

Chapter 2

Electricity markets and the role of coal fired power stations

Introduction

2.1 This chapter provides an overview of electricity markets in Australia and the contribution of coal fired power stations to electricity generation. The chapter then looks at Australia's obligations under the Paris Agreement and the role that retiring coal fired power stations can play in meeting these commitments.

Electricity markets in Australia

2.2 The National Electricity Market (NEM) and Western Australia's South-West Interconnected System (SWIS) are the largest electricity markets in Australia.¹ The NEM covers Australia's eastern and south-eastern coasts and comprises five states: Queensland, New South Wales (including the Australian Capital Territory), South Australia, Victoria and Tasmania.² The SWIS covers south-west Western Australia.³

2.3 The NEM and the SWIS cover 86 per cent and eight per cent, respectively, of Australia's electricity demand.⁴

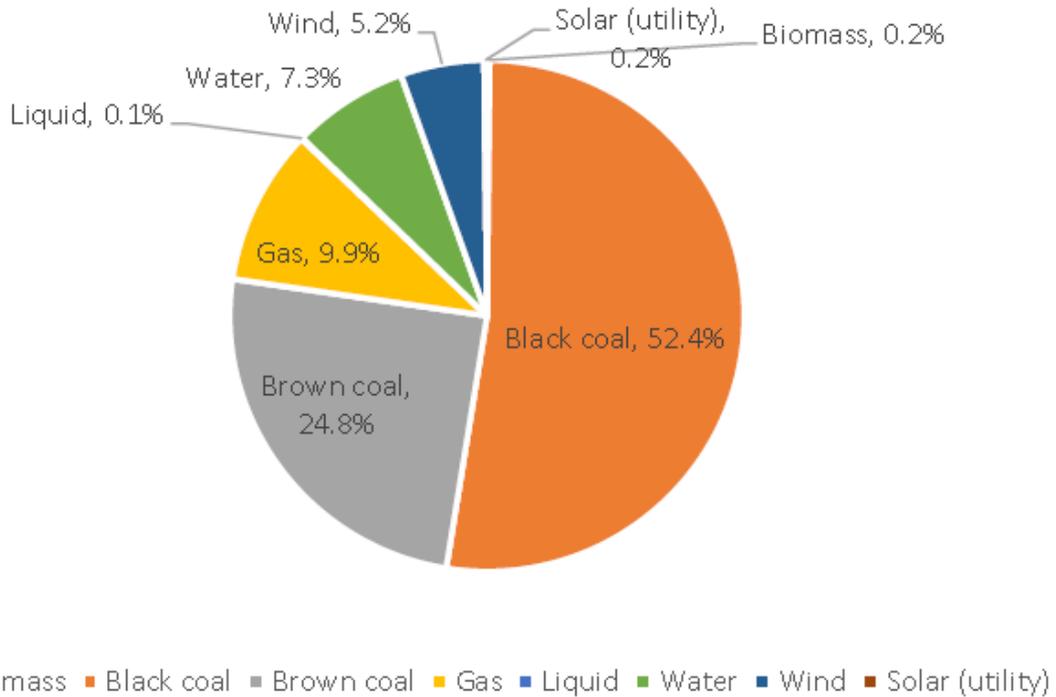
2.4 Currently, coal fired generation (both brown and black coal) makes up 78 per cent of electricity generation across the NEM. This is followed by gas, which accounts for 9.9 per cent. Figures 2.1 and 2.2 depict Australia's electricity generation mix.

1 Climate Change Authority, *Policy options for Australia's electricity supply sector: Special review research report*, August 2016, p. 24.

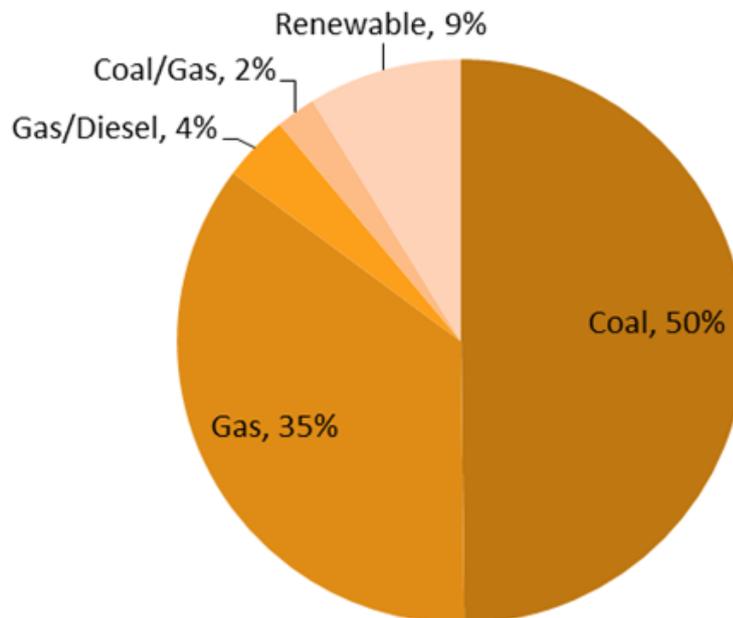
2 Australian Energy Market Operator (AEMO), *Fact Sheet: The National Electricity Market*, p. 1. Available at: <https://www.aemo.com.au/-/media/Files/PDF/National-Electricity-Market-Fact-Sheet.pdf> (accessed 6 November 2016).

3 Climate Change Authority, *Policy options for Australia's electricity supply sector: Special review research report*, August 2016, p. 24.

4 Climate Change Authority, *Policy options for Australia's electricity supply sector: Special review research report*, August 2016, p. 24.

Figure 2.1 Electricity generation mix in the NEM

Source: Australian Energy Council, *Submission 44*, p. 2.

