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The retirement of coal-fired power stations

The Australian Energy Council (the Energy Council) welcomes the opportunity to make a submission to the Senate Standing Committee on Environment and Communications on the retirement of coal-fired power stations.

The Energy Council is the industry body representing 21 electricity and downstream natural gas businesses operating in the competitive wholesale and retail energy markets. These businesses collectively generate the overwhelming majority of electricity in Australia and sell gas and electricity to over 10 million homes and businesses.

Australia's transitioning electricity sector

Australia's electricity system is transitioning towards a lower emissions economy, and this is encouraged by the Australian Government's ratification of the [Paris Agreement](#) (Paris, 12 December 2015), which aims to keep global warming below two degrees Celsius, and, ideally, below 1.5 degrees Celsius. Given this trend, Australia should manage the transition in a manner that supports investment decision making and Australia's international climate commitments.

The electricity market will continue to transition due to technological developments, increased use of renewables, and energy user choices. The further deployment of low and zero emissions generation as well as a reduction in emissions across the sector will be necessary if the sector is to contribute to the national emissions reduction task. The question is how to best manage this transition in the best interests of all stakeholders.

The importance of coal-fired power stations in the electricity generation fuel mix

Coal-fired power stations provide a number of valuable services to the electricity system:

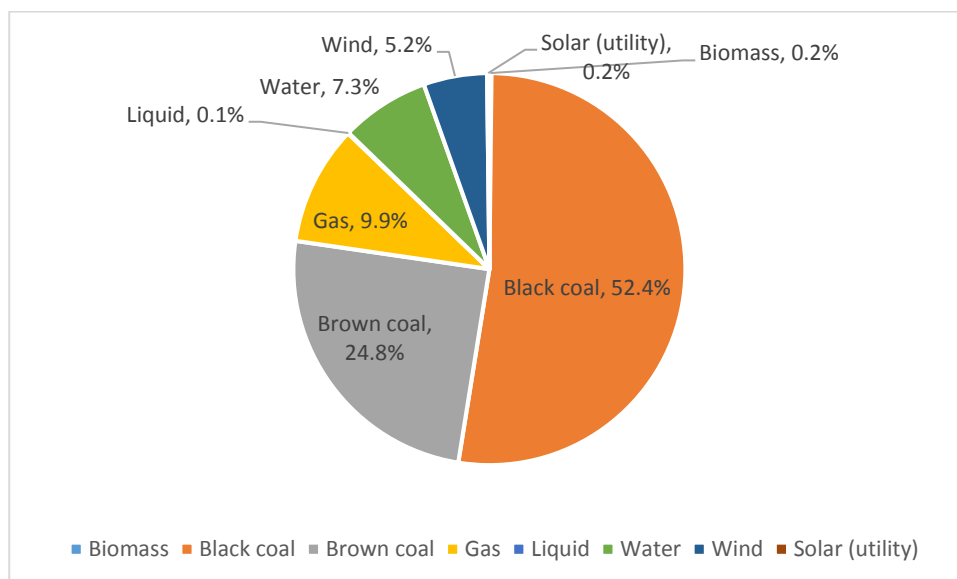
- Existing coal-fired power stations, which have relatively low fuel costs, provide low cost electricity. This is partly due to the externality of their emissions being unpriced, nevertheless this is the basis on which Australia's energy-intensive industry was established.
- They are dispatchable, meaning they can supply highly controlled electricity output on demand. Although coal-fired power stations may be less flexible than gas or hydro plants, they can increase or decrease output as required. As a result, their supply is very reliable, with only occasional unplanned outages.
- Stability and grid security. Coal-fired plants, or other plant based on rotating turbines, such as gas, hydro, nuclear or geothermal, are described as synchronous, which allows the electricity system to address rapid changes in frequency due to significant changes in either supply or demand. Maintaining

