects:
 1. North Queensland
 2. Central Queensland
 3. Southwest Queensland
 4. Northern NSW
 5. North-Central NSW
 6. Latrobe Valley

Step 2 involved applying different pricing approaches based on the type of contracts to arrive at the delivered costs of coal.

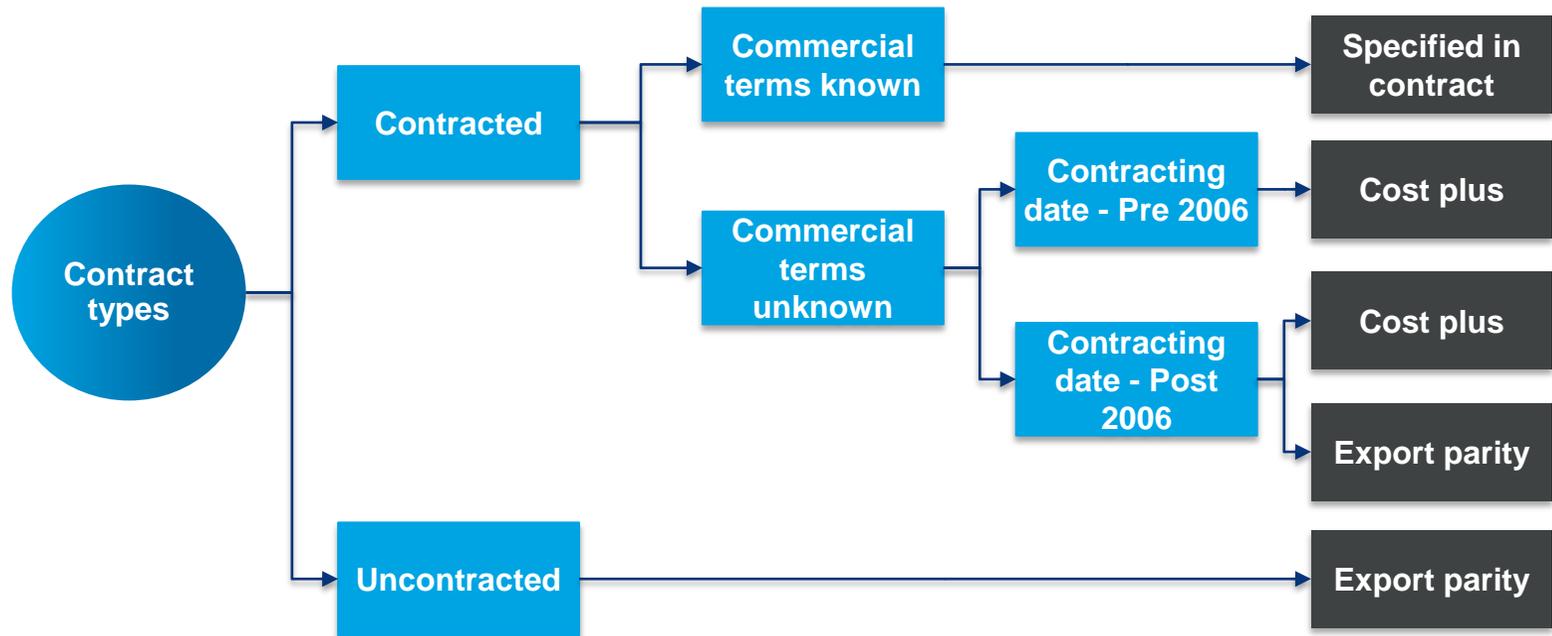
Scope

Step 2: Analyse the delivered cost of coal (Forecast for 2018/19 to 2040/41)

Key issues/assumptions

- » The pricing approach for the existing power stations have been shown in the diagram below.
 - » The contract related information is based on the information available in the public domain.
- » The pricing approach for new power projects is based on the marketability of coal in the export market and the access to export infrastructure:
 - » In case of existing access to export infrastructure and suitable coal quality, we adopted export parity pricing. Otherwise, we adopted cost plus approach.
 - » Although there may be some lead time to the development of new projects, we have provided projections starting from 2018/19 for the modelling purpose (as requested by AEMO).

Coal pricing approach – Existing power stations





Approach to cost plus and export parity pricing.