Figure 2.2 Electricity generation mix in the SWIS (2011)

Source: Australian Renewable Energy Agency, *Australia's off-grid clean energy market: Research Paper*, 8 October 2014, prepared by AECOM Australia, p. 13.

Coal fired power stations in Australia

2.5 Currently there are 24 coal fired power stations operating in Australia. The age and capacity of the stations is varied as shown in Table 2.1.

Table 2.1 Australia's operating coal fired power stations

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	Bluwaters 1	Black coal	2009		7	208.0
WA	Bluwaters 2	Black coal	2010		6	208.0
WA	Worsley (Alumina)	Black coal	1982-00		16-34	135.0

Source: Australian Energy Council, Submission 44, p. 5.

2.6 Table 2.2 lists the nine coal fired power stations which closed between 2010 - 2016 across four Australian states.

Table 2.2 Australia's decommissioned coal fired power stations

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	

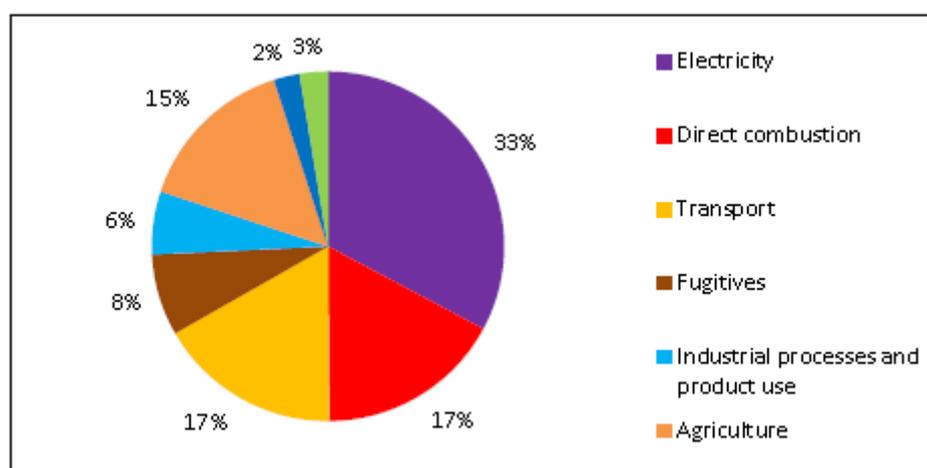
Source: Australian Energy Council, Submission 44, p. 6.

Emissions from electricity generation

2.7 The Clean Energy Council noted that the electricity sector contributes approximately one-third of Australia's emissions and that this trend is expected to continue:

Australia's electricity system was founded on centralised, carbon-intensive coal-fired generation. The sector is the single largest contributor to greenhouse gas emissions, and contributes approximately a third of our country's total emissions. This trend is expected to continue out to 2020 and beyond.⁵

Figure 2.3 Australia's domestic emissions by share, 1990-2014



Source: Clean Energy Council, *Submission 13*, p. 2 from Department of Environment, *Australia's emission projections 2014-15*, March 2015, page 9.

2.8 The Climate Change Authority (CCA), its August 2016 *Policy Options for Australia's electricity supply sector: Special review research report* (CCA's Special review research report), noted that of all the sources of electricity generation, coal contributed 88 per cent of emissions:

Of the generation sources that produce emissions, brown coal is the most emissions-intensive—that is, it produces the most greenhouse gas emissions per unit of generation—followed by black coal and gas...The total emissions from each fuel depend on the emissions intensity of the fuel itself and what share of total generation it makes up...Coal produces around 88 per cent of generation emissions, 35 per cent from brown coal and 53 per cent from black coal.⁶

5 Clean Energy Council, *Submission 13*, p. 2.

6 Climate Change Authority, *Policy Options for Australia's electricity supply sector: Special review research report*, August 2016, p. 15. Available at: <http://www.climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/files/SR%20Electricity%20research%20report/Electricity%20research%20report%20-%20for%20publication.pdf> (accessed 3 November 2016).

2.9 Ageing coal fired power stations are recognised as very high producers of pollution. The Climate Council stated:

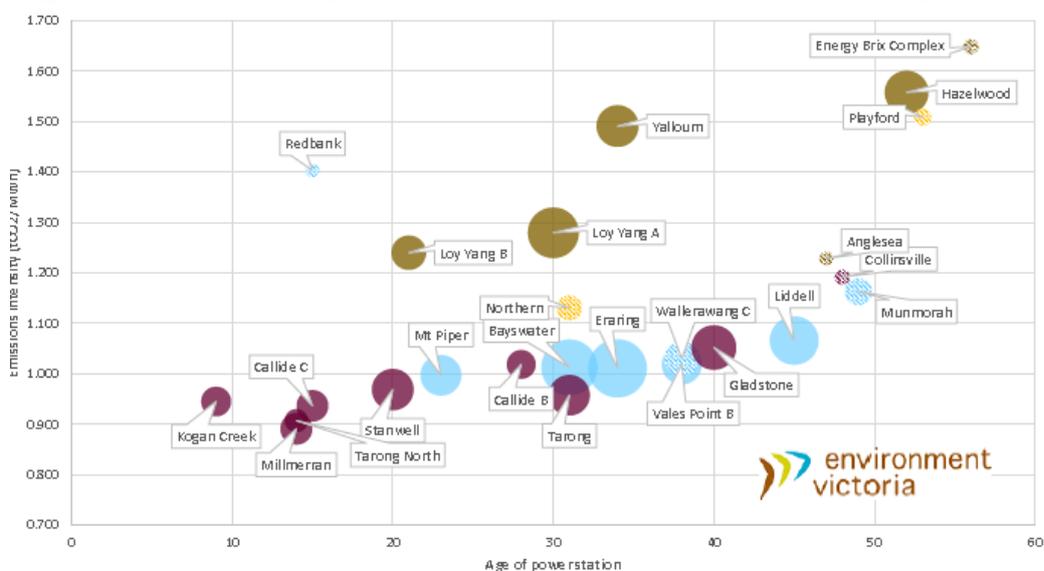
The majority of Australia's coal fired power stations are old, inefficient and unlikely to be able to be retrofitted with [carbon capture and storage (CCS)] technologies. Within a decade, around half of Australia's coal fuelled generation fleet will be over 40 years old, with some currently operating stations approaching 60 years, all using obsolete sub critical coal technology. These older plants will likely be too outdated, inefficient and carbon intensive to be candidates for retrofitting CCS technology.⁷