grid stability is complex and includes a number of factors to ensure a high quality and consistent energy supply. Ongoing stability includes maintaining the frequency of the network within tightly controlled parameters, and having sufficient inertia (the measure of the rotating mass of a generation unit) so that the frequency doesn't change too rapidly. A rapid change in frequency can lead to cascading failures and system collapse. While intermittent generators could, in theory, be configured to provide these services when they are available, their intermittency limits their ability to do so.¹ In regards to inertia, the speed rate of rotation of generators on the network determines the frequency of the system. As such, the greater the inertia in the system the less the network is susceptible to frequency variations outside the normal operating parameters due to sudden disturbances. Coal-fired power generation ('synchronous' generation) provides large levels of inertia. Wind and solar generation are asynchronous and are instead based on power electronics, as are batteries. This does not currently allow asynchronous generation to provide inertia, although the industry is investigating ways for renewables to potentially provide 'synthetic inertia'.

Synchronous generators also provide large levels of voltage control and support to allow electrical energy to be securely moved through the transmission system to meet consumer demand. Without this level of voltage support and control, Transmission Network Service Providers will be required to install additional voltage control and support equipment within the network. ElectraNet in South Australia is currently seeking approval to install additional voltage support and control equipment at Davenport at an additional cost of approximately \$50 to \$100 million to South Australian electricity consumers as a direct result of the retirement of Northern Power Station.² Also, increasing levels of remotely located intermittent generation within the existing network will require additional voltage control and support equipment to enable their energy output to be delivered to consumers, and in most cases, the additional cost of this is borne by consumers, as opposed to generation developers.

Currently, coal-fired generation (both brown and black coal) makes up 78 per cent of electricity generation across the National Electricity Market (NEM). This is followed by gas, which accounts for 9.9 per cent. Figure 1 depicts Australia's electricity generation mix.

Figure 1: Electricity generation mix in the NEM³



In a market where coal-fired and other dispatchable generators are leaving the market, such as in South Australia, the ability to obtain dispatchable services locally becomes increasingly challenging. While interconnectors can assist with providing both energy and ancillary services from other regions, a reduction in

¹ Deloitte Access Economics, *Energy markets and the implications of renewables – South Australian case study*, 26 November 2016, p.12.

² ElectraNet, *Northern South America Region Voltage Control RIT-T: Project Specification Consultation Report*, August 2016, p.4.

³ NEM-Review 2015-16

dispatchable generation will make NEM regions, such as South Australia, more vulnerable when the interconnectors are not available or are constrained. It is also likely to result in higher prices for both energy and ancillary services, and lower levels of inertia. Lower levels of inertia will result in the power system experiencing a higher Rate of Change of Frequency (RoCoF) during a system disturbance than is currently the case, leading to greater potential for cascading failure events, like those recently experienced in South Australia.

Renewable generation and likely future electricity demand

Incentives (including solar feed-in tariffs and renewable energy targets) for renewable generation have increased intermittent sources of power supply, such as solar and wind. While these types of renewables have higher overall costs compared to existing thermal power stations (due largely to their capital costs), they have low short run energy costs, meaning they can displace other forms of energy generation in the NEM energy dispatch order (known as the merit order). However, this intermittent generation can only be dispatched when the weather resource is available. This means that thermal (i.e. coal-fired power stations and gas plants) and hydro generation is still needed to ensure that overall demand can be met at all times. It is important to note that whilst intermittent generation can displace thermal power stations in the energy market, intermittent generation is not able to displace thermal generators in the eight Frequency Control Ancillary Services (FCAS) markets, each of which has the potential to move to very high price outcomes when insufficient FCAS services are available for dispatch.

Without incentives (such as the Large-scale Renewable Energy Target⁴), new renewable generators would be reliant on exposure to energy market revenue to cover their costs, which would act as a natural balancing mechanism. As supply increased it would slow down the rate of investment because new plant would find it progressively harder to cover its cost and would only come into the market when a gap in supply was evident. This slower rate of introduction would leave room for sufficient revenue for synchronous generation (including coal-fired power stations) and keep them in the market to the extent necessary to ensure a secure energy system, and reliable and affordable supply to consumers. This would occur unless, or until, a cheaper technology was able to provide flexible generation and ancillary services, including inertia. In contrast, the impact of the various renewable incentives now in place has seen an increase of intermittent generation, which has led to lower utilisation and revenue for coal-fired generators.