Scope

Cost plus approach

Key issues/assumptions to be analysed and discussed

- » **Forecast cost plus estimates are based on the Wood Mackenzie research information related to the various cost elements:**
 - » Mining cost
 - » Sustaining capex
 - » Processing & Overheads
 - » Margin
 - » Royalties
 - » Transportation

Export parity approach

- » **Export parity estimates involved the following steps:**
 - » Identify the contracted mines or the least cost option mines
 - » Establish products that can be sold from the mine
 - » Estimate price based on the specific type of products and the Wood Mackenzie's base case price forecasts .
 - » Estimate cost for each type of product
 - » Arrive at margin earned from each type of product on ROM tonne basis
 - » Select the product based on optimum margin
 - » Calculate the ex-mine price based on the optimum margin
 - » Add: transportation distance/ cost to power station
 - » Allow discount on account of comparatively lower risk of supply to domestic supply



1. Approach

2. Scenario development

3. Results



We have developed three scenarios consistent with the scenarios (Neutral, Fast Change and Slow Change) defined by AEMO (1/3).

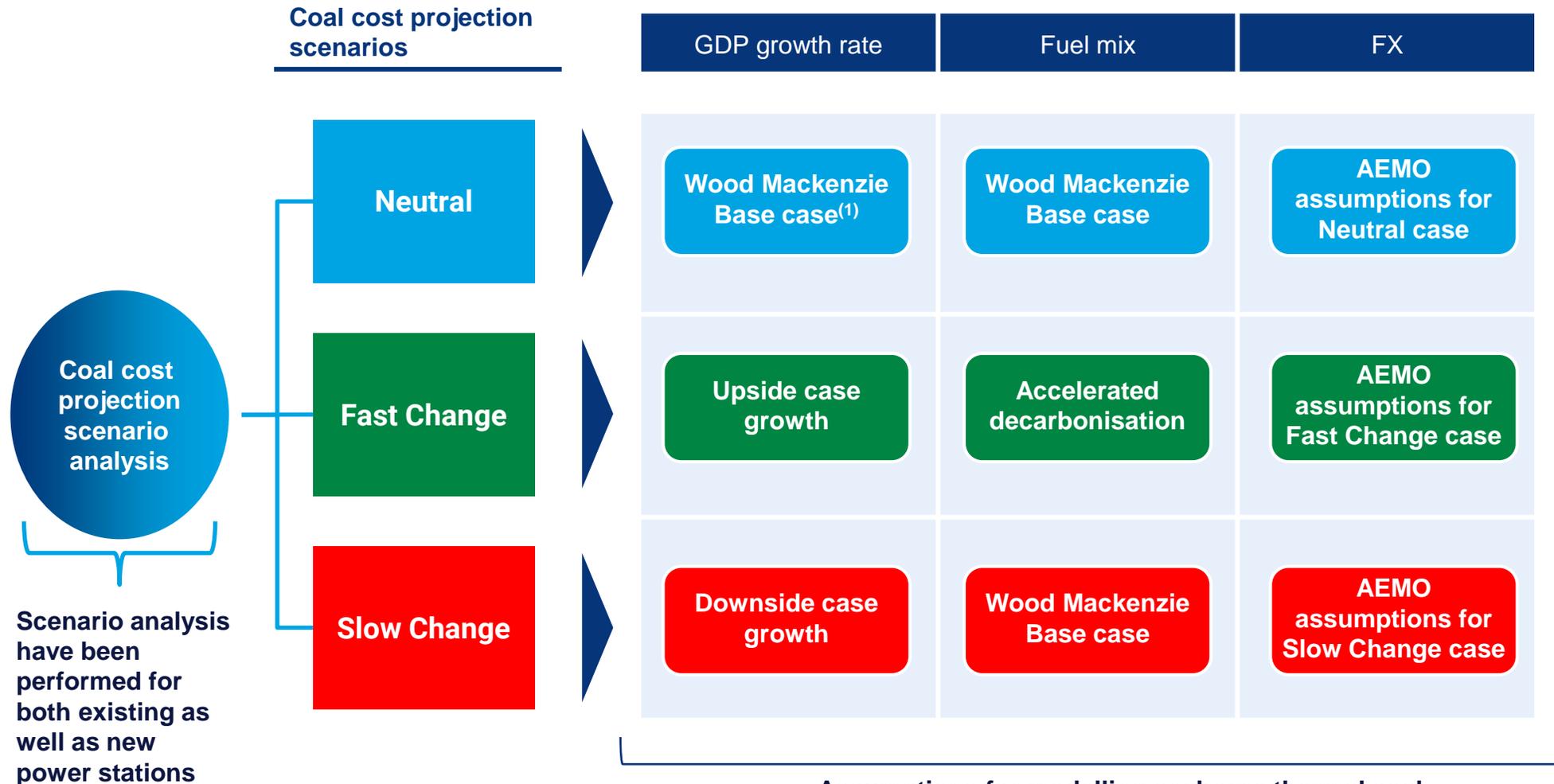
- **We have modelled cost of coal projections for different scenarios defined by AEMO⁽¹⁾:**
 - » Fast Change – a future where Australia’s economy is booming, population growth is strong, and emission reduction targets are aggressive, leading to rapid decarbonisation of the both the stationary energy sector and the transport sector. Consequently, growth in grid demand is relatively strong and there is a material change in the large-scale generation mix over time.
 - » Neutral – a future where modest economic and population growth is experienced, and existing carbon abatement policies are met and extended on a similar trajectory. Consequently, grid demand is relatively static, and change in the large-scale generation mix is largely driven by timing of coal-fired generation retirements.
 - » Slow Change – a future where Australia’s economic and population growth is weak, and proportionately more of the decarbonisation occurs through decentralisation, with a greater proportion of households and commercial businesses installing rooftop photovoltaic (PV) systems to help reduce energy costs. The transition towards zero emission vehicles is slow, as people have less disposable income and are buying new vehicles less often. Consequently, grid demand is in decline and the change in large-scale generation mix over time is less pronounced.
- **We have modelled the scenarios for delivered cost of coal to the power stations based on the assumptions consistent with the scenarios defined above:**
 - » Forecast price of thermal coal traded in seaborne market is one of the key assumptions for estimating delivered cost of coal.
 - » Seaborne thermal prices are in turn based on a set of macroeconomic assumptions (GDP growth rates) and power generation fuel mix for the thermal coal importing countries.
 - » While these assumptions were not provided by AEMO, we used the assumptions which are generally consistent with the definition of above scenarios.
 - » The approach has been explained further in the subsequent pages.

