IBISWorld
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December 2018

Power shock: Learning from Australia's mistakes in the electricity sector

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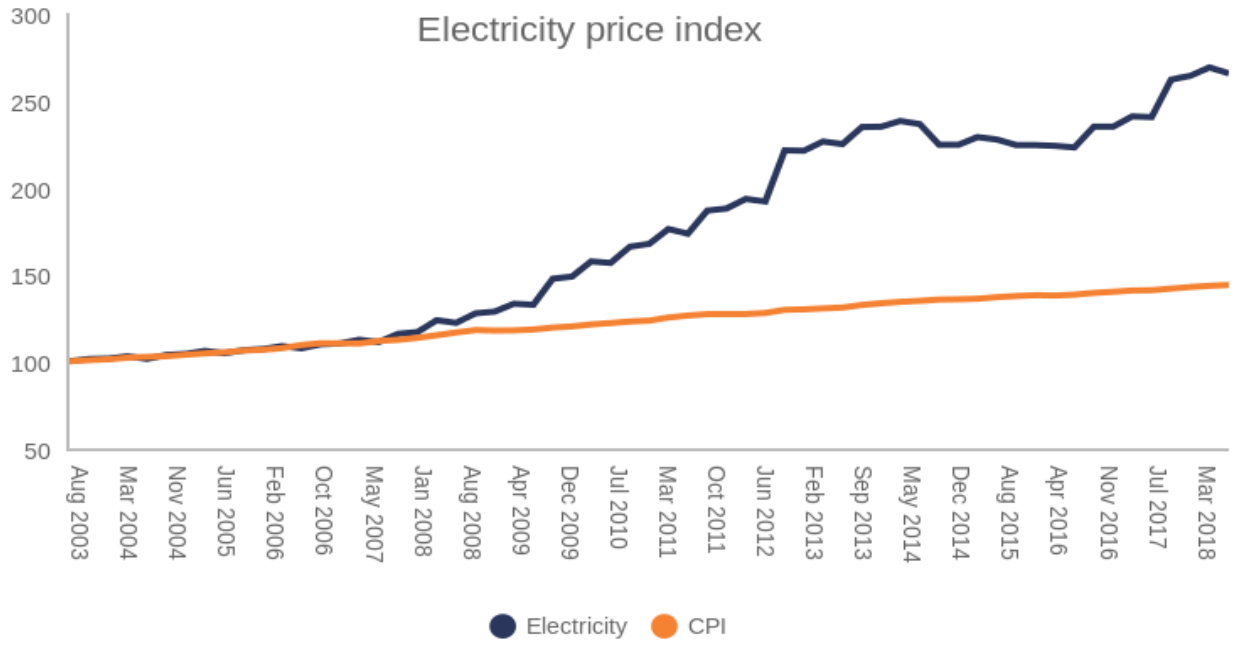
The Australian electricity supply chain has changed significantly over the past decade, presenting a threat to the entire economy. According to the ACCC, residential electricity prices across the National Electricity Market have risen by 56 % in real terms over the 10 years through 2017-18[1]. Rising electricity costs have contributed to higher household electricity bills, greater operating costs for Australian businesses, and stronger revenue growth for electricity providers[2]. Sustained price growth has been driven by multiple factors across the electricity supply chain, and requires a multi-dimensional policy response. This white paper analyses why prices have risen across the National Electricity Market, and how this issue can be addressed.



Source: ABS

1 ACCC, 2018
2 IBISWorld, 2018

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Executive Summary

Significant problems have arisen in the electricity supply chain over the past decade. Previous policy design and regulatory decisions have led to high prices and bills, exerting significant pressure on household spending and business profitability. Lowering prices will require significant adjustments in the generation, transmission and retail markets.

In terms of generation, the cost of producing electricity has risen significantly due to rising fuel costs and electricity firms rapidly decommissioning aging power stations. These trends have been exacerbated by the transition to renewable energy, which has undermined the viability of fossil fuel power stations by providing low cost power. As the country's reliance on renewable energy rises, additional infrastructure will be required due to the intermittent nature of renewable resources. New dispatchable generation capacity (such as gas power stations, pumped hydro systems or large-scale battery storage) will be required to preserve supply reliability. Investment in this infrastructure will ultimately need to be recovered through high electricity prices for households and businesses.

For transmission, regulation failure and poor policy design have allowed excessive investment in unneeded infrastructure. This factor has increased network costs, which account for the largest share of growth in household bills over the past decade. At the same time, rising network costs have driven households to purchase solar panels. Solar panel users can avoid the cost of the electricity network by purchasing less grid power. As a result, non-solar households have been forced to absorb a greater share of the network cost through higher bills.

In retail, market liberalisation has failed to create competitive pressure. Poor price transparency and confusing discounting practises have caused many consumers to give up on seeking the best available electricity price. Smaller retailers have been unable to gain market share despite offering attractive price discounts, due to consumers' disengagement. Both large and small retailers have offered cheaper electricity prices to attract new clients, but these offers have been cross-subsidised through higher prices charged to existing customers.

Amid these problems across the supply chain, environmental schemes have applied even greater pressure on household bills. The national Renewable Energy Target and state-based solar subsidies have delivered on the important goal of reducing greenhouse gas emissions. However, these schemes have also introduced significant costs into final electricity prices. Governments have struggled to balance the need for reliable and affordable electricity with the need to prevent environmental harm.

Overall, the supply chain has exhibited several failures due to previous policy developments that set the National Electricity Market on the wrong course. Significant policy change will be required to deliver better outcomes for households and businesses. Some of the failures in the supply chain are readily fixable, and these solutions are likely to lower prices over the next five years. However, the unavoidable need to develop new infrastructure will prevent prices from returning to the low levels of the past two decades.

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1 The Electricity Landscape

1.1 What is the National Electricity Market?

The National Electricity Market (NEM) includes the markets of Queensland, New South Wales (including the Australian Capital Territory), Victoria, South Australia and Tasmania. Western Australia and the Northern Territory are not connected to the NEM due to their distance from the eastern markets. In the NEM, generators produce electricity that is transported by high voltage transmission networks to local electricity distributors and major industrial energy users. Interconnectors enable electricity to be traded between states in the NEM. The assets that make up the NEM, including generators, transmission networks and distribution lines, are owned by both governments and private businesses. The NEM incorporates close to 40,000 km of transmission lines to supply over nine million customers. In 2016-17, close to 200 TWh[3] of electricity was supplied at a total cost of $16.6 billion.

1.2 The electricity supply chain

When an electrical device is activated, energy is instantly transmitted from a power station to the device, which requires an extensive supply chain. As demand for electricity rises, market regulators normally dispatch additional generation capacity. Once a generator is activated, it begins delivering electricity to the grid through the transmission network. These high voltage transmission lines efficiently transport electricity over long distances. Local distribution lines are connected to the transmission network through transformers, which convert high voltage electricity into low voltage. These distribution lines then carry low voltage electricity from a central hub to homes and businesses, providing power to customers.

1.2.1 Generation

Electrical power is difficult to store efficiently. The NEM therefore operates as a spot market, where supply is continually adjusted to match variable demand. Supply is adjusted through a centrally coordinated dispatch process, which is completed by the Australian Energy Market Operator (AEMO). Generators submit offers to provide electricity to the NEM for each of the 48 half-hour periods in a day. These bids are ranked from cheapest to most expensive by the AEMO, and are then dispatched in this order as demand rises. The AEMO adjusts supply to meet demand every five minutes, ensuring a consistent supply of reliable power to end consumers. All dispatched generators receive the same spot price for the electricity they provide. The spot price is based on the dispatch price of the most recently activated (and most expensive) generator[4]. As a result, the profit margins of less expensive generators rise as more expensive generators are activated.

1.2.2 Transmission and distribution

Five transmission network firms and 13 distribution firms operate in the NEM. The distribution network's total length is around 735,000 km, about 17 times longer than the total for transmission[5]. These firms are naturally occurring monopolies due to the inefficiencies that would result from having multiple independent networks of poles and wires. Network operators recover their costs and generate profit by charging electricity retailers for the right to use their infrastructure. To prevent these monopolies from price gouging, the Australian Energy Regulator (AER) determines the amount of revenue that network operators can recover from their customers.

1.2.3 Retail

Electricity retailers purchase electricity from generators through the spot market, and package it with network services for sale to customers. Retailers also charge an additional margin to cover the cost of acquiring customers, providing billing services, complying with environmental regulations and generating profit. The AER regulates retail energy markets to ensure efficient market operation, but does not set retail electricity prices.

3 Department of Environment and Energy, 2018

4 The spot price of electricity is calculated as the average dispatch price that occurs in a half hour period (six five-minute intervals). The dispatch price is the same for all active generators, and is equal to the bid price of the most recently activated generator.

5 Australian Energy Regulator, May 2017

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Source: Australian Energy Regulator

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1.3 The effect of rising electricity prices

A typical household electricity bill represents the sum of the costs that are incurred through each part of the electricity supply chain, and a margin for electricity retailers. Over the decade through 2017-18, cost growth in every part of the supply chain has caused household bills to rise at an annualised 8.3 %[6]. Consumers have sought to mitigate the negative effects of this trend by reducing average electricity use by 13.3 %[7] over the period. However, households and businesses have been forced to absorb higher costs as demand for electricity is highly inelastic[8].