The consequent effect is the displacement of this scheduled, dispatchable generation, which, as noted above, plays an important part in maintaining stability in a system with high renewable penetration.⁵ There are currently only three registered participants in the regulation FCAS market in South Australia (using the generating units at Torrens Island, Pelican Point, and Quarantine). Increasing connection of intermittent generation in South Australia may increase demand for regulation FCAS.⁶

Generation capacity in South Australia fell in 2015–16 with the closure of Northern and Playford power stations, which, in turn, has also increased the state's reliance on the interconnection with Victoria for energy supply.⁷

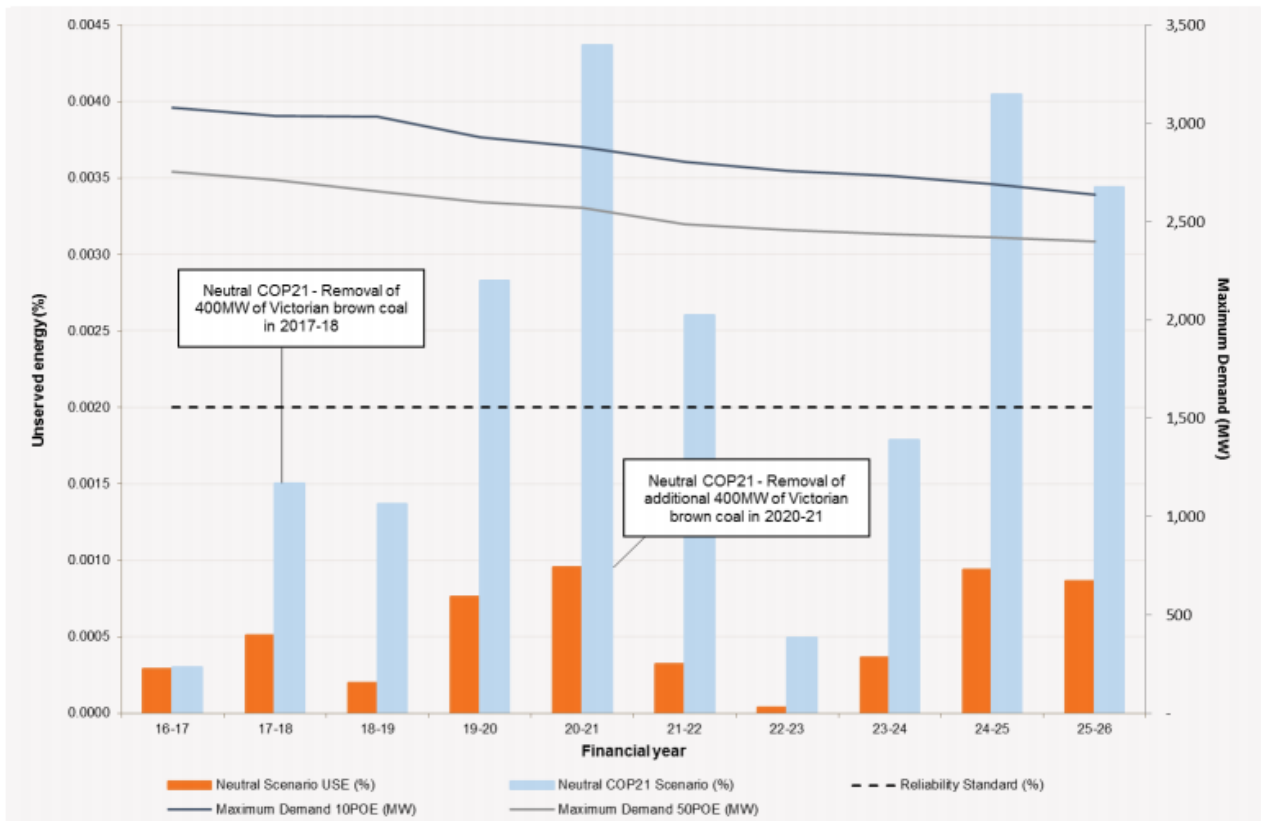
⁴ The LRET creates a financial incentive for the establishment or expansion of renewable energy power stations, such as wind and solar farms or hydro-electric power stations, by legislating demand for Large-scale Generation Certificates (LGCs). One LGC can be created for each megawatt-hour of eligible renewable electricity produced by an accredited renewable power station. LGCs can be sold to entities who surrender them annually to the Clean Energy Regulator to demonstrate their compliance with the RET scheme's annual targets. The revenue earned by the power station for the sale of LGCs is additional to that received for the sale of the electricity generated. <https://www.environment.gov.au/climate-change/renewable-energy-target-scheme>