Note: 1) Source: Scenarios, Inputs, Assumptions, Methodology, Timeline, and Consultation Process; 2019 Planning and Forecasting Consultation Paper; February 2019

We have developed three scenarios consistent with the scenarios (Neutral, Fast change and Slow change) defined by AEMO (2/3).

Key issue	Description
<p>GDP</p>	<ul style="list-style-type: none"> » GDP growth rate assumptions for the seaborne import countries were not provided by AEMO. Considering Neutral case as defined by AEMO and Wood Mackenzie Base case are both business as usual scenarios, we assumed the GDP growth assumptions for the Neutral case scenario in line with the Wood Mackenzie's Base case assumptions. » As defined by AEMO, the Fast Change scenario assumes global economic growth to be stronger compared to that in the Neutral case and the Slow Change scenario assumes global economic growth to be weaker compared to that in the Neutral case.
<p>Fuel mix</p>	<ul style="list-style-type: none"> » Fuel mix related assumptions for the seaborne import countries were not provided by AEMO. Considering Neutral case as defined by AEMO and Wood Mackenzie Base case are both business as usual scenarios, we assumed the fuel mix assumptions for the Neutral case scenario in line with the Wood Mackenzie's Base case assumptions. » In line with the scenario defined by AEMO, the Fast Change scenario assumes rapid decarbonisation of global economy. This case assumes rapid increase in renewables resulting in rapid decline in the demand for imported coal. » For the Slow Change scenario, we have assumed fuel mix similar to that of Base case.
<p>Foreign exchange rate (A\$/US\$)</p>	<ul style="list-style-type: none"> » Foreign exchange rates for Neutral, Fast Change and Slow Change scenarios were provided by AEMO.
<p>Operating costs of mines</p>	<ul style="list-style-type: none"> » We have applied same costs (Base case) for all scenarios.

We have developed three scenarios consistent with the scenarios (Neutral, Fast Change and Slow Change) defined by AEMO (3/3).



Assumptions for modelling seaborne thermal coal prices under different scenarios.