Higher electricity prices can threaten the entire economy through two channels:

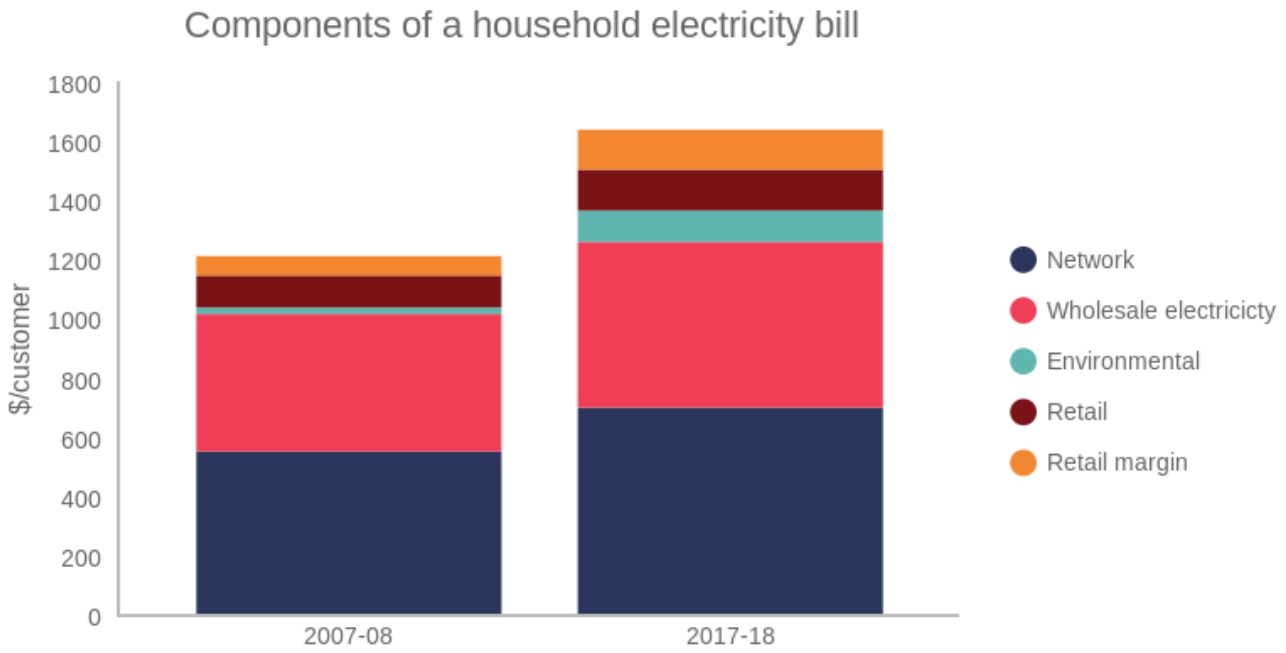
1.3.1 Consumer spending

Rising electricity prices can force households to reduce consumption expenditure. Higher electricity prices have made it increasingly difficult for households to pay their bills. Electricity costs were the largest household cost concern in 2017-18[9]. Meeting increases in electricity costs can force consumer to reduce expenditure on other basics, such as food, healthcare, household repairs or retail goods. Around

Electricity prices and discretionary income

Real household discretionary income represents households' post-tax income minus necessary expenses, such as medicine, food, and utility expenses. Changes in discretionary income have a significant influence on household spending, particularly among low-income households. Discretionary income has fluctuated over the past five years, as lower interest rates have offset the rising cost of essential services such as healthcare, insurance, and electricity. Discretionary income declined over the two years through 2017-18 due to rising electricity costs and sluggish wage growth. Overall, real household discretionary income is expected to grow at an annualised 0.3 % over the five years through 2018-19.

6 Department of Environment and Energy, 2018
7 ACCC, 2018
8 Inelastic refers to changes in demand that occur in response to changes in price. As electricity is vital for everyday life, demand for electricity only declines marginally in response to higher prices.
9 Choice Consumer Pulse, 2017



Source: ACCC

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20 % of residential customers in New South Wales were considered to be at a high risk of meeting their energy costs in 2016-17[10]. Rising electricity prices have encouraged a faster uptake of solar panels, which enable households to rely less on grid power. However, this option is generally limited to high-income households, due to the significant upfront cost associated with solar installation. Higher electricity prices therefore tend to have a greater negative effect on consumption expenditure for low-income households.

1.3.2 Business operating costs

Rising electricity costs have increased the cost of doing business. Australia has approximately 1.1 million small to medium enterprise (SME) electricity customers[11]. On average, annual electricity bills for SMEs increased by 19 % from April 2016 to October 2017[12]. In response to cost growth, businesses can raise product prices or reduce other operating costs. Businesses that cannot raise prices due to competitive pressure are likely to reduce wages and employee hours. In some instances, higher utility costs have had a significant negative effect on the global competitiveness of Australian firms.

Electricity prices and the aluminium supply chain

High electricity prices have threatened the viability of Australian manufacturing industries that are exposed to high import competition, such as those in the aluminium supply chain. The **Alumina Production industry** is particularly exposed due to the reliance on electricity in the Bayer process, which is used to refine raw bauxite into alumina. Australian aluminium smelters are also major users of electricity, and compete against imports from low-cost Asian economies. Electricity costs accounted for nearly 40 % of industry revenue in the **Aluminium Smelting industry** in 2017-18[a]. High electricity costs threatened the viability of the Portland aluminium smelter in Victoria in early 2017 and ultimately led to a $240 million assistance package from the state and federal governments.

a IBISWorld, 2018

2 The Generation Revolution

2.1 The changing generation mix

The way Australia generates power is changing. Over the decade through 2016-17, total renewable electricity generation increased at an annualised 8.2 %, while fossil fuel generation declined by 0.3 %[13]. Coal accounted for close to 63 % of Australian power generation in 2016-17, well below its share of more than 80 % at the beginning of the 21st century[14]. Renewables accounted for close to 16 % of total electricity generation. Investment in wind and solar infrastructure has driven growth in renewable generation, accompanying pre-existing hydro generation assets.

The need to prevent global warming is not the only underlying driver of this transition to renewable energy. The declining viability of aging infrastructure in the NEM is primarily driving this trend. The current fleet of Australian fossil fuel power stations in the NEM is 33 years old on average, and the average retirement age of these assets is 35 years[15]. Coal power stations become less efficient and less reliable over time due to a phenomenon known as creep cracking, where steel components in high temperature steam systems can fail, causing unexpected outages. As a coal power station ages, an increasing number of locations in the system may develop creep cracking. This problem therefore becomes increasingly expensive and time consuming to manage. Over the nine months through September 2018, coal-fired power stations broke down on 83 occasions[16]. The frequency of breakdowns has been increasing over the past decade. On average, one breakdown at a coal or gas power station occurred every 2.4 days in 2018.

The closure of the ENGIE's Hazelwood brown coal power station in March 2017 highlights the inevitable decline of

10 ACCC, 2017
11 ACCC, 2017
12 ibid
13 Department of Environment and Energy, 2018
14 ibid
15 Australian Energy Council, 2018
16 The Australia Institute, 2018

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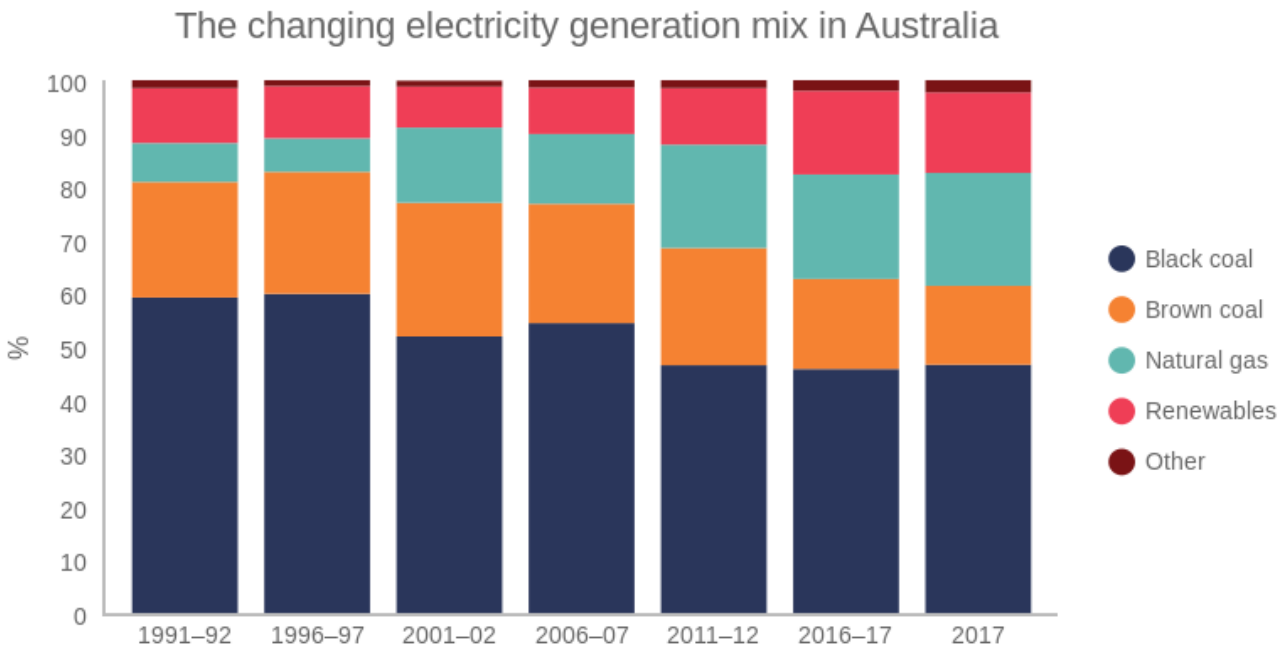
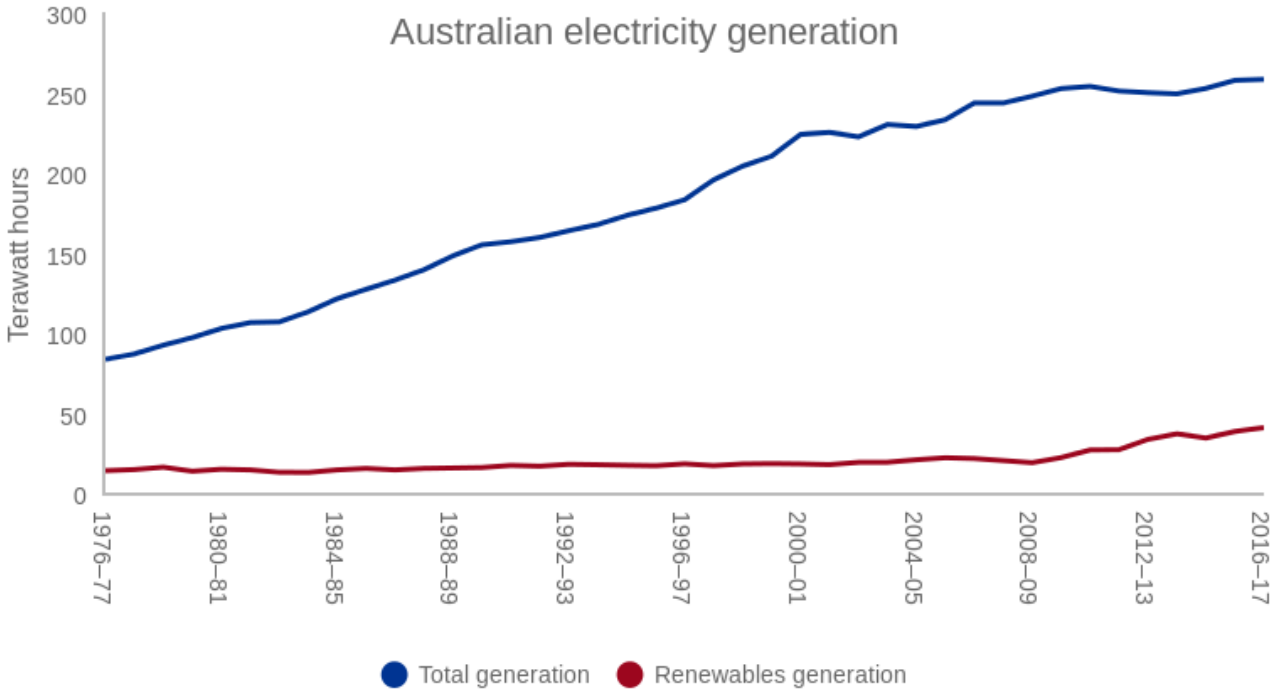