⁵ Deloitte Access Economics, *Energy markets and the implications of renewables – South Australian case study*, 26 November 2016, p.8.

⁶ Australian Energy Market Operator, *Electricity Statement of Opportunities*, August 2016, p.33.

⁷ *Ibid*, p.30.

Figure 2: South Australia supply adequacy (Neutral Growth and Neutral Growth COP21 scenarios)⁸



In the absence of new synchronous generation development, potential reductions in coal-fired generation capacity across the NEM will pose a risk to future supply reliability in South Australia. AEMO’s modelling included the assumption that 800 MW of thermal generation would be removed in Victoria in two steps. The first 400 MW in 2017-18 and another 400 MW in 2020-21. The recently announced closure of 1600MW of thermal generation at the Hazelwood power station in March 2017⁹, will only increase the challenge of maintaining system reliability.

The state and expected life span of Australia's coal-fired power plants

With the most recent announcement of the closure of the Hazelwood power station in March 2017, there is increasing concern about the future security of the electricity system, as well as the potential for an increase in electricity prices as coal-fired generation is withdrawn from the market.¹⁰

Australia’s coal-fired plants vary in age. Some coal-fired power stations are less than 10 years old, including Bluewaters power station in Western Australia, and Kogan Creek power station in Queensland. It would be premature to close power stations that are relatively new. While it is assumed that older plants will be the first to exit the market, this may not be the case, as any plant (regardless of its age) will need to exit the market if it is not profitable.

The ‘expected life span’ of any power station is driven by its economics: the period over which the asset is expected to be viable in the market, with normal repairs and maintenance. The purpose of the market is to

⁸ Ibid, p.32. Figure 2 does not take into account the recent announcement of the closure of Hazelwood

⁹ Engie Media release, *Hazelwood to close in March 2017*, 3 November 2016, <http://www.engie.com/en/journalists/press-releases/hazelwood-power-station-australia/>

¹⁰ Herald Sun Melbourne, *Labor’s pull on the plug*, 1 November 2016, <https://www.energycouncil.com.au/media/6293/herald-sun-editorial.pdf>

provide price signals to allow owners to identify when and whether it is worth refurbishing a power station to maintain its operation, or when a power station should exit the market.

Currently, there are 24 coal fired power stations operating in Australia, Table 1 lists the operating coal-fired power stations by state.