Note: 1) Aligned with 2018 H2 thermal coal market outlook



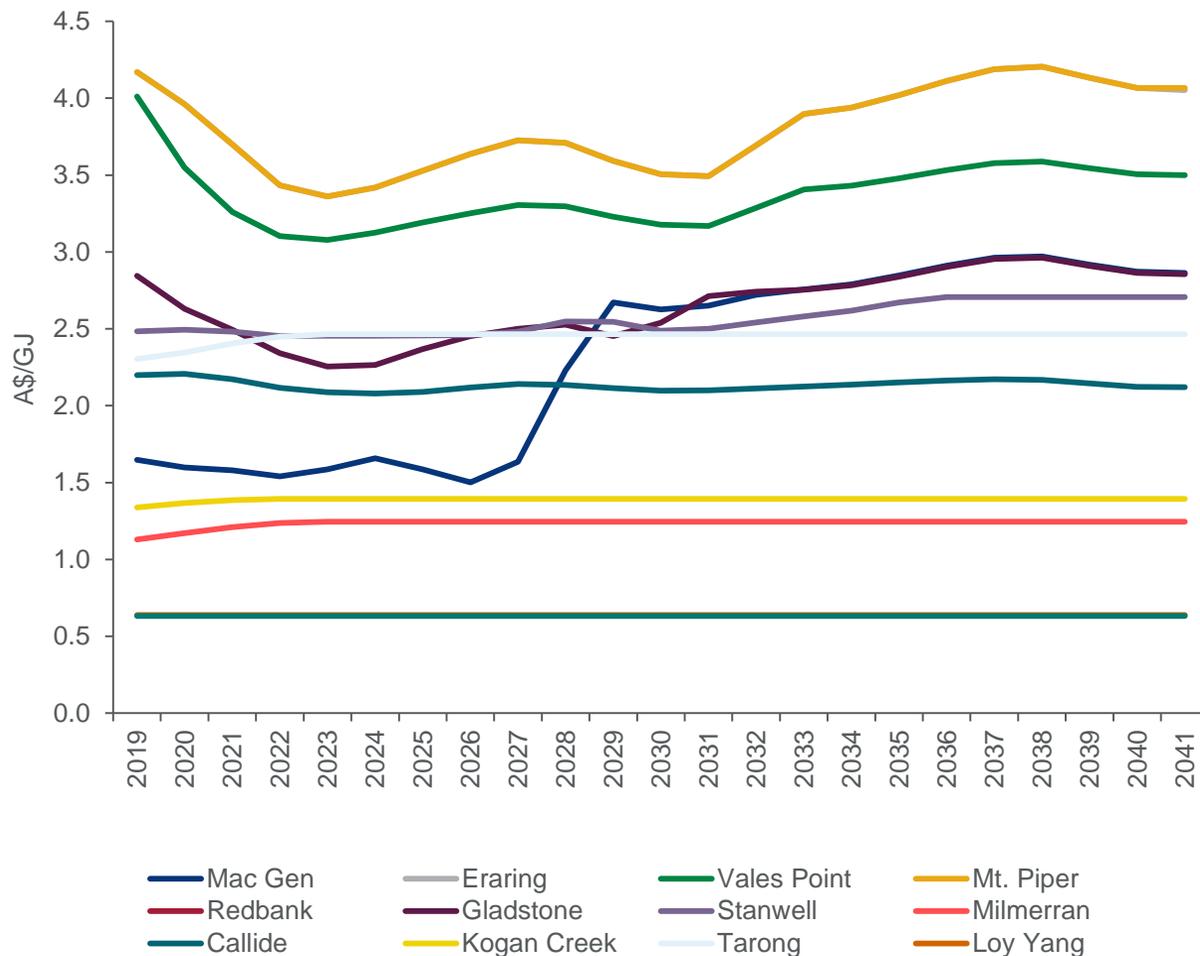
1. Approach

2. Scenario development

3. Results

Forecast delivered costs of coal follow different patterns based on the arrangement of the coal supply and the type of coal.