Source: Department of Environment and Energy



Source: Australian Energy Statistics

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coal-based power in Australia. To keep Hazelwood operational, ENGIE needed to invest $400 million in revamping the Hazelwood plant[17]. To make this strategy economically viable, the investment would have required the company to sell electricity at a price well in excess of current and projected market rates. Hazelwood was the tenth coal-fired power station to exit the NEM since 2012, and the largest generator to exit since the NEM was formed in 1998[18]. Australia's largest electricity generation companies, AGL, Origin and EnergyAustralia, have all rejected new coal projects, citing a lack of economic viability.

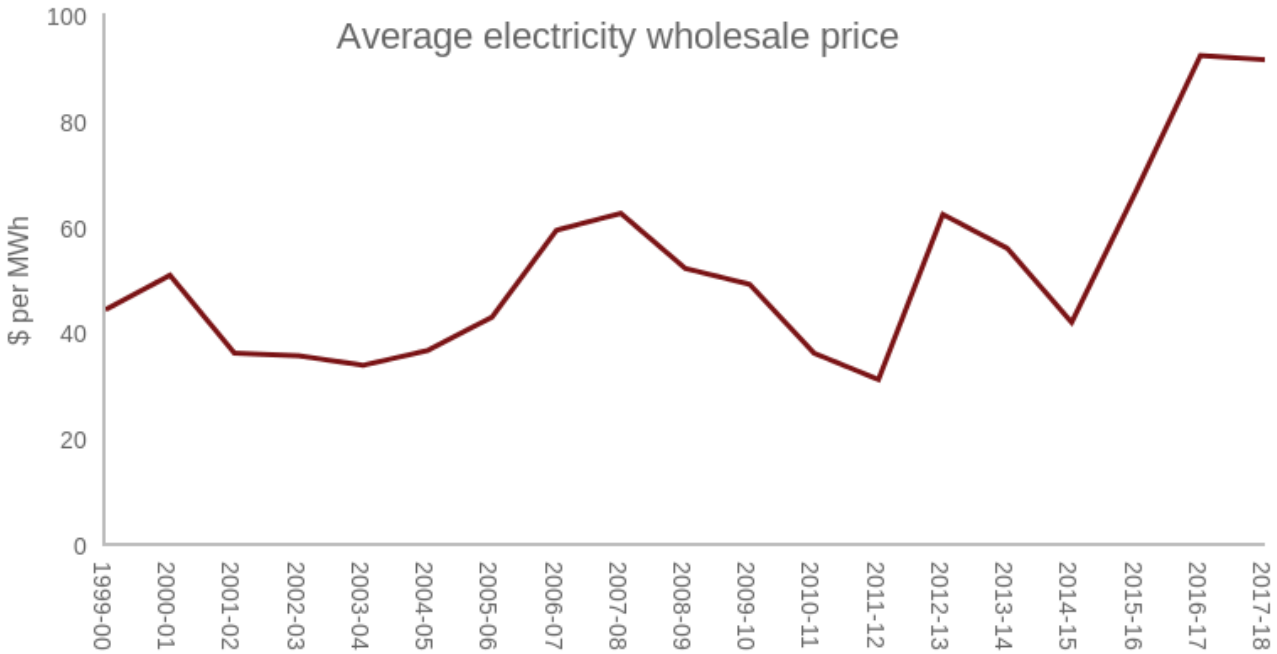
2.2 Why are generation costs increasing?

The cost of generating electricity is represented by the wholesale price, which increased at an annualised 10.4 % over the five years through 2017-18. Most of this growth occurred over the two years through 2016-17, when the wholesale price jumped from $40 per MWh to over $90 per MWh. The decommissioning of excess capacity and higher input costs has driven this price growth.

2.2.1 Decommissioning of excess capacity

The removal of excess generation capacity from the NEM was the largest contributor to rapid growth in wholesale prices over the two years through 2016-17. Prior to its closure in March 2017, the Hazelwood brown coal-fired power station provided about 20 % of Victoria's annual power[19]. In combination with the closure of South Australia's Northern brown coal-fired power station in May 2016, total generation capacity in the NEM was 3.6 % lower in 2016-17[20]. These power stations closed as they were no longer profitable amid the low-price market environment of the NEM prior to 2015-16.

17 ABC News, 2016
18 ibid
19 Australian Energy Regulator, 2018
20 Australian Energy Regulator, 2018



Source: Australian Energy Regulator

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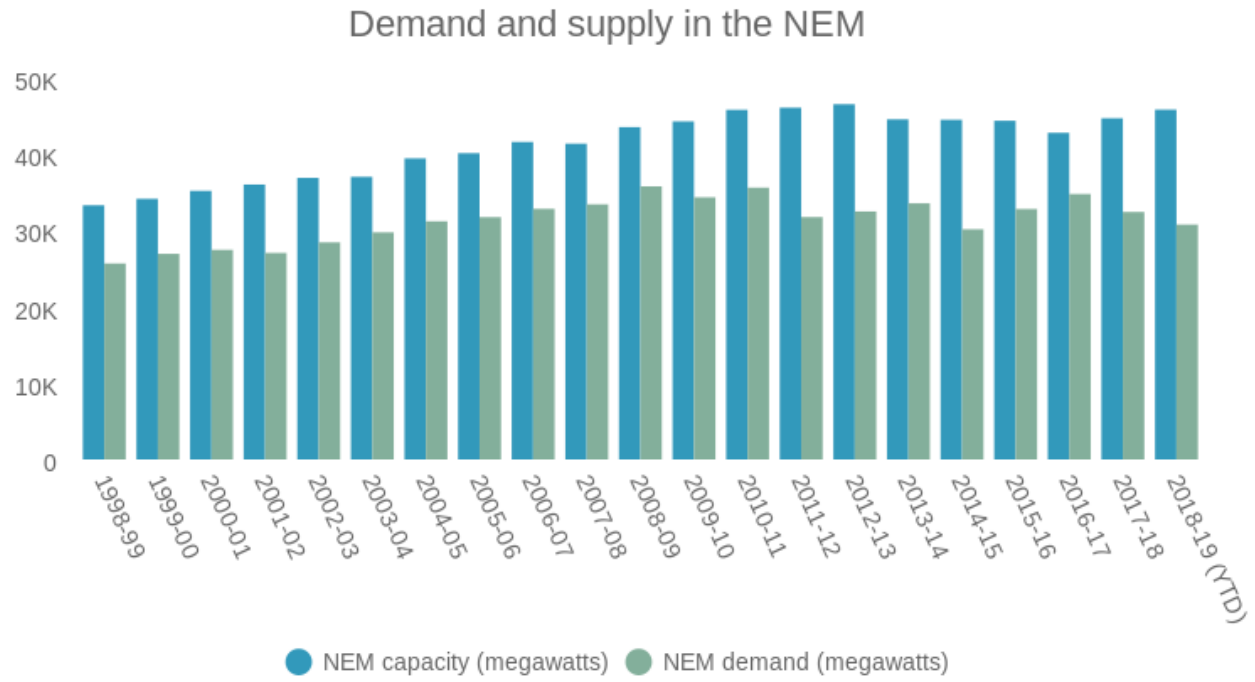
These power station closures are a symptom of the historic oversupply of generation capacity in the NEM. Since 1998, the wholesale price of generation has fluctuated at around $50 per MWh, with the exception of the drought over the two years through 2009, and the brief imposition of the carbon tax over the two years through 2013-14. Prices remained at this low level for two reasons. First, public investment covered the original cost of building generation capacity prior to the NEM. After electricity markets were liberalised, the private owners of these assets only needed to cover their operational costs, rather than initial development costs. This factor enabled these firms to be profitable while charging low prices. Second, total generation capacity across the NEM continued to increase in line with growing electricity demand, particularly through renewable generation developments. This factor exerted downward pressure on prices by creating excess supply.

In 2008-09, the story changed. Electricity demand peaked and then began to decline across Victoria, New South Wales and South Australia. Over the five years through 2014, electricity consumption declined by 7 % across the eastern seaboard, while the economy grew by 13 % [21]. This change was due to several factors, such as the uptake of solar panels, more efficient energy use and the closure of some large industrial sites[22]. As a result, overcapacity emerged in the market as rising supply and falling demand led to low prices. The operating environment for existing coal-fired power stations became particularly difficult as renewable competitors had near-zero running costs (i.e. no need to purchase fuel supply). In addition, renewable generators could afford to operate at a lower pricepoint in the NEM, as they can also generate revenue outside of the market by selling renewable energy certificates[23].

