ICRC

independent competition and regulatory commission

BACKGROUND PAPER

Developments in the electricity market

Report 14 of 2020, November 2020

The Independent Competition and Regulatory Commission is a Territory Authority established under the *Independent Competition and Regulatory Commission Act 1997* (the ICRC Act). The Commission is constituted under the ICRC Act by one or more standing commissioners and any associated commissioners appointed for particular purposes. Commissioners are statutory appointments. Joe Dimasi is the current Senior Commissioner who constitutes the Commission and takes direct responsibility for delivery of the outcomes of the Commission.

The Commission has responsibilities for a broad range of regulatory and utility administrative matters. The Commission has responsibility under the ICRC Act for regulating and advising government about pricing and other matters for monopoly, near-monopoly and ministerially declared regulated industries, and providing advice on competitive neutrality complaints and government-regulated activities. The Commission also has responsibility for arbitrating infrastructure access disputes under the ICRC Act.

The Commission is responsible for managing the utility licence framework in the ACT, established under the *Utilities Act 2000* (Utilities Act). The Commission is responsible for the licensing determination process, monitoring licensees' compliance with their legislative and licence obligations and determination of utility industry codes.

The Commission's objectives are set out in section 7 and 19L of the ICRC Act and section 3 of the Utilities Act. In discharging its objectives and functions, the Commission provides independent robust analysis and advice.

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1. Introduction

The Independent Competition and Regulatory Commission (the Commission) is undertaking a review of the form of price control it uses to regulate retail electricity prices. In the review, the Commission will consider current and potential market developments that may have implications for the effectiveness of the current form of price control. The Commission released an issues paper as part of the review on 16 October 2020.[1]

The Australian electricity market is undergoing a rapid transition, which according to Australian Energy Market Operator (AEMO), is acknowledged to be the world's fastest energy transition.[2] This paper provides additional background information on the developments in the Australian electricity market to help the Commission's stakeholders when preparing submissions to the issues paper.

A key development in the wholesale market is a rapid change in the energy generation mix. Ageing coal-fired generators are leaving the market and small to medium scale renewable energy generators are entering. Reflecting the increase in renewable energy generation, and technological improvements that have reduced the cost of renewables, wholesale electricity prices have been decreasing in recent years.[3] Energy generated from renewable sources are weather dependent and hence not as reliable as the energy generated from well performing coal-fired generators. The reliability issue and other emerging issues related to the change in the energy generation mix are being addressed by energy businesses and government agencies.

The retail market in the ACT is also undergoing a transformation. The level of competition in the market is increasing and customers are moving from standing offers to market offers. Customers are also increasingly moving away from flat rate tariffs to time-of-use and demand tariffs. These changes in the retail market have changed ActewAGL's standing offer customer mix and hence have implications on the effectiveness of the form of price control used by the Commission.

Implications for the Commission's review of the form of price control

Under the Commission's form of electricity price control, the Commission regulates the maximum weighted average price change that ActewAGL can apply across its basket of standing offer tariffs from one year to the next. The Commission calculates the maximum weighted average price change using a pricing model, which estimates the individual cost components that would be incurred by an efficient retailer in a similar position as ActewAGL when providing electricity

[1] ICRC 2020.
[2] AEMO 2020, p 8.
[3] AER 2020a.

services to customers on regulated tariffs. More details on the Commission's form of price control are available in the issues paper on the review of the retail electricity form of price control.[4]

The individual cost components in the Commission's pricing model can be grouped into three broad categories: wholesale costs (the costs associated with purchasing electricity from the wholesale market, representing 44 per cent of total costs); network costs (the cost of transmitting and distributing electricity from generators to consumers, representing 43 per cent of total costs); and retail costs (costs faced by retailers in providing services to customers and the retail margin, representing 13 per cent of total costs).

The market developments described in this paper have affected ActewAGL's standing offer customer mix. The change in ActewAGL's customer mix has implications for the network cost component of the Commission's pricing model and, therefore, the appropriateness and effectiveness of the form of price control. Further details on the implications of market developments for the form of price control are available in section 2.3 of the issues paper on the review of the retail electricity form of price control.[5]

The structure of the electricity market

This background paper focuses on developments in the National Electricity Market (NEM), which covers five regions: Queensland, New South Wales, Victoria, South Australia, and Tasmania. The Australian Capital Territory falls within the NSW region.