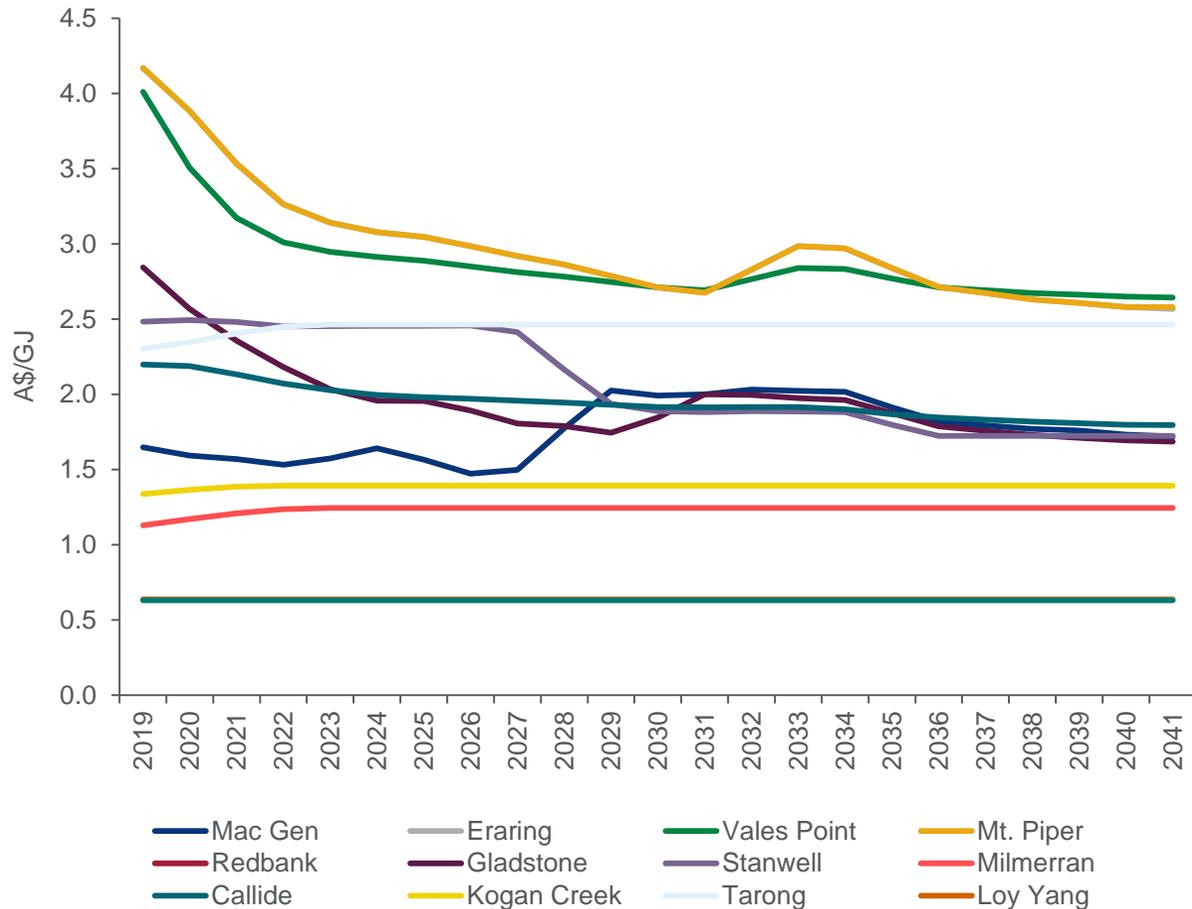
Delivered cost of coal – Neutral scenario



- ◆ **Power stations with captive supply of coal**
 - » For the power stations with captive supply of coal, delivered costs of coal are generally flat and are generally reflective of operating costs. Apart from the captive supply, there are a few power stations where the supply has been contracted on a fixed rate. These power plants also have a relatively flat delivered cost of coal during the contract period.
- ◆ **Power stations contracted on export parity basis**
 - » For the power stations with coal supplied on export parity based costs, delivered costs generally follow Wood Mackenzie's Base Case view of the thermal coal prices. The delivered costs also differ between the stations due to the type of coal being assumed for estimating costs. For instance, a power station sourcing coal with low value in use in the export market will pay a relatively lower price on an export parity basis compared to a power station sourcing coal with high value in use.

Forecast delivered costs of coal in the Fast scenario are lower compared to that in the Neutral scenario due to fuel mix related assumption.