2.10 A number of submitters also noted that power stations using brown coal were the highest emitters of carbon dioxide. For example, Environment Victoria stated:

Black coal generators in NSW and Queensland are roughly 30-40% less polluting than Victoria's brown coal generators.⁸

2.11 Figure 2.4 graphs the operating and recently decommissioned coal fired power stations in the NEM by age and emissions.

Figure 2.4 Coal fired power stations in the National Electricity Market



Source: Environment Victoria, *Submission 16*, p. 5.⁹

7 Climate Council, *Australia's Electricity Sector: aging, inefficient and unprepared*, 2014, p. 70. Available at: <http://www.climatecouncil.org.au/uploads/f9ba30356f697f238d0ae54e913b3faf.pdf> (accessed 6 November 2016).

8 *Submission 16*, p. 6. See also Associate Professor Frank Jotzo, *Proof Committee Hansard*, 9 November 2016, p. 13; 350.org, *Submission 19*, pp. 7–8; La Trobe Valley Sustainability Group, *Submission 56*, p. 3.

9 The size of each circle represents the capacity of each generator. Victorian generators = brown circles; NSW = blue circles; QLD = maroon circles; SA = gold circles. Power stations that have closed in the past two years are represented by the diagonal lines through the circles. The graph only shows power stations in the NEM, not power stations in Western Australia which are part of the SWIS.

2.12 The Hazelwood power station, in Victoria's Latrobe Valley, for example, is the most intense in carbon emission in Australia. It is a brown coal power station and generates emissions at 1.52 tonnes of carbon dioxide (CO₂) for each megawatt hour (MWh) of electricity produced.¹⁰ This amounts to 15 million tonnes of CO₂ emissions per year, which accounts for approximately 2.8 per cent of Australia's total emissions.¹¹ Its high level of emissions is in part due to its age; Hazelwood has eight units that were constructed between 1964 and 1971, making it the oldest coal fired generator operating in Victoria.¹² Once Hazelwood closes in March 2017, Yallourn power station, also in the Latrobe Valley, will have the highest emission intensity in Australia.

Health impacts of coal fired power stations

2.13 Some submitters to the inquiry commented that pollution from coal fired power stations causes ongoing environmental damage and health problems for nearby communities. For example, Doctors for the Environment Australia submitted:

Coal-fired power plants are substantial sources of air pollutants which cause significant health problems. The three main pollutants are sulphur dioxide, SO₂, a mix of nitrogen oxides referred to as NO_x, and particulate matter in the PM₁₀ or PM_{2.5} size range. SO₂ and NO_x are both powerful respiratory irritants, causing asthma, chronic lung disease, and restricted lung growth in children. Fine particle pollution causes similar respiratory problems but is also associated with ischaemic heart disease, lung cancer, and increased mortality.

The pollutants can travel long distances, so even though power stations are located outside cities they are contributing to major city pollution as well as having higher impacts on the local towns. This has been illustrated in Sydney where research by CSIRO and the Australian Nuclear Science Technology Organisation (ANSTO) showed that half of the sulphate particles at Richmond in western Sydney could be traced back to one of the coal-fired power stations despite these being located 70, 90 and 140 Km away.

...While the climate change effects of coal-fired power are distant and delayed, the air pollution effects are regional and immediate, so should be taken into consideration in planning the transition of power generation

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- 10 Roger Dargaville, *The case for shutting down Hazelwood power station – some facts and figures*, 5 July 2012, Available at: <https://theconversation.com/the-case-for-shutting-down-hazelwood-power-station-some-facts-and-figures-7940> (accessed 3 November 2016).
- 11 Dylan McConnell, *Closing Victoria's Hazelwood power station is no threat to electricity supply*, 26 September 2016. Available at: <https://theconversation.com/closing-victorias-hazelwood-power-station-is-no-threat-to-electricity-supply-66024> (accessed 7 November 2016).
- 12 Roger Dargaville, *The case for shutting down Hazelwood power station – some facts and figures*, 5 July 2012.

away from fossil fuels. The best estimate of the dollar value of the health harm from coal-fired power in Australia is AUD \$13 per MWh...¹³

2.14 The Australian Conservation Foundation (ACF) argued that coal fired generators impose significant external costs to human health, the environment, and public infrastructure, which typically falls disproportionately on coal-dependent communities.¹⁴ The ACF noted that estimated costs of health damages associated with coal combustion for electricity in Australia amount to \$2.6 billion per annum.¹⁵

2.15 The Latrobe Valley Sustainability Group argued that community health benefits would result from the closure of coal fired power stations, and noted:

The Latrobe Valley has had and continues to have higher than normal instances of cardiovascular, cancer and lung diseases and this is consistent with studies from around the world which have linked particulate pollution and pollution from NOx and SOx gases with higher occurrence of these diseases.¹⁶

2.16 Port Augusta City Council noted that it faces significant problems in relation to environmental damage, air pollution and emissions of ash and coal dust as a result of the Northern Power station's closure in 2016 without adequate environmental mitigation planning.¹⁷

Meeting our Paris Agreement obligations

2.17 On 22 April 2016, Australia signed the Paris Agreement, which is designed to strengthen the United Nations Framework Convention of Climate Change (UNFCCC). Pursuant to the Paris Agreement signatory countries, must use specific measures in order to address climate change, such as:

(a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;

(c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.¹⁸

13 *Submission 53*, pp. 11–12. See also CEN, *Submission 34*, p. 2; The Australia Institute, *Submission 73*, Attachment 1, p. 3.