The NEM comprises a transmission network and a distribution network. Large generators generate electricity using coal, gas, hydro, wind, or solar energy for sale in the NEM. Once generated, the electricity is released to the transmission grid which transports electricity along high voltage power lines to industrial energy users and local distribution networks. Distribution networks transport electricity to end-use customers. Figure 1.1 illustrates the electricity supply chain.

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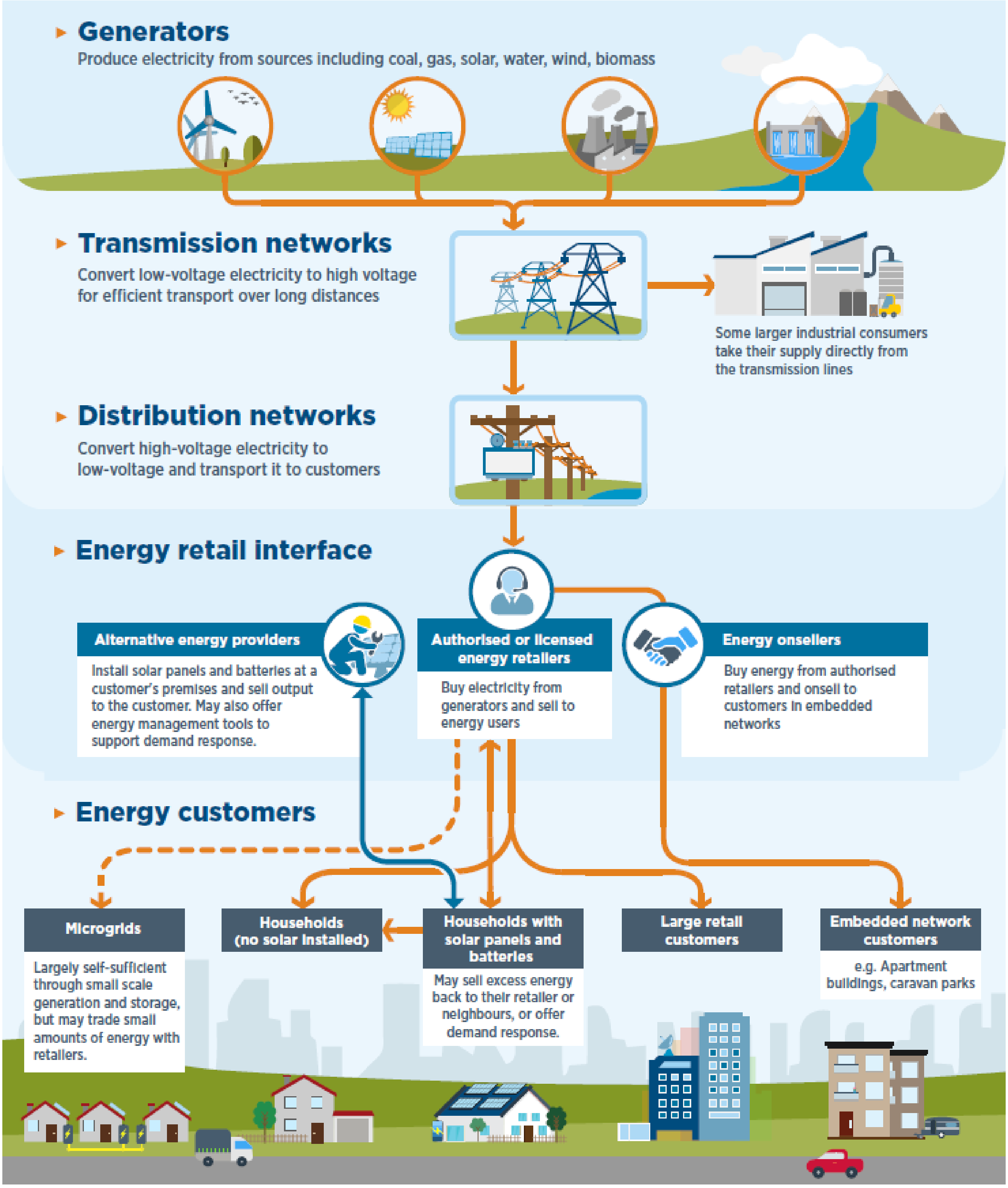
[4] ICRC 2020.