Overcapacity peaked in 2014-15, forcing the exit of Northern and Hazelwood. As a result, the electricity market quickly moved closer to an equilibrium as lower supply was more evenly matched with lower demand. To make up for the loss of Hazelwood and Northern, additional electricity output has been required from black coal and gas fired power

21 Sandiford, Forcey, Pears, McConnell, 2015
22 Sandiford, Forcey, Pears, McConnell, 2015
23 Through the Large-scale Renewable Energy Target scheme, electricity retailers are required to purchase some renewable energy. Renewable generators create certificates when they generate and sell these certificates to retailers.



Source: Australian Energy Regulator

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stations. Black coal and gas fired power stations have higher fuel costs than brown coal power stations, leading to higher wholesale prices. Rising wholesale electricity prices represent the market operating efficiently to balance supply and demand through price signals.

2.2.2 Higher input costs

As reliance on black coal and gas fired power stations has been rising, the input costs for these facilities have also been growing. For these generators to remain viable, higher input costs have been passed on to downstream consumers through higher wholesale prices. The domestic price of natural gas has risen at an annualised 5.5% over the ten years through 2017-18[24] due to the development of LNG exports on the eastern seaboard. These exports have linked the domestic market to the global market and caused the domestic LNG price to rise to parity with the global price. The domestic price of black coal surged by 61.4% in 2017[25] due to growth in the global price, precisely when reliance on black coal power stations was highest.

The structure of the NEM wholesale pricing system has compounded the effect of higher gas prices. As discussed in section 1.2.1, all active generators in the NEM receive the same price for their output. The most expensive generator in use determines this price. Gas-fired generation is typically the most expensive form of electricity generation in the NEM. As a result, the price of all generation in the NEM rises as the cost of gas-fired generation rises.

Growth in black coal prices

The **Black Coal Mining industry** is highly volatile, reflecting its exposure to shifts in global supply and demand for coal. Coking coal prices rebounded significantly in 2016-17, largely due to industrial policy changes in China. In April 2016, the Chinese Government announced that it would restrict the number of production days per year at Chinese coal mines from 330 to 276. This move benefited Australian producers, as the loss of Chinese supply led to significant increases in the global prices of metallurgical and thermal coal. As a result, industry revenue surged by an estimated 57.0% in 2016-17. In addition, the purity of Australian black coal is particularly high, enabling some local miners to charge a premium over global prices for black coal.

2.3 Generation outlook

Over 6,000 MWh of renewable generation capacity is expected to enter the NEM from 2018 to 2022[26], which will likely exert downward pressure on generation prices over the short term. However, generation costs are unlikely to return to the low level seen over the past two decades. Expensive investment will be required to ensure reliability in conjunction with the transition to renewable generation. Consumers and businesses will be forced to absorb higher generation costs during this process. However, interventions in other parts of the electricity supply chain can reduce total electricity bills.

2.4 Reliable, renewable, affordable?

The NEM needs to deliver reliable and affordable electricity, and Australia needs to transition to renewable generation to help prevent global warming. Renewable technology is improving and helping to deliver cheap and environmentally friendly energy to the NEM. However, additional infrastructure is necessary to ensure that renewable assets are reliable. As sunlight and wind are intermittent, solar panels and wind farms cannot always immediately dispatch electricity to the NEM. Dispatchable generation capacity is required to quickly supply the market when solar and wind energy sources are unavailable. Dispatchable capacity includes gas-fired power stations, hydroelectric dams and large-scale battery storage.

Although the cost of renewable generation is falling, the cost of dispatchable capacity remains high. To finance the development of this infrastructure, wholesale prices in the NEM will also need to remain high. AGL's Liddell black coal power station, a major source of power in New South Wales, is currently expected to close by 2022. To replace this facility, AGL is planning to develop a combination of gas generation, renewable generation, battery storage and other

24 IBISWorld, 2018
25 IBISWorld, 2018
26 COAG Energy Council, 2017

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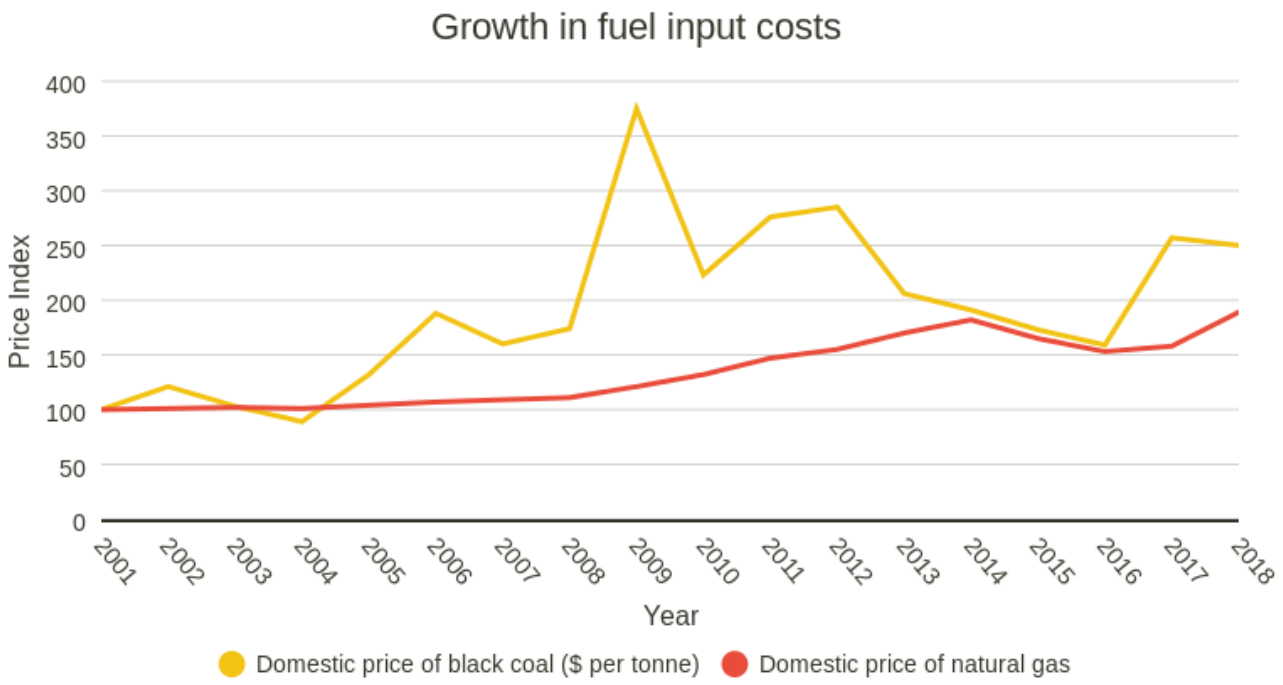

Source: IBISWorld

investments. For this project to be viable, wholesale prices in the NEM will need to remain above $83 per MWh on average for the next 15 years[27]. This amount represents a significant increase from the average $50 per MWh price exhibited over the past two decades.

3 Poles and Wires

3.1 Why have network costs increased?

Network costs are the largest component of household electricity bills, accounting for about 43 % in 2017-18[28]. These costs include transmission, distribution and metering expenses. Network costs have also been the fastest growing segment of final bills over the past decade. The costs of the network are primarily determined by the need for sufficient capacity during peak periods, rather than depreciation occurring due to general use over time. For example, the network requires sufficient capacity to enable widespread use of air conditioning during a heat wave, despite this capacity being rarely used. Almost 25 % of total network capacity in the NEM is used for less than 90 hours each year[29].

Significant inefficiencies have emerged in the regulated network and distribution markets over the past decade, contributing to overall growth in network costs. One of the largest inefficiencies has been overinvestment in unnecessary network capacity, which is known as gold plating. The AER determines the amount of revenue that network operators in the NEM generate each year. This amount is intended to cover the cost of building and operating network assets, alongside an additional profit margin. As a result, network operators that expand their networks are allowed to generate higher revenue. This revenue growth results in greater costs for electricity retailers, and ultimately homes and businesses. The asset base of all network operators has risen over the decade through 2017-18[30]. This trend contrasts with declining demand for electricity in the NEM since 2008-09.

27 AGL Energy Ltd, 2017
28 ACCC, 2018
29 ibid
30 Australian Energy Market Commission, 2017

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Investment across the network is increasingly appearing to exceed optimal levels. One estimate states that 50 % of investment in transmission and distribution networks, worth close to $20 billion, has been excessive over the 12 years through 2017[31]. Part of this investment has been allowed to occur due to an appeal mechanism known as the Limited Merits Review (LMR), which was implemented in 2008. The LMR enabled private network firms to challenge AER determinations regarding the revenue they were allowed to receive. The Federal Government repealed the LMR in October 2017 in an effort to reduce network costs.

Despite ensuring greater reliability, overinvestment in network infrastructure can threaten the NEM's long-term economic viability. High network costs lead to high electricity bills, which can encourage households and business to decrease electricity consumption or invest in non-grid power systems. Historically, limited substitutes to grid power were available. However, the rise of solar and battery systems has created a viable substitute for some electricity users. Solar users can avoid network costs by using less grid power. As a result, households without solar are forced to absorb a higher share of the cost of the electricity network through higher bills. This in turn leads to more households transitioning to solar, which becomes a self-perpetuating trend. Despite fulfilling other public policy objectives, such as reducing environmental harm, public subsidies for solar systems are likely to have contributed to this problem[32].