14 *Submission 69*, pp. 3–4.

15 *Submission 69*, p. 4.

16 *Submission 56*, p. 4.

17 *Submission 62*, p. 3.

18 United Nations Framework Convention on Climate Change, Paris Agreement, 12 December 2015, Article 2. As of 22 November 2016, there are 197 signatories of the Agreement and 112 parties who have ratified it domestically.

2.18 On 10 November 2016, the Federal Government ratified the Paris Agreement alongside the Doha Amendment to the Kyoto Protocol after the Joint Standing Committee on Treaties recommended that Australia ratify both treaties. The two Agreements together formalise Australia's 2030 and 2020 emissions reduction targets.¹⁹

2.19 Countries that are signatories to the Paris Agreement have also utilised the importance of accelerated and planned closures of coal fired generators in meeting their climate goals. To date the United Kingdom, France, Canada, Austria, Denmark and the Netherlands have all commenced the implementation of coal closures in their electricity markets.²⁰

Australian Government climate policy

2.20 In line with its obligations under the Paris Agreement, the Australian Government has committed to reduce emissions to 26–28 per cent below 2005 levels by 2030.²¹ The Department of the Environment and Energy (the Department) states that:

This target represents a 50–52 per cent reduction in emissions per capita and a 64–65 per cent reduction in the emissions intensity of the economy between 2005 and 2030.²²

2.21 The Department contends that this reduction, when considered per person and emissions intensity basis, will exceed other countries such as the United States, Japan, the European Union, Korea and Canada.²³ However, a number of submissions have outlined that Australia's current commitments will not be adequate to meet our obligation to keep global warming below two degrees. Submitters also outlined that current climate and energy policies would not be adequate to meet current commitments let alone an adequate contribution to keeping global warming below two degrees. The ACF stated:

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- 19 Minister for Foreign Affairs, the Hon Julie Bishop MP, 'Ratification of the Paris Agreement on Climate Change and the Doha Amendment to the Kyoto Protocol', *Media release*, 10 November 2016. Available at: http://foreignminister.gov.au/releases/Pages/2016/jb_mr_161110a.aspx?w=tb1CaGpkPX%2FISOK%2Bg9ZKEg%3D%3D (accessed 18 November 2016). Pursuant to the Kyoto Protocol, Australia has agreed to reduce its greenhouse gas emissions by five per cent compared with 2000 levels by 2020.
- 20 See: Rob Gillies, *Associated Press*, 'Canada to phase out coal-fired electricity by 2030', 21 November 2016. Available at http://hosted2.ap.org/APDEFAULT/cae69a7523db45408eeb2b3a98c0c9c5/Article_2016-11-21-CN--Canada-Coal%20Phase%20Out/id-ed19c7d510034c66a42e64902df91a43 (accessed 22 November 2016).
- 21 Department of the Environment and Energy, *Australia's 2030 climate change target*, 2015. Available at: <https://www.environment.gov.au/climate-change/publications/factsheet-australias-2030-climate-change-target> (accessed 7 November 2016).
- 22 Department of the Environment and Energy, *Australia's 2030 climate change target*, 2015.
- 23 Department of the Environment and Energy, *Australia's 2030 climate change target*, 2015.

According to the Climate Action Tracker, to meet the federal government's Paris targets, emissions must fall 1.9 per cent annually on average. Instead, they are rising about 1.2 per cent a year. This is a clear indication that current climate policy is failing to achieve required pollution reduction.

Australia's initial target of 26-28 per cent pollution reduction on 2005 levels by 2030 is inadequate compared to other similar economies and compared to the actual goal of keeping global warming to 1.5-2°C. If other countries followed Australia's ambition it would lead to 3-4°C of warming above preindustrial levels.²⁴

2.22 Environment Victoria highlighted that even a conservative assessment of the global emission reductions required suggests there is very little time to accommodate significant reductions in Australia:

According to the Stockholm Environment Institute analysis, there is very little room for further emissions of greenhouse gases if global temperatures are to be kept "well below 2°C" – much less below the less dangerous 1.5°C. This analysis notes that these are generous estimates of the available budgets, and argues that a reasonable likelihood of limiting warming to below 1.5°C implies a global carbon budget of less than (and perhaps significantly less than) 250 billion tonnes of carbon dioxide equivalent (Gt CO₂) from the start of 2015. Australia's share of this budget equals less than four years of its current emissions.²⁵

2.23 The Australian Government's plan is driven by Direct Action policies which are claimed to 'reduce emissions, increase energy productivity and improve the health of soils and the environment', a key feature of which is the Emissions Reduction Fund (discussed below).²⁶

2.24 There are two Australian government policies which are relevant to the electricity sector: the Renewable Energy Target (RET); and the Emissions Reduction Fund (ERF) crediting and purchasing mechanism.²⁷

2.25 The Clean Energy Regulator states:

The [RET] is an Australian Government scheme designed to reduce emissions of greenhouse gases in the electricity sector and encourage the additional generation of electricity from sustainable and renewable sources.²⁸

24 *Submission 69*, p. 5.

25 *Submission 16*, p. 4.

26 Department of the Environment and Energy, *Australia's 2030 climate change target*, 2015.

27 See Climate Change Authority, *Policy Options for Australia's electricity supply sector: Special review research report*, August 2016, p. 20.

28 Clean Energy Regulator, *About the Renewable Energy Target*, 15 September 2016. Available at: <http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target> (accessed 6 November 2016).