[5] ICRC 2020.

Figure 1.1 Electricity supply chain



Source: AER 2020a.

Energy retailers purchase electricity from the NEM at wholesale prices and sell it to residential and business customers. Retail prices paid by consumers consist of wholesale energy purchase costs, network costs, other costs incurred by retailers when providing retail services, and a retail profit margin.

Structure of this paper

This paper is organised as follows. Chapter 2 of the paper discusses the developments in the wholesale electricity market in the NEM. Chapter 3 discusses the developments in the retail market with a particular focus on the ACT energy market.

2. Developments in the wholesale market

Australia's wholesale energy market is undergoing a significant transformation. This chapter describes the features of the transition, identifies the drivers of the transition, and analyses the impact of the transition on wholesale electricity prices. The chapter concludes by discussing the issues arising from this transition and actions currently being taken by government agencies to smooth the transition.

2.1 Features of the transition

A key feature of the Australia's energy market transition is the change in the energy generation mix from coal-fired generation to renewable generation. Another feature is the increased volatility in energy supply and demand which has resulted from the increase in renewable energy generation in the electricity system.

2.1.1 Energy generation mix

Australia's energy generation mix is changing rapidly from a centralised system of large-scale mostly coal-fired generation towards smaller-scale, dispersed renewable generation (mostly wind and solar). Between 2014 and 2020, more than 4000 MW of coal fired generation capacity left the NEM but no significant coal or gas fired generation has been added to the market.[6] Over the same period more than 7000 MW of new renewable generation capacity entered the market.[7]

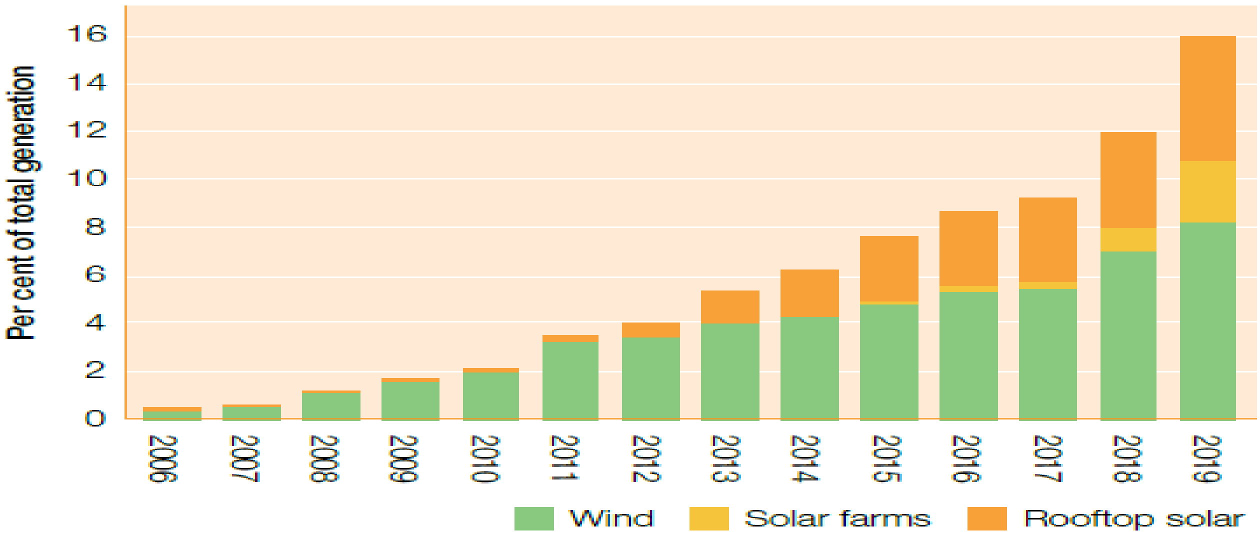
Coal-fired generation, however, is still the dominant supply technology in the NEM, accounting for 68 per cent of the electricity traded in the NEM in 2019.[8] In terms of capacity, coal-fired generation only accounts for 37 per cent of the generation capacity in the NEM.[9] However, their ability to generate electricity continuously means coal-fired power plants still play a very important role in the NEM.[10]

[6] AER 2020a.
[7] AER 2020a.
[8] AER 2020a.
[9] AER 2020a.
[10] AER 2020a.