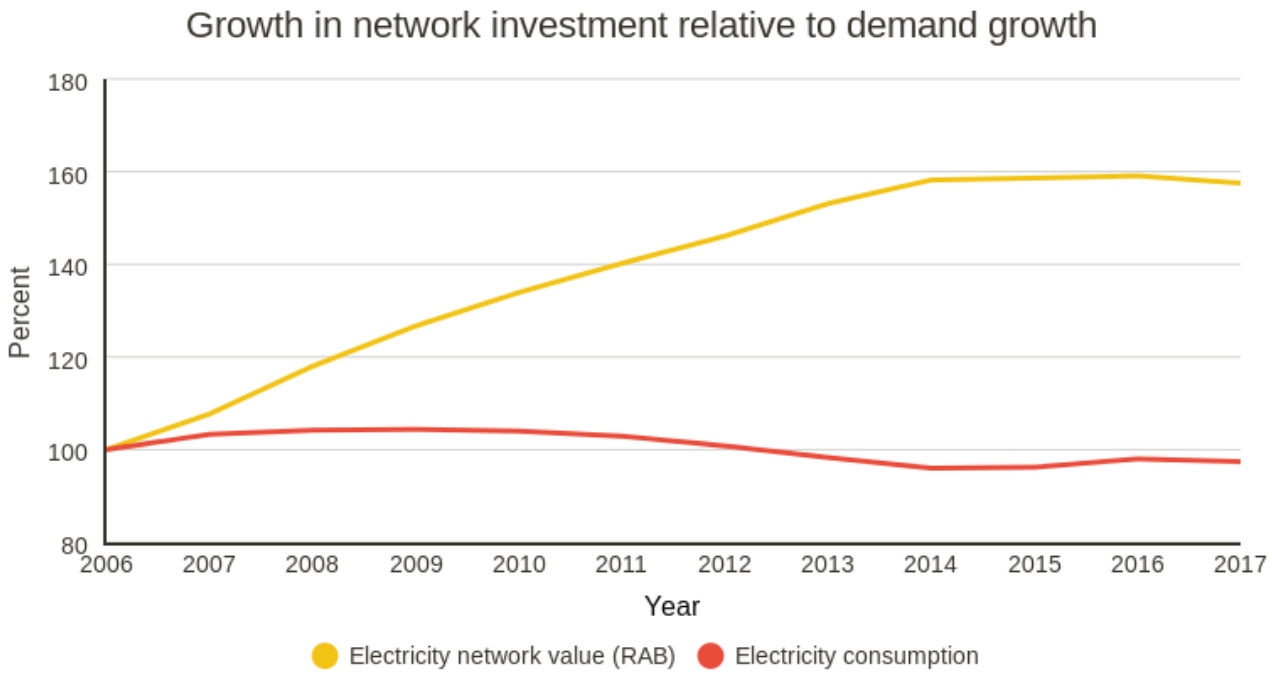
31 Grattan Institute, 2018

32 ACCC, 2018

Network investment drives construction revenue

The **Heavy Industry and Other Non-Building Construction industry** has benefited from investment in new electricity generation, transmission, and distribution facilities over the past decade. In particular, renewable energy projects have represented a growing share of new generation capacity. Revenue from electricity infrastructure is expected to account for 12.7 % of total industry revenue in 2018-19[b].

b IBISWorld, 2018



Source: AEMC and AER

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3.2 What is a reliable network?

Each state and territory government controls how transmission and distribution reliability is regulated, and the reliability that is required. As a general rule, the Australian Energy Market Commission (AEMC) maintains a target reliability standard such that supply meets 99.998 % of annual electricity demand[33]. A trade-off between reliability and affordability tends to occur, as high reliability levels are expensive to provide, but result in lower interruption costs to customers.

The South Australian black out of 28 September 2016 illustrated the cost and consequences of network reliability. On that day, two tornadoes with wind speeds of between 190 and 260 kilometres per hour tore through multiple transmission lines[34]. The damage to these lines resulted in series of grid failures that ultimately resulted in a complete loss of power across the state. The ultimate cost of the black out for the South Australian economy was $367 million[35]. To prevent disasters like the one that occurred in South Australia, regulators can invest in redundancy infrastructure to ensure that power can continue to be delivered when the network is damaged. For example, New South Wales introduced a transmission standard in 2005, where the network operator had to ensure the network could continue to operate normally despite a disruption to any element of the network[36]. In the same year, Queensland regulated that their state network had to incrementally improve reliability each year[37]. In both cases, these regulations significantly increased network costs.

The performance of transmission networks

The **Electricity Transmission industry** operates Australia's high-voltage electricity networks, which connect generators and final markets. Industry revenue is expected to fall at an annualised 3.7 % over the five years through 2018-19, to $3.0 billion. In 2018-19, industry revenue is expected to fall by 7.3 % due to the AER's revenue reductions for the industry's largest player, Powerlink. The AER significantly reduced Powerlink's maximum allowed revenue for its 2017-2022 regulatory period, due to a lower required rate of return on capital.

3.3 Network outlook

Significant changes are likely to occur across the transmission and distribution networks. In 2018, an ACCC inquiry into the electricity sector recommended that governments reduce the value of publicly owned networks to lower revenue caps for network operators. For private networks, the ACCC recommended that governments provide rebates to customers to offset the effects of past overinvestment. The AER's regulatory powers are also likely to strengthen to monitor the effects of these changes, and prevent overinvestment in the future[38].

Over the long term, network costs are likely to remain higher than historical levels as electricity generation becomes decentralised. Good solar and wind resources are likely to be situated away from existing transmission lines, requiring new lines to be built. New interconnectors between states will also likely be required as the NEM relies more on renewable generation[39]. Infrastructure will also need to be updated to account for the greater degree of two-way power generation, as a rising number of households feed solar generation back into the grid. The cost of this infrastructure is unavoidable for final electricity users.

4 Retail

4.1 A failing market

Retailers are the link between the electricity sector and consumers. Retail firms aggregate the various costs of generating and delivering electricity into a single bill. Retailers are also liable for government regulatory schemes such as the Renewable

33 Australian Energy Market Commission, 2018
34 Australian Energy Market Operator, 2018
35 ABC News, 2016
36 NSW Government Industry & Investment, 2010
37 ACCC, 2018
38 ACCC, 2018
39 Grattan Institute, 2018

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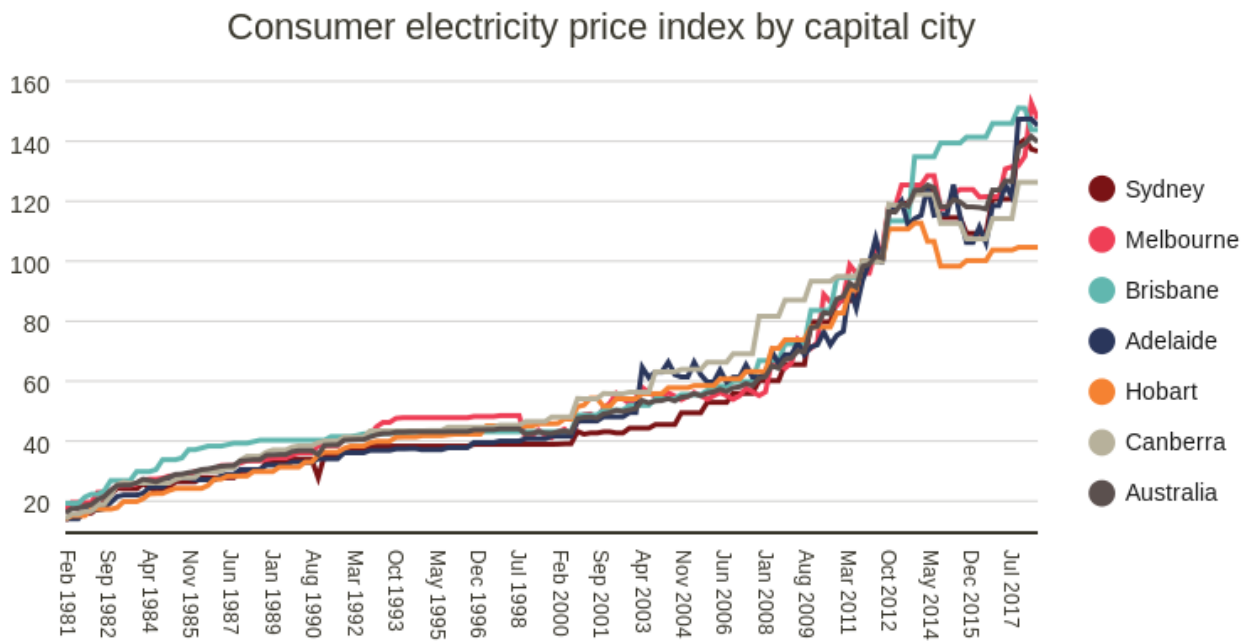

Source: ABS 6401

Energy Target. Retailers pay for these schemes and pass the cost on to consumers. Retailers also provide secondary functions that are equally important, including customer service management and bill smoothing. Bill smoothing involves using hedging mechanisms to absorb daily volatility in wholesale prices, enabling retail electricity prices to remain largely consistent.

Retail competition in the electricity market is a fairly recent development in Australia, as price controls have been removed across the NEM over the past decade. This deregulation aimed to allow market competition between retailers to exert downward pressure on supply chain costs, and to pass these savings on to consumers through lower prices. However, retail costs have increased over the past decade, despite growth in the number of retail competitors[40]. The retail component of household electricity bills has increased over the past decade, including growth in both costs and margins for retailers[41]. Overall, competitive pressure has failed to deliver lower retail costs for homes and businesses.

4.2 The cost of competition

The market includes two types of retail customers: those disengaged from price changes and those who actively seek out cheaper electricity offers. Major electricity retailers have benefited from a large share of their customers being disengaged from the market, often remaining on high-price electricity service contracts despite cheaper alternatives being available. To attract and retain active customers, major players have offered aggressive price discounts to new customers that have been effectively cross-subsidised by excessive payments from disengaged customers. In this context, small electricity retailers have only been able to compete to acquire active customers, as disengaged customers have been unresponsive to price discounting. As a result of this trend, both large and small electricity retailers have spent a high and growing share of total expenditure on acquiring and retaining customers, leading to cost growth and therefore price growth across the entire market. The gap between the best and worst offers in the market has grown over the past decade, effectively acting as a

40 ACCC, 2018
41 ACCC, 2018

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tax on disengaged customers that are either unable or unwilling to seek out cheaper electricity[42].

Electricity retailers employ complex pricing systems that make it difficult for consumers to compare offerings from different firms. This factor has led to a large share of retail customers becoming disengaged. Most retailers advertise discounted electricity rates, although the benchmark that the discount refers to can differ significantly. In addition, discount contracts often rely on the customer paying on time. These discounts are only achieved 56 % of the time for payment plan customers[43].

4.3 The costs and benefits of vertical integration

Three major players, Origin, AGL and EnergyAustralia, dominate the electricity retailing landscape. Together, these firms serve over 70 % of retail customers in the NEM[44]. Although many new players have entered the electricity retailing industry, the market shares of the major players have not significantly declined[45]. The large players enjoy several significant advantages over their smaller rivals due to their economies of scale and greater capacity for vertical integration.