2.26 There are two schemes operating as part of the RET:

The Large-scale Renewable Energy Target, which encourages investment in renewable power stations to achieve 33 000 gigawatt hours [GWh] of additional renewable electricity generation by 2020, and

The Small-scale Renewable Energy Scheme, which supports small-scale installations like household solar panels and solar hot water systems.²⁹

2.27 The ERF is described by the Clean Energy Regulator as:

...a voluntary scheme which operates to provide incentives for a range of organisations and individuals to adopt new practices and technologies to reduce their emissions.³⁰

2.28 A participant must register with the ERF, secure a contract with the Australian Government through an auction, run the project according to the method chosen and report back to the ERF, and as a result gain Australian Carbon Credit Units (ACCUs) for the reductions that have been achieved and sell them.³¹

2.29 The ERF uses this system as an exchange scheme for carbon emissions, which is described as a 'safeguard mechanism'. The Clean Energy Regulator states that:

While the crediting and purchasing elements provide incentives for businesses to reduce their emissions, the safeguard mechanism will ensure that emissions reductions purchased by the government are not offset by significant increases in emissions above business-as-usual levels elsewhere in the economy.³²

2.30 The ERF and safeguard mechanism have been the subject of significant public controversy and the government's claims for the polices have been highly contested. A number of submissions highlighted the inadequacies of the policies. For example, Environment Victoria stated:

A number of reputable analyses have suggested that the Federal government's Direct Action Policy (DAP) and more specifically the [ERF] will not be able to achieve the 5 percent cut to emissions that the Government has agreed to, let alone reductions consistent with Australia's contribution to staying under a 2°C limit.²⁰ In fact, modelling by SKM MMA and Monash University's Centre of Policy Studies found a

29 Clean Energy Regulator, *How the scheme works*, 28 October 2015. Available at: <http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target/How-the-scheme-works> (accessed 6 November 2016).

30 Clean Energy Regulator, *About the Emissions Reduction Fund*, 15 February 2016. Available at: <http://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund> (accessed 7 November 2016).

31 Clean Energy Regulator, *How does it work*, 21 October 2016. Available at: <http://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund/How-does-it-work> (accessed 7 November 2016).

32 Clean Energy Regulator, *The safeguard mechanism*, 13 January 2016. Available at: <http://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund/the-safeguard-mechanism> (accessed 7 November 2016).

likely increase in emissions by 8-10 percent by 2020. In a study by Reputex, emissions growth of 16 percent by 2020 was projected under DAP.

The "Safeguard Mechanism" of the ERF was intended to create a cap on total emissions, but the design of the mechanism means it provides no safeguard at all. Indeed, analysis by Environment Victoria found that emissions from the energy sector could theoretically increase by 120 million tonnes per year without breaching the safeguard mechanism. This included possible increases of 40-50 million tonnes from coal-burning power stations alone.

...

Ultimately, the [ERF] exerts no pressure on coal generators, and therefore plays no role in modernising our electricity supply.³³

The role of the electricity sector in meeting emissions targets

2.31 A number of submissions highlighted the key role that the electricity sector could play in Australia meeting its emissions reductions targets. For example, Environment Victoria argued:

While decarbonisation is required across all sectors of Australia's economy, our earliest and largest opportunity to reduce climate pollution is through a managed phase out of Australia's fleet of coal-burning power stations.³⁴

2.32 The CCA's Special Review research report stated:

Available studies consistently find that Australia has opportunities to achieve cost-effective reductions in electricity sector emissions as part of national action consistent with limiting warming to 2 degrees.³⁵

2.33 The CCA noted that the electricity sector is Australia's largest single source of emissions and that decarbonising the sector will require withdrawal of high-emissions generators over the coming decades.³⁶

2.34 The CCA's recommendations were underpinned by an independent modelling from the Jacobs Group on achieving a below two degrees scenario which showed that by 2030 brown coal stations would be closed and over two-thirds of black coal would also be decommissioned.³⁷

33 *Submission 16*, p. 9.

34 *Submission 16*, p. 6.

35 Climate Change Authority, *Policy Options for Australia's electricity supply sector: Special review research report*, August 2016, p. 21.

36 Climate Change Authority, *Towards a Climate Policy Toolkit: Special Review on Australia's Climate Goals and Policy*, August 2016, pp. 110 and 115.

37 Jacobs Group, *Climate Change Authority Report: Modelling illustrative electricity sector emissions reduction policies (iteration with CGE modelling)*, June 2016. Available at: <http://climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/files/SR%20Modelling%20reports/Jacobs%20modelling%20report%20-%20CGE%20scenarios.pdf> (accessed 22 November 2016).

Timeline for action to achieve Paris Agreement obligations

2.35 The committee received evidence outlining a variety of timelines for the transition of the electricity sector. Environment Victoria stated that while Australia's energy system was undergoing transformation, 'it is not occurring at the pace necessary to properly address the challenge of global warming'.³⁸

2.36 Associate Professor Frank Jotzo, Director of the Centre for Climate Economics and Policy, ANU College of Asia & the Pacific and Professor John Wiseman, Deputy Director of the Melbourne Sustainable Society Institute, University of Melbourne, provided the committee with information from their work on the International Coal Transitions Research project:

The Nationally Determined Contributions (NDCs) submitted under the UNFCCC Paris Agreement imply significant reductions in the share of coal in primary energy by 2030. Holding the increase in global temperature to well below 2°C and pursuing efforts to limit it to 1.5°C would require even deeper reductions in coal use in the energy system by 2030 and 2050, even allowing for [carbon capture and storage] technology.

Relevant research and advocacy efforts have so far focused, with a high degree of success in many places, on stopping new coal plants. **But early phase out of both coal production and consumption assets will also be necessary to stay well below 2°C.**³⁹

2.37 In his primary submission to the inquiry, Associate Professor Jotzo outlined a timeframe for transition which sees electricity supply carbon-free by 2050:

Achieving a low-emissions economy requires a low-carbon or zero-carbon electricity system. As shown in the Deep Decarbonisation Pathways Project, other pillars of decarbonisation are electrification of transport and energy use in buildings and industry, with greater energy efficiency, as well as emissions savings in industry and agriculture and carbon sequestration on the land.