Table 1: Australia's operating coal fired power stations¹¹

Coal Fired Power Stations (Operating)						
State	Power station	Primary fuel type	Year of commissioning	Announced year of decommissioning	Age (years)	Capacity (MW)
NSW	Eraring	Black coal	1982-84		32-34	2,880.0
NSW	Bayswater	Black coal	1982-84	2035	32-34	2,640.0
NSW	Liddell	Black coal	1971-73	2022	43-45	2,000.0
NSW	Mt Piper	Black coal	1993		23	1,400.0
NSW	Vales Point B	Black coal	1978		38	1,320.0
VIC	Loy Yang A	Brown coal	1984-87	2048	29-32	2,210.0
VIC	Hazelwood	Brown coal	1964-71	March 2017	45-52	1,760.0
VIC	Yallourn W	Brown coal	1975, 1982		34-41	1,480.0
VIC	Loy Yang B	Brown coal	1993-96		20-23	1,026.0
QLD	Gladstone	Black coal	1976-82		34-40	1,680.0
QLD	Tarong	Black coal	1984-86		30-32	1,400.0
QLD	Stanwell	Black coal	1993-96		20-23	1,460.0
QLD	Callide C	Black coal	2001		15	810.0
QLD	Millmerran	Black coal	2002		14	851.0
QLD	Kogan Creek	Black coal	2007		9	750.0
QLD	Callide B	Black coal	1989		27	700.0
QLD	Tarong North	Black coal	2002		14	443.0
QLD	Yabulu (Coal)	Black coal	1974		42	37.5
QLD	Gladstone QAL	Black coal	1973		43	25.0
WA	Muja	Black coal	1981, 1986		30-35	1,070.0
WA	Collie	Black coal	1999		17	340.0
WA	Bluewaters 1	Black coal	2009		7	208.0
WA	Bluewaters 2	Black coal	2010		6	208.0
WA	Worsley (Alumina)	Black coal	1982-00		16-34	135.0

¹¹ Energy Supply Association of Australia, *Electricity Gas Australia 2015*.

Table 2: Australia's decommissioned coal fired power stations¹²

Coal Fired Power Stations (Closed)						
State	Power station	Primary fuel type	Year of commissioning	Date of closure	Age (Years)	Capacity (MW)
NSW	Munmorah	Black coal	1969	Jul-12	43	600.0
NSW	Redbank	Black coal	2001	Aug-14	13	143.8
NSW	Wallerawang C	Black coal	1976-80	Nov-14	38	1,000.0
VIC	Morwell	Brown coal	1958-62	Aug-14	52-56	189.0
VIC	Anglesea	Brown coal	1969	Aug-15	46	160.0
QLD	Collinsville	Black coal	1968-98	Dec-12	14-44	180.0
QLD	Swanbank B	Black coal	1970-73	May-12	42	500.0
SA	Northern	Brown coal	1985	May-16	31	546.0
SA	Playford	Brown coal	1960	May-16	56	240.0

Over recent years several power stations have closed, noting that some of these were commissioned in the 1960s. The market can manage this transition in a manner that maintains Australia's energy security. However, this will require sufficient dispatchable generation, inertia and FCAS services to maintain a secure and reliable operation. There must be sufficient financial incentive to maintain or procure plant that can supply these services.

Market Mechanisms

Australia has undergone a number of policy changes over the past 15 years, which has resulted in a mismatch of Commonwealth and state policies and led to investment signal distortions in the market. This has resulted in the energy industry not being able to anticipate the necessary changes and make appropriate investment decisions to achieve a secure, reliable energy market. The numerous carbon and energy policies initiated by individual jurisdictions are resulting in increased cost and higher risk for energy users and challenging the integrity of the NEM.

A benefit of the market is that it can discover what the real economic life of a power station is and when it is worthwhile to invest in refurbishing a plant to extend its operating life. Stable carbon policy is needed to inform this investment decision making, and potentially signal that coal-fired power station emissions intensity may lead them to close earlier than without a carbon policy.

Without material changes to better integrate carbon and energy policy in national frameworks, Australian energy customers will pay more for their electricity, or potentially face more supply risk, in the transition to achieving a cleaner energy system. A national carbon reduction mechanism will provide more efficient and reliable national abatement outcomes than a series of disconnected targets and schemes in individual jurisdictions.

¹² Energy Supply Association of Australia, *Electricity Gas Australia 2015*.