Vertical integration occurs when a firm both generates and retails electricity. These firms are known as gentailers. Since the NEM's creation, all major players have moved towards vertical integration as it enables firms to efficiently reduce hedging costs. For example, when wholesale prices rise, additional costs for the retail division are offset by additional revenue in the generation division. In contrast, stand-alone retailers rely on financial hedging contracts to reduce exposure to price fluctuations, and these contracts are more expensive and less efficient. Gentailers also benefit from greater security of supply as they own generation infrastructure.

In theory, the benefits of vertical integration should be passed on to consumers through cheaper prices and greater reliability. However, vertical integration can also have a negative influence. As vertical integration has increased, the availability of stand-alone generation has declined. As a result, small stand-alone retailers have less access to generation, creating a barrier to expansion and competition in the retail market[46].

4.4 Retail outlook

The outlook for retail costs is less certain than for other elements of the electricity supply chain. The 2018 ACCC inquiry into the electricity sector presented several recommendations, including establishing an industry-wide pricing mechanism to let customers easily compare various retail offers[47]. The ACCC has also recommended other regulatory changes to make it easier for consumers to change retailers. If these recommendations are implemented, competition in the retail market may become more effective, ultimately driving better outcomes for consumers. However, these changes may not be sufficient to reverse the growth of retail costs over the past decade.

5 Environmental Costs

5.1 Why does Australia need environmental policies?

Australia needs environmental policies to protect the long-term interests of the economy. Over the past century, the release of greenhouse gases into the atmosphere and the removal of natural carbon sinks through deforestation has led to a significant increase in average global temperatures[48]. As global temperatures rise, the environment becomes less hospitable to human needs. Australia is heavily exposed to the risks of climate change, and is likely to exhibit stronger

42 ACCC, 2018
43 ibid
44 ACCC, 2018
45 IBISWorld, 2018
46 ACCC, 2018
47 ACCC, 2018
48 NASA, 2018

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temperature growth than the global average. Modelling suggests that under the business-as-usual scenario, average temperatures in Australia will rise by between 2.6 to 4.8 degrees by 2090[49].

The negative effects of climate change are numerous and unpredictable. Rising temperatures have begun to melt the polar ice caps, leading to growth in sea levels. Over $226 billion worth of Australian infrastructure is at risk if sea level were to rise by 1.1 metres by 2100[50]. In future decades, rising sea levels are likely to cause an influx of refugees into Australia from low-lying pacific islands. Sea levels are currently increasing by around 3.2 millimetres per year, and are estimated to have increased by nearly 85 millimetres since 1993[51].

Climate change also represents an existential threat to Australian agriculture industries. Warmer temperatures in Australia are likely to increase the frequency and severity of droughts, leading to significantly lower agricultural yields. Similarly, the frequency of natural disasters such as cyclones, droughts, and bushfires is expected to increase. Greater exposure to natural disasters is anticipated to cause significant damage to infrastructure, and hotter average temperatures will lead to higher cooling costs, as well as lower labour force productivity.

Climate change is also a threat to marine resources. Since the beginning of the Industrial Revolution, surface ocean waters have become 30 % more acidic. Ocean acidification disrupts the reproductive capacity of marine species, and also threatens coral reefs. Close to 50 % of the Great Barrier Reef has already died, and the remainder is expected to be lost by 2050 unless major action is taken[52]. The Great Barrier Reef generates approximately 64,000 jobs in Australia and contributes an estimated $5.7 billion dollars[53] in revenue through the **Tourism industry**[54].

Conclusive scientific evidence shows that climate change is occurring as a result of anthropogenic activity. Failure to prevent further warming is likely to lead to lower economic productivity and reduced standards of living in future decades. In addition, it is unclear whether the effects of global warming are reversible.

Climate change and livestock industries

Livestock farming industries such as the **Sheep Farming industry**[c] and **Beef Cattle Farming industry**[d] are particularly vulnerable to climate change due to their high reliance on water. Almost 15,500 litres of water are required to produce one kilogram of beef[e]. Livestock industries are also one of the largest contributors to Australia's greenhouse gas emissions due to methane produced by animals. Indirectly, agricultural industries also contribute to carbon emissions through deforestation to create grazing land.

c IBISWorld, 2018
d IBISWorld 2018
e USGS, 2016

5.2 How does environmental policy affect electricity prices?

Environmental costs have accounted for close to 20 % of total growth in electricity bills over the past decade. Over the ten years through 2017-18, environmental costs grew from 1.8 % of an average bill to 6.5 % [55]. During this period, governments sought to implement environmental protection policies while ensuring a reliable and affordable supply of electricity. Intense political pressure regarding energy and climate policy has resulted in several failed policy frameworks, including an emissions trading scheme, carbon tax, direct action plan and, most recently, the National Energy Guarantee. The government's ongoing failure to develop a cohesive policy framework has increased the risk for private firms to invest in new infrastructure in the NEM. Environmental policies that are relevant to the NEM include the international Paris Climate Agreement, the national Renewable Energy Target and state-based solar subsidies.

49 CSIRO and BOM, 2015
50 Department of Climate Change and Energy Efficiency, 2011
51 NASA, 2018
52 Deloitte Access Economics, 2017
53 ibid
54 IBISWorld. 2018
55 ACCC, 2018

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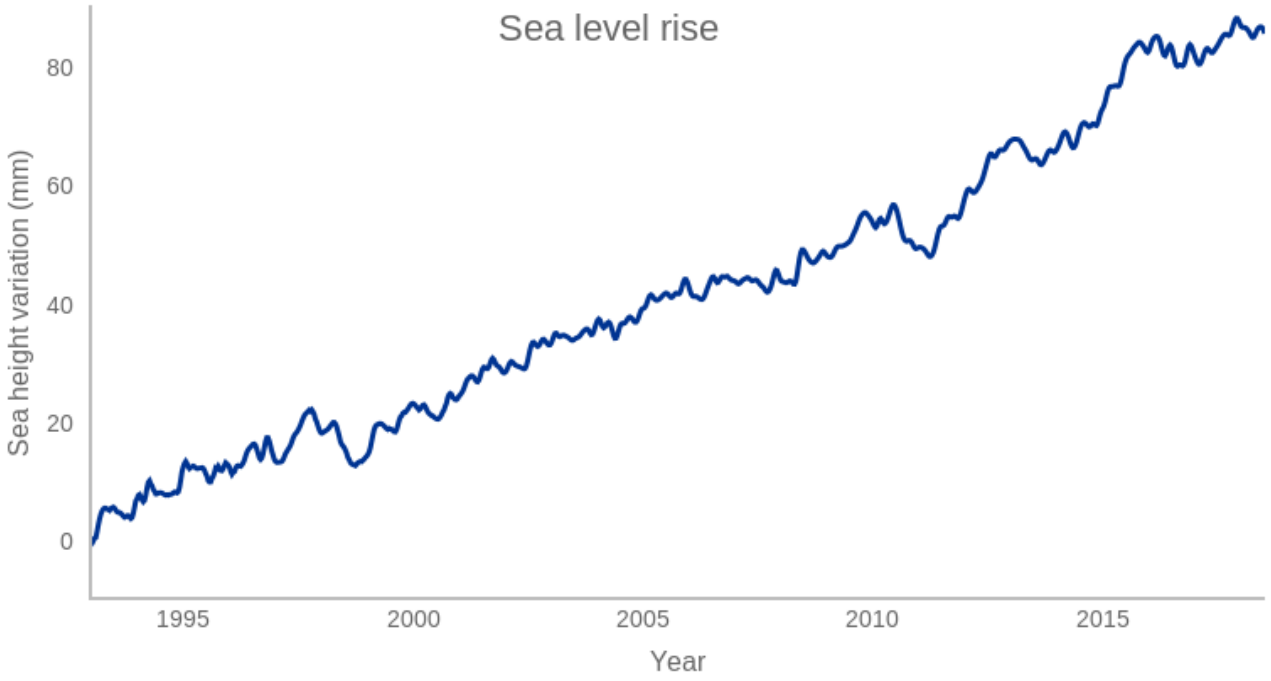
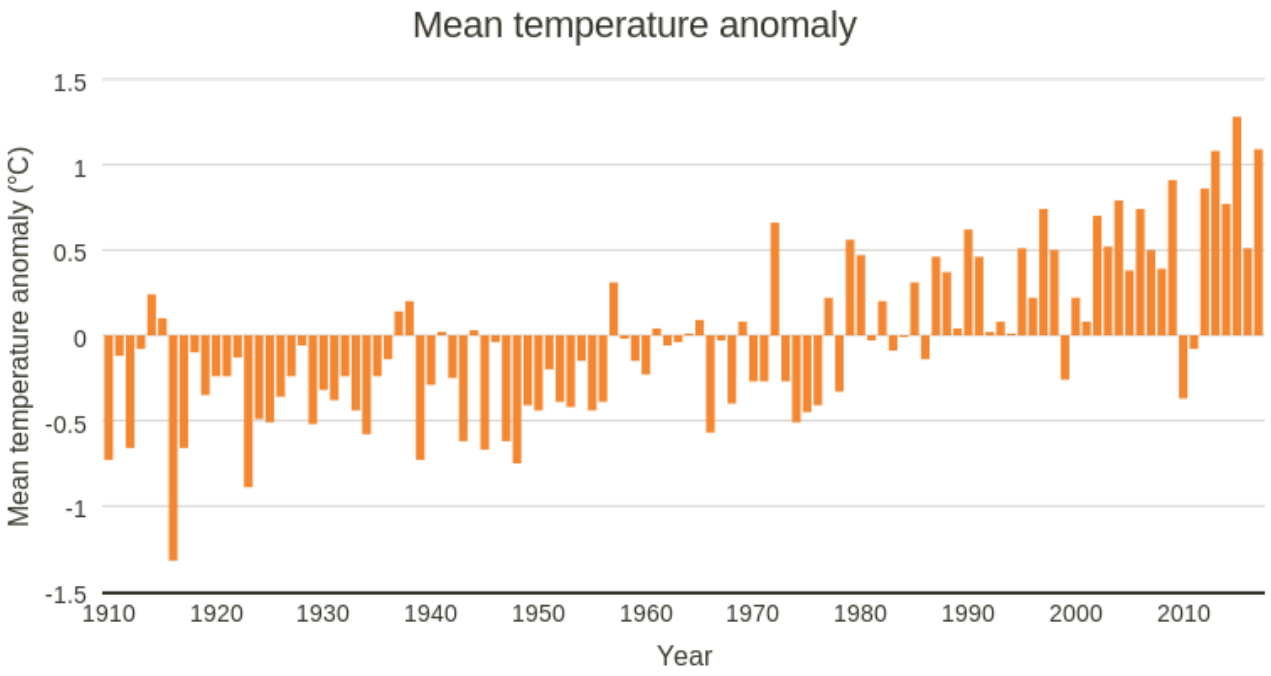


Source: climate.nasa.gov



Source: Australian Bureau of Meteorology
(Based on a 30-year climatology (1961-1990)

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5.2.1 How does the Paris Climate Agreement affect the NEM?