Delivered cost of coal – Fast scenario

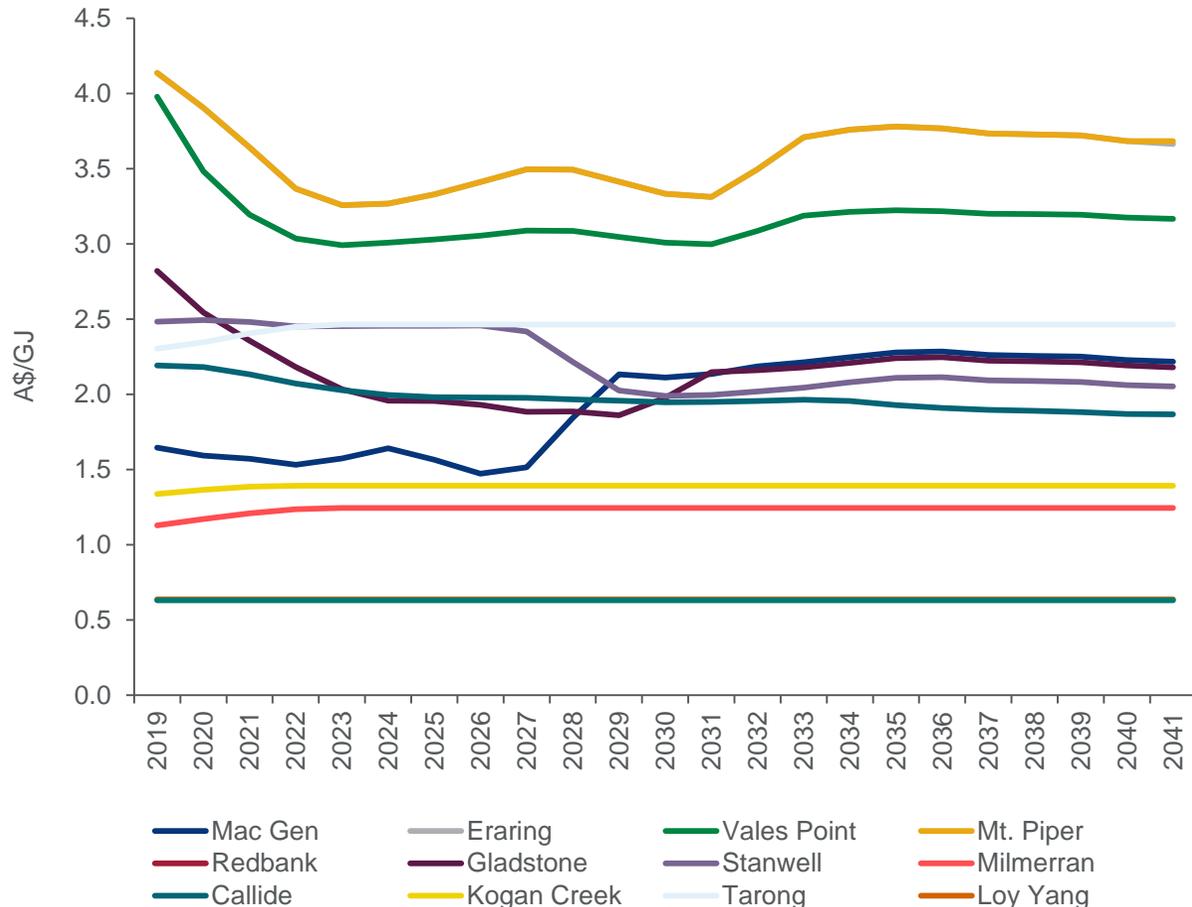


- Delivered costs of coal for the power stations not exposed to export parity prices are unaffected by Fast scenario.
- For the power stations exposed to export parity prices, delivered costs are lower due to relatively lower price of thermal coal in the export market.
- Delivered costs are lower in the Fast scenario due to fuel mix related assumptions. Increase in renewables driving rapid decline in the demand for imported coal will result in a significantly lower price of thermal coal despite stronger economy. Fuel mix related assumption for this scenario is in line with the IEA Sustainable Development Scenario (SDS).
- The IEA SDS scenario assumes rapid decarbonisation compared to business as usual case. The IEA SDS scenario ⁽¹⁾ is fully aligned with the Paris Agreement’s goal of “holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C”.

Note: 1) Source: <https://www.iea.org/weo/weomodel/sds/>

Forecast delivered costs of coal in the Slow case scenario are lower compared to that in the Neutral scenario due to macroeconomic economic assumptions.

Delivered cost of coal – Slow scenario



- Delivered costs of coal for the power stations not exposed to export parity prices are unaffected by Slow scenario.
- For the power stations exposed to export parity prices, delivered costs are lower due to relatively lower price of thermal coal in the export market.
- Delivered costs are lower in the Slow scenario due to relatively weaker economic growth resulting in lower imported coal demand which in turn has resulted in overall lower prices for thermal coal in the export market. Foreign exchange rate assumptions as per AEMO is the another driver contributing to the relatively lower costs in this scenario.



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