Policy mechanisms to encourage the retirement of coal-fired power stations from the National Electricity Market

Australia should manage the transition away from emissions intensive generation in an orderly manner that supports investment decision making and Australia's ratification of the Paris Agreement. The transition should also ensure the affordability and reliability of the energy market. This could be achieved in a number of ways:

- *A carbon pricing mechanism*

This could take the form of an economy-wide scheme like a cap-and-trade scheme or carbon tax. Alternatively, it could take the form of an electricity sector mechanism, such as a baseline and credit scheme.

Regardless of the design of the price mechanism, high carbon prices will significantly negatively impact emissions intensive generation. This could lead to multiple closures within one region placing pressure on system security and regional communities simultaneously. It would also lead to significant asset value loss for the owners of those generators, making it difficult to re-invest in replacement capacity.

In its recent report, 'Special Review on Australia's climate goals and policies'¹³, the Climate Change Authority (CCA) recommends an emissions intensity scheme for the electricity generation sector. The CCA argue that an emissions intensity scheme, as a market mechanism, will allow Australia to meet its emissions reduction goals and decarbonise the electricity sector at lower cost than would be possible otherwise. The CCA do note that while electricity prices will rise under an emissions intensity scheme, the rise will be less than under a cap and trade scheme.

- *Renewable energy targets*

Between 2020 and 2030, technological change is likely to see renewables become increasingly competitive against coal and gas. Bain & Company estimates that grid scale solar could become the cheapest source of generation by 2030. Of course, given the different characteristics of different types of generation, this is a limited point of comparison.

Policies that support the forced, subsidised entry of lower emission generation can reduce the emissions intensity of the electricity market, but generally do not manage the transition of the existing generation fleet because they distort market price signals. Solutions that specify a technology, location or timeframe tend to also be a higher cost way to reduce emissions. Modelling of renewable energy targets typically do not take into account the changes in system security and the cost of measures to address this. Nor are these factors currently embedded in the design of existing renewable support schemes.

- *Regulatory closure*

Regulatory closure, or even the requirement to give an extended closure notice, may prejudice both financing arrangements and supply contracts of power plants. This may then precipitate a disorderly closure if loans are called in early or suppliers terminate contracts. However, all of this depends on the type of regulatory closure.

- An emissions standard at end of technical life - An emissions standard could be applied to coal-fired power stations to require their modernisation or closure at the end of their technical life.

Given the age profile and geographic distribution of Australia's existing coal-fired power stations, the transition away from emissions intensive generation could be managed across multiple regions under this model, relieving pressure on system security and individual communities.

While less efficient than a carbon price, the transition may be easier to manage. However, electricity price rises could be brought forward, putting pressure on households and energy intensive industries.

The first coal-fired power station to close would also be disadvantaged as they would not benefit from any uplift in prices. The remaining power stations would benefit from higher prices earlier, potentially offsetting the loss of the option to extend the life of the power station.

¹³ Australian Government, Climate Change Authority, Towards a climate policy toolkit: Special review on Australia's climate goals and policies, August 2016,
<http://www.climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/files/Special%20review%20Report%203/Climate%20Change%20Authority%20Special%20Review%20Report%20Three.pdf>

- Payment for closure - Government or industry-funded closure of emissions intensive electricity generation could manage this first mover disadvantage. However, without an effective carbon price in the electricity sector or an emissions standard at end of technical life, purchased abatement could be eroded by the remaining generators extending their asset lives in the face of higher electricity prices. There is also an asymmetry between the costs and benefits of closure, creating a first mover disadvantage. The costs of closure are borne by the individual power station while the benefits of closure are delivered to the remaining market participants via more sustainable returns. In addition, bringing forward the large remediation costs attached to power stations and mines can be a serious barrier to exit.
- Market mechanism - Jotzo and Mazouz¹⁴ examined the closure of power stations using a market mechanism whereby power stations bid the price they would require to be paid to close. The regulator then chooses the most cost effective bid, and the remaining power stations pay for that closure in proportion to their carbon dioxide emissions. Jotzo and Mazouz, argue that their market mechanism overcomes the difficulties of: government not having sufficient information about business cost structure to accurately choose which power station would be the most cost effective to close; and the lack of political acceptability¹⁵, and would reduce emissions in the most cost effective manner.
- Extended notice - Companies typically proceed to closure only after all options have been considered including sale, repurposing, mothballing or reduction in units operating. This is usually after the power station has been operating at a loss for some time and forecasts show conditions deteriorating. In these instances, plant owners need to be able dictate the closure period that best meets business requirements rather than follow a generic or principle based process. To extend closure timeframes might require either customers buying hedges or Government providing support at a level that keeps the plant viable over the extension period.