The new renewables that entered the market were mostly wind and solar.[11] Wind and solar (including rooftop solar) accounted for around 16 per cent of total energy generated in the NEM in 2019, up from less than 2 per cent in 2009 (figure 2.1).

New renewable energy generators are often located in areas with rich renewable sources such as wind and solar. Therefore, these generating units are spread out across the NEM. Furthermore, these generating units are small to medium size units.[12]

Figure 2.1 Renewable generation in the NEM

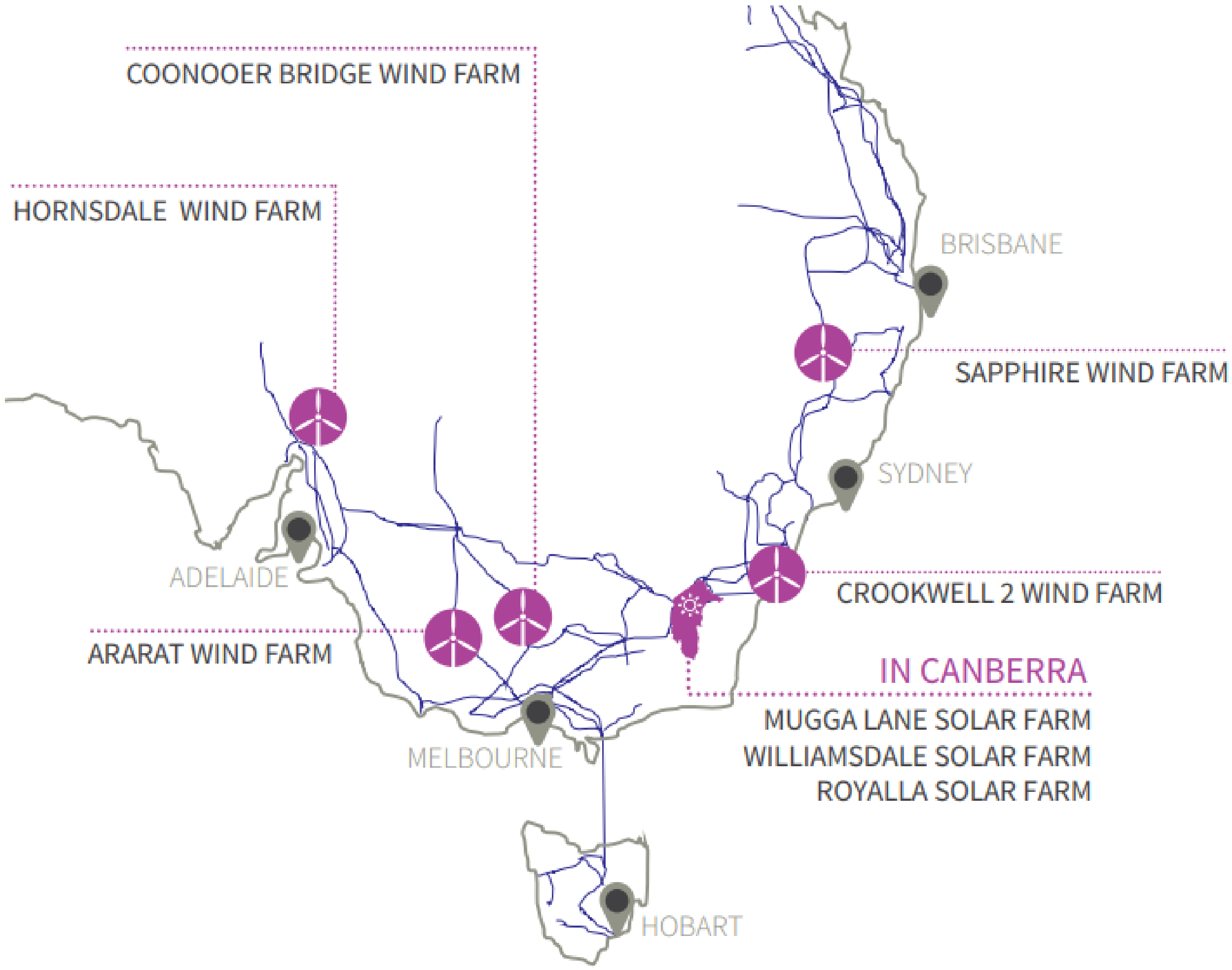


Source; AER 2020a

Among Australian states and territories, the ACT has made a strong contribution to the transformation in the energy generation mix. In 2016, the ACT government legislated its target of '100 per cent renewable electricity by 2020'.[13] To achieve this target, the ACT Government has invested in wind and solar farms located across the NEM (Figure 2.2) that can feed electricity into the national grid to offset the electricity used by ACT residents and businesses.