Various analyses have shown the viability of an electricity system based on renewables in Australia. Modelling prepared by the CSIRO for the Australian Deep Decarbonisation Pathways report shows a scenario where electricity supply transitions to renewables during the 2020s and 2030s and is carbon-free by 2050, while electricity demand increases substantially to accommodate electrification and economic growth.

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38 *Submission 16*, p. 6.

39 See Associate Professor Frank Jotzo, *Submission 4*, Attachment 2, p. 1, and Professor John Wiseman, *Submission 5*, p. 8. Emphasis in original. Article 4 of the Paris Agreement provides that Parties shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures with the aim of achieving the objectives of such contributions.

In this scenario, black coal fired electricity is largely phased out by the early 2030s, while the more emissions intensive brown coal fired plants are all closed by 2020.⁴⁰

2.38 The CCA in its Special Review, *Towards a climate policy toolkit: Special Review on Australia's Climate Goals and Policies*, noted:

To achieve its emissions reduction goals, Australia's emissions must decline more steeply in the coming years than they have in the past.⁴¹

2.39 The Climate Institute argued that, without addressing the situation in the immediate future, urgent damaging measures would be required past 2030 in order to meet the Paris Agreement requirements and avoid catastrophic global warming. It states:

...climate action after 2030 would need to be more extreme – more than 80 per cent of the coal-fired generation fleet would have to be closed in less than five years and new clean energy capacity would have to jump four-fold and keep rising. The impacts of such a disruptive shift would be felt across the economy.⁴²

2.40 The Climate Institute recommends that a policy framework be put in place to achieve net zero emissions by mid-century. Among other strategies to meet this target, The Climate Institute recommends the systematic retirement of the existing ageing power generators to ensure that all have exited by 2035, and to replace these stations with zero or very low emission energy technology.⁴³

2.41 The Climate Institute submitted:

Separate pieces of analysis by the Climate Change Authority, the Climate Institute, and ClimateWorks Australia and the Australian National University find that, irrespective of the policy (or policies) used to reduce electricity emissions consistent with the 2°C goal, all existing coal-fired power stations need to retire before 2035. This deadline is also consistent with analysis by the IEA which finds that all OECD countries need to "all but phase out" generation from "unabated" coal stations by 2035.

If the exit pathway is not consistent with net zero emissions by 2050, the risk remains that it will have to be adjusted in the future. The greater the

40 *Submission 5*, pp. 2–3.

41 Climate Change Authority, *Towards a Climate Policy Toolkit: Special Review on Australia's Climate Goals and Policy*, August 2016, p. 50. Available at: <http://climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/files/Special%20review%20Report%203/Climate%20Change%20Authority%20Special%20Review%20Report%20Three.pdf> (accessed 21 November 2016).

42 The Climate Institute, *Policy Brief: A switch in time: Enabling the electricity sector's transition to net zero emissions*, April 2016, p. 1. Available at: http://www.climateinstitute.org.au/verve/resources/TCI_A-Switch-In-Time_Final.pdf (accessed 7 November 2016).

43 The Climate Institute, *Policy Brief: A switch in time: Enabling the electricity sector's transition to net zero emissions*, April 2016, p. 1.

gap between the exit pathway and the net zero emissions goal, the greater and more disruptive the eventual adjustment will have to be. Our analysis finds that, for example, a pathway consistent with the government's current 2030 emission reduction target of 26-28 per cent below 2005 levels would consume more than 90 per cent of the sector's thirty-year carbon budget in the first ten years, necessitating a precipitous drop in electricity emissions and a very rushed and messy transition to cleaner energy in the early 2030s.⁴⁴

2.42 Origin Energy Limited (Origin) stated that the 2030 emissions reduction target is 'significant'. Origin went on to explain the scale of change necessary:

In order to achieve it, the nation's annual emissions will need to be reduced from current levels of about 545 MtCO₂ to about 440 MtCO₂ in 2030, or a bit over 100 MtCO₂ in terms of an annual point in time difference.

In order to meet this target and the deeper emissions reductions that will be required over the longer term then a suite of comprehensive policies will be required....

Electricity is the largest source of emissions in Australia, at about a third. Using the electricity sector as an example and assuming it makes a proportional contribution to the reductions mentioned above, then this is equivalent to about a 33 MtCO₂ pa reduction on current levels. To put this in context, this is equivalent to closing one of the most emissions intensive brown coal-fired generators in Victoria plus probably another one or two further black coal-fired generators in other regions and replacing them completely with renewable energy. This illustrates the scale of the challenge ahead for both the nation and the electricity sector. We note that the Paris Agreement envisages increasing the ambition of national targets over time.⁴⁵

Increasing generation of renewables over time

2.43 In order to meet the Paris Agreement targets and to effectively retire coal fired power stations, it has been contended that there must be a correlating increase in renewable energy systems.⁴⁶

2.44 Many submitters and witnesses who presented evidence to the committee argued that if coal fired power stations were to close, they would need to be replaced with power stations using different energy sources in order to maintain energy security. Mr Andrew Stock, Climate Councillor, Climate Council, stated that:

Currently the [coal] sector is the largest contributor to Australia's emissions, at 188 million tonnes in 2015. By any measure, whether it is a pro rata adjustment to the reductions that are required and committed to now by this

44 The Climate Institute, *Submission 58*, pp. 3–4.

45 *Submission 39*, p. 2.