Maintenance of electricity supply, affordability and security

Australia's energy system security will not be maintained by chance during the dynamic transition which is underway. Instead it will require careful evaluation of the current market design and regulatory frameworks to ensure they remain fit for purpose; clear institutional roles and responsibilities; advanced planning and forecasting capability; and, ultimately, commercial investments by diverse energy providers which must be capable of pricing and managing foreseeable risks.

Energy service providers are committed to supporting robust, evidence-based policy processes and welcome stable, long term energy and climate policy. As the electricity market is experiencing increasing penetration of renewables, mechanisms to ensure electricity security need to be made in light of this change.

Policy mechanisms to give effect to a just transition for affected workers and communities likely impacted by generator closures

The Energy Council considers that the government should be the body to assist in the just transition of the coal-fired power stations. Ideally, all levels of government should work together to create opportunities for displaced workers and other transitional support policy mechanisms for the affected communities more broadly.

Jotzo and Mazouz¹⁶ explores the issue of integrating social costs into the electricity sector restructuring costs, and estimates a cost of \$150 million in social costs as a result of closing one power station in the Latrobe

¹⁴ Jotzo and Mazouz, *Brown coal exit: A market mechanism for regulated closure of highly emissions intensive power stations*, Economic Analysis and Policy, No 48, 2015, p.71-81.

¹⁵ Ibid, p.80

¹⁶ Jotzo and Mazouz, *Brown coal exit: A market mechanism for regulated closure of highly emissions intensive power stations*, Economic Analysis and Policy, No 48, 2015, p.79.

Valley. This would entail a 1-2 per cent increase to retail electricity prices across the NEM for one year, however, it would be a 5-14 percent increase to wholesale prices over the course of one year.¹⁷

However, the Energy Council views social costs as a role for government. Coal-fired power station companies will already incur large costs for environmental site remediation and worker compensation, and therefore it is unrealistic to consider these companies should provide additional contribution for social issues. Furthermore, it is inappropriate and regressive for electricity consumers to pay a levy in order to be able to provide funds for social costs.

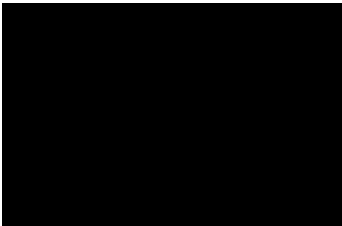
Conclusion

The most immediate barrier for Australia's electricity sector successfully transitioning to a net zero emissions economy, which includes the eventual closure of coal-fired power stations, is the absence of a national long term climate and energy policy. Major investment is required for future energy generation, as coal-fired power stations are decommissioned. Such investment will not take place unless there is policy that investors expect to last through multiple election cycles.

Delayed national policy, and mismatched Commonwealth and state energy and climate policy will increase costs and see the potential early closure of coal-fired power stations, leaving the energy market open to supply, affordability and security issues, as demonstrated by recent events in South Australia. To assist and manage the transition towards a net zero emissions economy, a national, stable climate and energy policy is required.

Any questions about our submission should be addressed to Carly Weate, Policy Adviser by email to carly.weate@energycouncil.com.au or by telephone on (03) 9205 3100.

Yours sincerely,



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¹⁷ Ibid, p.80.