The Paris Climate Agreement is a commitment by 181 countries to reduce greenhouse gas emissions to limit global warming to less than two degrees Celsius above pre-industrial levels. Australia joined the Paris Agreement in April 2016, committing to cut greenhouse gas emissions by 26 % to 28 % below 2005 levels by 2030. To reach the target set by the Paris Agreement, Australia must produce less than 4,800 million tonnes of greenhouse gas emissions between 2021 and 2030. However, current forecasts suggest that Australia will produce close to 5,650 million tonnes during this period[56]. Australia therefore needs to implement policies that will reduce expected emissions by at least 850 million tonnes between 2021 and 2030.

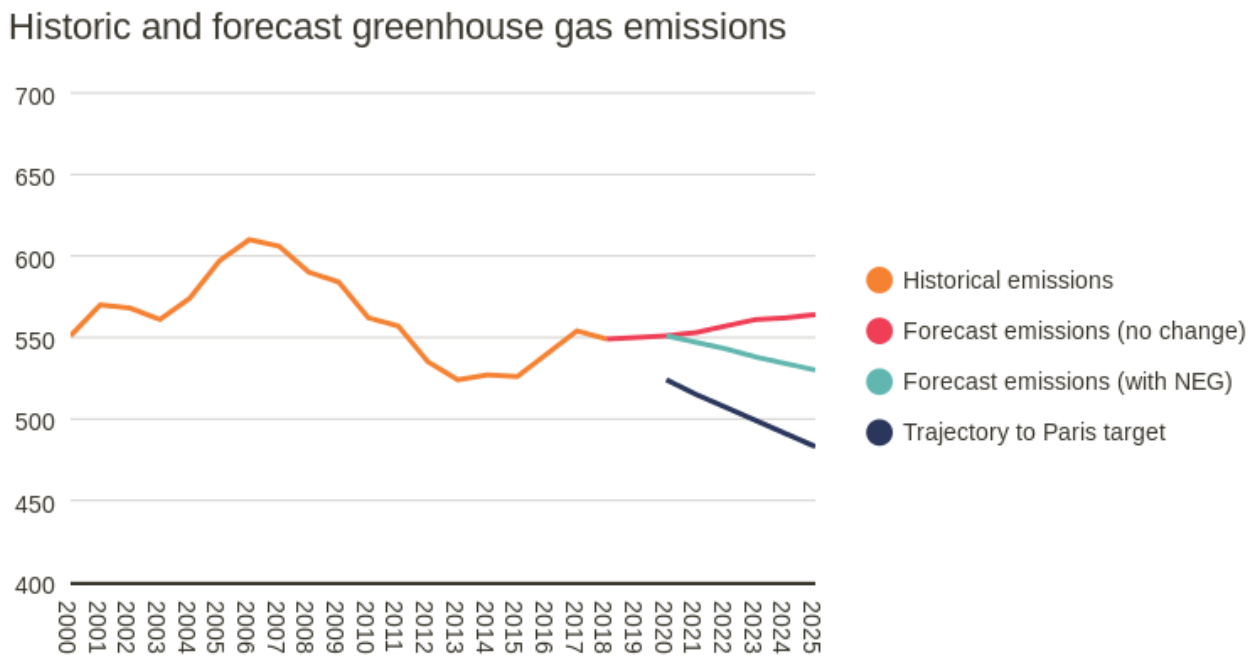
Electricity generation accounts for close to 31 % of total Australian greenhouse gas emissions[57]. Total economy emissions could be reduced through significant adjustments to the rest of the economy, such as reducing livestock production. However, the cost of reducing emissions in other sectors of the economy would likely be greater than reducing the cost of electricity generation emissions. Meeting the Paris Climate Agreement target will therefore require significant adjustments to generation practices in the NEM. These adjustments are achieved through national and state policies.

5.2.2 National schemes

The Renewable Energy Target (RET) was first implemented in 2001. This scheme is designed to encourage investment in renewable energy generation by requiring retailers to derive an increasing proportion of sold electricity from renewable sources each year. Although this scheme has delivered on the important goal of developing renewable energy generation, it has also introduced significant costs to customer bills. In 2016-17, 44 % of the environmental component of electricity bills was attributable to the RET[58]. Fortunately for consumers, the price of renewable energy is expected to fall as renewable energy supply meets and exceeds demand from retailers by 2020.

The RET also affects electricity generation. As renewable generation sources have a near zero marginal cost (meaning

56 Department of Environment and Energy, 2017
57 ACIL ALLEN Consulting 2018
58 ACCC, 2018



Source: Department of Energy and Environment

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that wind and sunlight are free), these generators can bid power into the NEM at extremely low cost. This factor exerts downward pressure on electricity spot prices.

5.2.3 State schemes

Over the past 20 years, state governments have implemented a variety of schemes to encourage consumers to take up solar panels. Premium feed-in-tariffs (PFIT) have been the primary mechanism used to achieve these targets. PFIT involves owners of solar panels receiving payments above market value for the electricity they generate and feed back into the distribution network. Solar panel owners receive payments from distribution network operators, and distribution firms recover this cost by levying higher electricity prices on all customers. Solar panel users also avoid paying for network costs due their lower use of grid power. As a result, a greater share of network costs are allocated to non-solar consumers. Entry to PFIT schemes has ended over the past decade in response to greater than expected solar uptake. However, previous entrants to these schemes will likely continue to benefit from these policies until the schemes expire in 2031. PFIT costs represented 33 % of the total environmental costs included in an average household bill in 2016-17[59].

5.3 Environmental cost outlook

The outlook for environmental costs is mixed. The costs of the RET and state PFIT schemes are expected to decline as the supply of renewable energy rises. However, additional indirect costs will likely remain high and possibly rise over the next decade. Indirect costs include the price of political instability, which has undermined private investment in new electricity infrastructure. Due to frequent and ongoing changes to environmental and energy policy over the past decade, profitability for new infrastructure in the NEM remains uncertain. To account for this uncertainty, private investors are likely to require an additional risk premium to commit to infrastructure funding. Consumers will likely ultimately bear this risk premium through higher prices.

6 Lessons and outlook

6.1 What went wrong?

Multiple factors have caused problems in the electricity sector over the past decade. At every stage of the supply chain, successive governments have made policy decisions that set the NEM on the wrong course. In generation, a hasty and unplanned transition from fossil fuel to renewable energy has disrupted the wholesale market. This change has been particularly difficult to manage due to structural changes to the Australian gas market over the past decade. In network operation, inefficient regulation has allowed firms to make excessive investments, ultimately resulting in unnecessarily high costs for final consumers. In retail, poor market design and price transparency have led to weak competitive pressure, enabling retail margins to rise despite a growing number of competitors. Amid these problems, environmental policy has exacerbated price tension, despite its importance in achieving other public policy objectives.

6.2 Lessons for the future

6.2.1 If you fail to make a decision, the decision is made for you

Although the Abbott, Turnbull and Morrison governments have resisted taking action on climate change, the inescapable reality of the challenge has led the business community to take action independently. Across the entire supply chain, electricity companies and consumers have begun transitioning to green energy on their own terms. For example, AGL Limited has resisted calls to keep the coal-fired Liddell power station open past 2022, and instead plans to replace the facility with a combination of gas generation, renewable assets and battery storage. Some of Australia's largest corporations, such as Woodside Petroleum, have called for the reimplementation of a market-based carbon price similar to the short-lived carbon pollution reduction scheme implemented by the Gillard government in 2012[60]. When the Turnbull

59 ACCC, 2018
60 AFR, 2018

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government dumped the proposed National Energy Guarantee in August 2018, the leaders of major Australian companies such as Ernst & Young, BHP Billiton and Woolworths condemned the decision as detrimental to business confidence and international competitiveness[61]. The Federal Government's failure to lead an orderly transition to the next phase of electricity supply in Australia has resulted in considerable confusion and uncertainty, which has ultimately caused the cost of electricity to rise. **In the future, governments should recognise and accept difficult challenges, rather than refusing to accept their existence. At the very least, governments should respond to the needs of the business community by promoting policy stability.**

Cooking with gas: The remarkable growth of the LNG industry

The **Liquefied Natural Gas Production industry** has grown significantly over the past five years. Revenue from Australian LNG production is projected to rise at an annualised 20.5 % over the five years through 2018-19, to reach $43.5 billion[f]. Australian LNG exports have increased from 14.3 million tonnes in 2006-07 to an expected 73.3 million tonnes in 2018-19. In 2018-19, ten LNG facilities are expected to be operational in Australia. New projects have been developed in Queensland, including the Queensland Curtis LNG venture (completed in June 2015), the Gladstone LNG venture (completed in October 2015), and the Australia Pacific LNG venture (completed in June 2016). These projects represent the first coal seam gas LNG export projects in the world.

f IBISWorld, 2018

6.2.2 The interests of the economy should take precedence over the interests of a single industry

The transition to the next phase of electricity supply has been disrupted by the poorly timed liberation of the LNG market. Originally, the transition from coal-based power to renewable energy was expected to be smoothed through the greater use of gas, which was fairly low cost and a good dispatchable accompaniment to intermittent renewable generation. However, the ability to use gas as a stabilising source of energy was undermined by government decisions to allow the development of massive LNG export facilities over the past decade. As Australian gas has been shipped overseas, the domestic supply of LNG has been undermined at precisely the point when domestic demand was highest[62]. Although the LNG boom has created jobs and contributed significant value to the economy, governments have failed to recognise the negative implications for Australian energy security. **In the future, governments should permit projects that adequately balance and protect the interests of the business community and consumers.**