46 Clean Energy Council, *Power Shift: A blueprint for a 21st century energy system*, p. 15. Available at: <http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/reports/2016/power-shift.pdf> (accessed 7 November 2016).

nation by 2030, or possibly a further extension of that based on the inability of the current [Intended Nationally Determined Contributions (INDCs)] to meet the two-degrees Celsius glide path, abatement in the electricity sector could be required by 2030 of between around 50 million tonnes and 100 million tonnes per year, recognising that currently it is around 188 million tonnes per year. So these are very large adjustments. The current renewable energy target, the large-scale target, will only reduce abatement in that time frame by around 30 million tonnes a year, if it is fully developed. So we believe that we will need to see large-scale scale-up of renewable energy. Indeed not just the Climate Council but any number of studies have indicated that, for Australia to meet the emissions abatement/reduction targets that it has committed to, a substantial portion of Australia's coal-fired stations will need to close by 2030.⁴⁷

2.45 When asked if replacing existing coal fired power stations with new, more energy efficient power stations should be considered as an alternative option to renewable energy, Ms Kelly O'Shannassy, Chief Executive Officer, Australian Conservation Foundation noted:

I do not believe it is, because what we base our work on, and the international work on, is the notion of a carbon budget—the amount of emissions you have left in order to reach those goals in the Paris Agreement—and it is very clear that we need to get to net zero levels of pollution by mid-century to have a chance of the two degrees...

... So it is a better option to replace the current fleet, which does need replacing, with plant that does not produce those net levels of emissions right now. The technology is showing that renewable energy sources are our best opportunity.

2.46 On the choice between building new coal fired or renewable power stations Associate Professor Jotzo told the committee:

Stepping back from environmental policy objectives, the current levelised cost of electricity, in terms of new build of renewables and coal-fired power, are just about on par. With stagnating electricity demand at the moment, we do not really need large amounts of extra capacity right now or in the next few years. Essentially, the capital costs of coal-fired power stations are not changing over time whereas renewable's costs are falling. Add to that that most investors would be factoring in the probability of some form of carbon constraint or cost of carbon at some point in the future, and I would judge it highly unlikely that you would see commercial investment in coal-fired plants in Australia at any point in the future.⁴⁸

47 *Proof Committee Hansard*, 9 November 2016, p. 1.

48 *Proof Committee Hansard*, 9 November 2016, p. 17.

Maintaining electricity security and reliability

2.47 Maintaining the security and stability of the electricity market is a critical issue in the debate regarding the future of coal fired power stations. As the Australian Mines and Metals Association explained in its submission:

...if Australia reduces its reliance on coal (through the retirement of coal fired power stations) and if the demand for energy (electricity) were to remain or increase, without the same amount out of supply being brought on to the market by alternative energy sources, the price of energy (electricity) will rise as well as elevating the risk of supply shortages (dependent on inventory levels).⁴⁹

2.48 When retiring power stations, a priority should therefore be placed upon maintaining sufficient power stores. The NEM currently has a surplus of available energy. In the 2014-15 financial year, the NEM held between 7,650 megawatts and 8,950 megawatts of surplus capacity, particularly in New South Wales, Victoria and Queensland.⁵⁰

2.49 The ACF submitted:

According to the Australian Energy Market Operator (AEMO), surplus generation capacity and flattening demand mean that no new generation is needed in the next ten years. The Independent Market Operator in Western Australia has also declared that "no new capacity will be required in the South West Interconnected System until 2023-24".⁵¹

2.50 Dr Roger Dargaville of the Melbourne Energy Institute argues that many coal fired power stations have been running at lower capacity due to the excess power in the NEM. Thus, increasing capacity in these power stations would assist in maintaining sufficient stores in the NEM, while assisting the transition to renewable energy replacements and providing energy security.⁵²

2.51 Environment Victoria also referred to the excess capacity in the NEM providing security of supply:

Until recently, rising electricity demand has been making the task of replacing coal-fired electricity with renewable energy more difficult. However, since the early 2010s the National Electricity Market has had significantly more capacity than will be needed for some years. This excess electricity generation capacity in the NEM has created an opportunity to

49 *Submission 67*, p. 2.

50 Mr Dylan McConnell, *FactCheck: does Australia have too much electricity?* 10 September 2014. Available at: <https://theconversation.com/factcheck-does-australia-have-too-much-electricity-31505> (accessed 7 November 2016).

51 *Submission 69*, p. 10.

52 Dr Roger Dargaville, *The case for shutting down Hazelwood power station – some facts and figures*, 5 July 2012, Available at: <https://theconversation.com/the-case-for-shutting-down-hazelwood-power-station-some-facts-and-figures-7940> (accessed 3 November 2016).

remove existing coal-fired generation with no short-term risk to the security of supply.⁵³

2.52 This argument is also supported by The Australia Institute, which noted that idling mines and stations increase environmental harm and delay the producers' requirement to take responsibility for the rehabilitation of the area.⁵⁴

2.53 The Clean Energy Council submitted:

While surplus generation capacity remains in the electricity market, complementary mechanisms like the RET [Renewable Energy Target] are important to drive the construction of new renewable energy generators. An additional complementary mechanism is needed to allow for an orderly closure and withdrawal of the most polluting power stations.⁵⁵

2.54 In terms of the reliability of the network as coal fired power stations are retired and replaced with renewable energy, the ACF noted:

The Australian Energy Market Operator (AEMO) has also confirmed that the National Electricity Market can operate with 100 per cent renewable energy while meeting the current National Electricity Market reliability requirement. In other words, 100 per cent renewable energy can meet the energy needs of the NEM 99.998 per cent of the time.⁵⁶

2.55 The Clean Energy Finance Corporation made a related point:

An electricity system with high levels of renewables is capable of delivering baseload electricity supply if the system is flexible enough to respond to shortfalls in intermittent generation supply (i.e. wind and solar farms) with dispatchable generation, time-shifting and storage (e.g. bagasse, hydro, solar thermal, micro grids, pumped hydro, batteries etc) and through additional transmission interconnection capacity that integrates NEM regions.⁵⁷

53 *Submission 16*, p. 6.