6.2.3 The negative implications of renewable energy need to be recognised and accounted for

Solar and wind energy are free and readily available, enabling renewable energy generators to operate at near-zero marginal cost. This means that renewable energy generators can be profitable regardless of what the prevailing price for electricity is in the NEM. Although low cost energy is a benefit for consumers in the long term, the implications are negative in the short term. The low-cost of renewable energy has rapidly undermined the competitiveness of coal-fired generation, leading to the hasty and unexpected removal of base-load generation capacity, such as the abrupt shutdown of the Hazelwood coal-fired power plant in Victoria's Latrobe Valley. **In the future, governments need to recognise the need for renewable energy. However, governments must also accept the negative effects of renewables on grid stability and design policy to preserve coal-fired generation until renewable technology is able to fully provide base-load capacity.**

6.2.4 Regulation needs to be frequently reviewed and adjusted where necessary

Many of the issues in the electricity supply chain have been allowed to occur through a failure to adjust inefficient regulation. A prime example of this was the implementation of the Limited Merits Review (LMR) in 2008, which enabled electricity transmission network operators to challenge and overturn AEMO decisions to limit their revenue from monopolistic networks. Until the LMR's removal in June 2017, challenges against the AEMO had become routine. Governments were too slow to address this issue and failed to prevent network costs from driving up electricity bills. Furthermore, state governments in Queensland, New South Wales, and Tasmania implemented poorly designed

61 ABC News, 2018
62 IBISWorld, 2018

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reliability standards for distribution networks in 2005. The standards were legally binding and short-sighted, set in reference to arbitrary targets rather than the value customers placed on reliability. These policies have led to inefficient investment in network infrastructure in these states. **In the future, governments need to be proactive in designing and adjusting regulation, rather than reacting to failures after the damage has already been done. Governments should move quickly to implement regulation regarding future issues in the NEM, such as time-based price tariffs and the risk of stranded assets.**

6.2.5 Regulators need to ensure price complexity doesn't undermine efficient decision making

Over the past two decades, a lack of oversight has allowed the retail electricity market to become inefficient. For competition to be effective, consumers need to have a clear way to compare offers from retailers. Governments should make it easier to compare retail offers by changing regulation to force retailers to provide offers in reference to an industry benchmark. Furthermore, governments should prompt consumers to take a more active approach in seeking out the best electricity offer. In August 2018, the Victorian Government introduced a new policy that gives $50 to any household that visits a state government website that helps them find cheaper electricity and gas deals. Other state governments would benefit from copying this initiative. **In the future, governments should assist consumers by reducing market complexity and lessening the information advantage retailers have over consumers.**

6.3 Where are we going?

Significant growth in the price of electricity has encouraged greater scrutiny of the electricity sector over the past decade. Numerous government inquiries have uncovered a litany of market failures. The government will likely implement potential regulatory solutions for many of these problems. For example, price transparency in the retail market will likely improve as retail firms' confusing discount practises are banned. However, some drivers of electricity price growth are unavoidable, and higher prices may become the new normal in the NEM. New generation and transmission infrastructure will need to be developed, and households and businesses will ultimately need to absorb this cost. The structure of electricity markets may need to change in response to the availability of cheap and intermittent renewable power. Above all else, cohesive government policy at both the state and federal level will be critical to securing affordable, renewable and reliable power in future years.

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References

1. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page v
2. IBISWorld, 2018. "D2640 Electricity Retailing in Australia"
3. Department of Environment and Energy, 2018. "Australian Energy Update 2018", page 20
5. Australian Energy Regulator, 2017. "State of the Energy Market", page 94
6. Department of Environment and Energy, 2018. "Australian Energy Update 2018", figure 2.7
7. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page vi
9. Choice Consumer Pulse, 2017. "Australians' attitudes to cost of living 2014-2017", page 4
10. ACCC, 2017. "Retail Electricity Pricing Inquiry: Preliminary Report", page 15
11. ACCC, 2017. "Retail Electricity Pricing Inquiry: Preliminary Report", page 16
12. ACCC, 2017. "Retail Electricity Pricing Inquiry: Preliminary Report", page 16
13. Department of Environment and Energy, 2018. "Australian Energy Update 2018" page 23
14. Department of Environment and Energy, 2018. "Australian Energy Update 2018" page 23
15. Australia Energy Council, 2018. "Australia's power stations: Is there a generation gap?", accessed 23 November 2018 https://www.energycouncil.com.au/analysis/aging-generation-australias-coal-fired-fleet/
16. The Australia Institute, 2018. "Colossal fossil failures", page 1
17. ABC News, 2016. "Worksafe notices detail extent of repairs needed at Hazelwood power station", accessed 23 November 2018 http://www.abc.net.au/news/2016-12-01/worksafe-notices-detail-extent-of-repairs-needed-at-hazelwood/8082318
18. ABC News, 2016. "Worksafe notices detail extent of repairs needed at Hazelwood power station", accessed 23 November 2018 http://www.abc.net.au/news/2016-12-01/worksafe-notices-detail-extent-of-repairs-needed-at-hazelwood/8082318
19. Australian Energy Regulator, 2018. "AER electricity wholesale performance monitoring Hazelwood advice", page 1
20. Australian Energy Regulator, 2018. "National Electricity Market electricity consumption", accessed 23 November 2018 https://www.aer.gov.au/wholesale-markets/wholesale-statistics/national-electricity-market-electricity-consumption
21. Sandiford M, Forcey T, Pears A, McConnell D, 2015. "Five Years of Declining Annual Consumption of Grid-Supplied Electricity in Eastern Australia: Causes and Consequences", page 96
22. Sandiford M, Forcey T, Pears A, McConnell D, 2015. "Five Years of Declining Annual Consumption of Grid-Supplied Electricity in Eastern Australia: Causes and Consequences", page 97
24. IBISWorld, 2018. "F6212 Domestic price of natural gas"
25. IBISWorld, 2018. "F4601 Domestic price of black coal"
26. COAG Energy Council, 2017. "Energy Security Board Advice The National Energy Guarantee", page 4
27. AGL Energy Ltd, 2017. "NSW Generation Plan", slide 2
28. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 156
29. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 156
30. Australian Energy Market Commission, 2017. "Electricity Network Economic Regulatory Framework Review", page 42
31. Wood, T, Blowers, D and Griffiths, K (Grattan Institute), 2018. "Down to the Wire: A sustainable electricity network for Australia", page 3
32. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 167
33. Australian Energy Market Commission, 2018. "Reliability", accessed 23 November 2018 https://www.aemc.gov.au/energy-system/electricity/electricity-system/reliability
34. Australian Energy Market Operator, 2017. "BLACK SYSTEM SOUTH AUSTRALIA 28 SEPTEMBER 2016", page 6

Power shock: Learning from Australia's mistakes in the electricity sector

35. ABC News, 2016. "Worksafe notices detail extent of repairs needed at Hazelwood power station", accessed 23 November 2018 http://www.abc.net.au/news/2016-12-09/sa-blackout-costs-could-have-been-worse-business-sa-says/8106600
36. NSW Government Industry & Investment, 2010. "Transmission Network Design and Reliability Standard for NSW", page 4
37. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 166
38. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 171
39. Wood, T, Blowers, D and Griffiths , K (Grattan Institute), 2018. "Mostly working: Australia's wholesale electricity market", page 42
40. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 221
41. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page v
42. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page xi
43. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page xi
44. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 135
45. IBISWorld, 2018. "D2640 Electricity Retailing in Australia"
46. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 131
47. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page xxii
48. NASA, 2018. "A blanket around the Earth", accessed 23 November 2018 https://climate.nasa.gov/causes/
49. CSIRO and BOM, 2015. "Climate Change in Australia", accessed 23 November 2018 https://www.climatechangeinaustralia.gov.au/en/
50. Department of Climate Change and Energy Efficiency, 2011. "Climate Change Risks to Coastal Buildings and Infrastructure," page 3
51. NASA, 2018. "Sea Level", accessed 23 November 2018 https://climate.nasa.gov/vital-signs/sea- level
52. Deloitte Access Economics, 2017. "At what price? The economic, social and icon value of the Great Barrier Reef", page 59
53. Deloitte Access Economics, 2017. "At what price? The economic, social and icon value of the Great Barrier Reef", page 59
54. IBISWorld, 2018. "X0003 Tourism in Australia"
55. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page v
56. Department of Environment and Energy, 2017. "Australia's emissions projections 2017", page 3
57. ACIL Allen Consulting, 2018. "The NEG Emissions Obligation – Does it do enough?", viewed 23 November 2018 https://acilallen.com.au/insights/neg-emissions
58. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 215
59. ACCC, 2018. "Restoring electricity affordability and Australia's competitive advantage", page 215
60. Australian Financial Review, 2018. "Woodside's Peter Coleman slams Australia's 'abyss of indecision' on energy", accessed 23 November 2018 https://www.afr.com/business/woodsides-peter-coleman-slams-australias-abyss-of-indecision-on-energy-20181113-h17um1
61. ABC, 2018. "Business leaders slam Turnbull Government's 'destructive' energy backflip", accessed 23 November 2018 https://www.abc.net.au/news/2018-08-21/groundhog-day-business-confidence-sapped-by-energy-policy/10146322
62. IBISWorld, 2018. "OD5536 Liquefied Natural Gas Production in Australia"

a. IBISWorld, 2018. "C2132 Aluminium Smelting in Australia"
b. IBISWorld, 2018. "E3109 Heavy Industry and Other Non-Building Construction in Australia"
c. IBISWorld, 2018. "A0141 Sheep Farming in Australia"
d. IBISWorld, 2018. "A0142 Beef Cattle Farming in Australia"
e. USGS, 2016. "The Water Content of Things: How much water does it take to grow a hamburger?", accessed 23 November 2018 https://water.usgs.gov/edu/activity-watercontent.php
f. IBISWorld, 2018. "OD5536 Liquefied Natural Gas Production in Australia"