54 Dr Richard Denniss and Rod Campbell, 'Two birds. one little black rock: Solving the twin problems of incentives for retirement of coal fired generation and funding rehabilitation liabilities', *Policy Brief*, The Australia Institute, December 2015, p. 8. Available at: http://www.tai.org.au/sites/default/files/P157%20Two%20birds%20one%20little%20black%20rock%20%5BPRINT%5D_1.pdf (accessed 3 November 2016).

55 Clean Energy Council, *Submission 13*, p. 4.

56 *Submission 69*, p. 6.

57 *Submission 64*, p. 8.

COAG review of energy security

2.56 In October 2016, the Council of Australian Government (COAG) Energy Council agreed to 'an independent review to develop a national electricity blueprint to ensure Australia's energy security as we transition to a lower emissions future.'⁵⁸

2.57 The review will be led by Australia's Chief Scientist, Dr Alan Finkel AO. A preliminary report will be prepared for the COAG meeting in December and a final report is expected to be presented in early 2017.⁵⁹

2.58 On the matter of Dr Finkel's review, Mr Andrew Stock, Climate Councillor, Climate Council (the Council) told the committee:

...the Finkel review currently underway reviewing the national electricity market must ensure that the NEM is structured to manage this major electricity sector transition and decarbonisation and that the national electricity objectives should include emissions abatement as a fourth aim.⁶⁰

National Electricity Objective

2.59 The Australian Energy Market Operator (AEMO) operates the NEM. The Australian Energy Market Commission (AEMC) makes and amends the National Electricity Rules that underpin the NEM. These include rules that:

- govern the operation of the NEM—the competitive wholesale electricity market and the associated national electricity system;
- govern the economic regulation of the services provided by monopoly transmission and distribution networks; and
- facilitate the provision of services to retail customers.

2.60 The AEMC conducts independent reviews and provides advice to governments on the development of electricity markets. When performing these functions, the AEMC is required by law to have regard to the National Electricity Objective as stated in the National Electricity Law:

To promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to – price, quality, safety, reliability, and security of supply of

58 The Hon Josh Frydenberg MP, Minister for the Environment and Energy, 'Ministers agree to independent review to develop a national energy security blueprint', *Media release*, 7 October 2016. Available at: [http://www.joshfrydenberg.com.au/siteData/uploadedData/Minister%20Frydenberg%20-%20Media%20Release%20-%20Ministers%20Agree%20to%20Independent%20Review%20of%20the%20National%20Electricity%20Market%20\(7%20October%202016\)_fa799071-3c5b-46d0-a180-b72b3e78fa62.pdf](http://www.joshfrydenberg.com.au/siteData/uploadedData/Minister%20Frydenberg%20-%20Media%20Release%20-%20Ministers%20Agree%20to%20Independent%20Review%20of%20the%20National%20Electricity%20Market%20(7%20October%202016)_fa799071-3c5b-46d0-a180-b72b3e78fa62.pdf) (accessed 6 November 2016).

59 The Hon Josh Frydenberg MP, Minister for the Environment and Energy, 'Ministers agree to independent review to develop a national energy security blueprint', *Media release*, 7 October 2016.

60 *Proof Committee Hansard*, 9 November 2016, p. 1.

electricity; and the reliability, safety and security of the national electricity system.⁶¹

2.61 Some stakeholders to the inquiry argued that decarbonisation or a pollution reduction objective should be included in the National Electricity Objective.⁶²

2.62 Mr Jonathan Upson, Senior Business Development Manager, Infigen Energy expressed support for the objective to be broadened:

That is a very important point. Currently, the national electricity objective is all about security, supply and cost—that is it. So if you put in a rule change that does not contribute to cost or security or supply, it gets rejected because that is not the national electricity objective. So it is very important that there be a third objective for reducing emissions, or however you want to portray it, because when rule changes are proposed, they will have to evaluate all three of those criteria. I admit it is going to be a challenge to balance the three objectives, but that is where we are today. If you want to reduce emissions in the electricity industry, it needs to be something that is uniform not only in legislation and in our Paris commitments; it needs to be in the national electricity objective as well.⁶³

2.63 Representatives from AGL Energy indicated their broad support for the better integration of energy in climate policy settings:

I think it is something that certainly needs to be referenced...one of the difficulties that we currently have is that the regulatory bodies within our market do not necessarily have a mandate to consider legitimate Commonwealth public policy goals around decarbonisation. Their mandate is really defined by their specific aspects...I think they need a little bit more permission, so to speak, through that objective to really integrate those two policy streams.⁶⁴

61 Australian Energy Market Commission, *National Electricity Market*, <http://www.aemc.gov.au/Australias-Energy-Market/Markets-Overview/National-electricity-market#NEO> (accessed 21 November 2016).

62 See for example, Mr Andrew Stock, Climate Councillor, Climate Council, *Proof Committee Hansard*, 9 November 2016, p. 1.

63 *Proof Committee Hansard*, 17 November 2016, p. 59.

64 Dr Timothy Nelson, Head of Economic Policy and Sustainability, AGL Energy, *Proof Committee Hansard*, 17 November 2016, p. 7.

2.64 Mr Kieran Donoghue, General Manager Policy, Australian Energy Council indicated that changing the objectives may not be the most effective mechanism:

We do not think that would be likely to be a particularly effective instrument. It may depend a bit on the detail. In practice that would require some of the energy market agencies to effectively try to make some difference decisions. But if there is not that clarity in the national polity then trying to change the objectives of the NEO would not be an effective substitute for that. Conversely, if we do get that clarity which we need, there would be no particular need to embed anything new in the NEO because we would have the clarity and the judgement about rules, and applying the rules would be in the context of that. So we do not think it would actually do what its supporters seem to think it would do. It is a proxy for getting policy right at the national level.⁶⁵

65 *Proof Committee Hansard*, 17 November 2016, p. 15.