[11] https://www.aemc.gov.au/energy-system/electricity/changing-generation-mix
[12] AER 2020a.
[13] https://www.environment.act.gov.au/energy/cleaner-energy/renewable-energy-target-legislation-reporting

Figure 2.2 Locations of ACT's wind and solar farms within the national electricity market



Source: https://www.environment.act.gov.au/__data/assets/pdf_file/0007/987991/100-Renewal-Energy-Tri-fold-ACCESS.pdf

2.1.2 Variability of electricity supply and demand

The variability of electricity supply and demand in the NEM has increased in recent years.

On the supply side, an increasing amount of electricity in the NEM is being generated from wind and solar, which are weather dependent. As a result, electricity generated from these sources is variable and can be difficult to predict. For example, solar panels depend on sunlight to generate energy. Therefore, energy generation from solar panels is lower on cloudy days. Furthermore, electricity generated through solar panels is seasonal. In winter, when the days are short and the sun is lower in the sky, output is lower than in the other seasons. Electricity generated through wind is also variable because the output fluctuates with wind speed.[14]

Variability in demand is also linked to weather conditions, which are hard to predict on a day to day basis. Electricity consumers with rooftop solar PV units use energy generated from those units when the weather is favourable for electricity generation from solar panels. This makes them less dependent on the grid when their solar panels are meeting more of their electricity demand. However, on cloudy days or in winter, these customers use more electricity from the grid to meet their energy demand.

2.1.3 Grid-scale storage

Introduction of grid-scale storage by energy businesses is another feature of the energy market transformation. Grid-scale storage helps smooth some of the variability in supply and demand discussed above. It also addresses the reliability issues of renewable energy discussed in section 2.4.1 below.

Grid-scale storage refers to methods used for large-scale energy storage within an electricity grid. There are two main methods used in Australia for large-scale energy storage: battery storage and pumped hydroelectricity storage.[15] These systems are used to store energy when wind and solar plants generate high amounts of electricity. For example, these systems can store energy during the day when solar plants generate electricity or during times of favourable wind conditions when wind farms are generating high amounts of electricity.

Large-scale batteries

Large-scale batteries can discharge stored energy to the grid at night or when the weather is not favourable to generate renewable energy. Large-scale battery storage has not been commercially viable until recently.[16] However, technological advancements in recent years have put downward pressure on the cost of this technology and battery usage in the Australian energy grid is expected to continue to grow.[17]

The main grid-scale battery storage system in Australia is South Australia's Hornsdale Power Reserve, which is the largest lithium-ion battery in the world.[18] The battery's initial capacity was 100MW but the capacity was expanded to 150MW in August 2020.[19] Four more grid-scale

[14] https://www.ga.gov.au/scientific-topics/energy/resources/other-renewable-energy-resources/wind-energy
[15] https://www.cleanenergycouncil.org.au/resources/technologies/energy-storage
[16] AER 2020a.
[17] https://arena.gov.au/renewable-energy/battery-storage/
[18] https://hornsdalepowerreserve.com.au/#:~:text=At%20100MW%2F129MWh%2C%20the%20Hornsdale,providing%20essential%20grid%2Dsupport%20services.
[19] https://www.cefc.com.au/case-studies/neoen-expands-hornsdale-power-reserve-big-battery/

batteries were in service in Australia at the end of 2019: Dalrymple battery[20] and Lake Bonny battery[21] in South Australia and Gannawarra battery and Ballarat battery in Victoria.[22]) Fifteen large-scale batteries were under construction across Australia at the end of 2019.[23]

The ACT Government announced in September 2020 that two large-scale batteries will be built in the ACT to provide 200 MW of additional renewable electricity capacity (Box 2.1)

Box 2.1 ACT's big batteries

The ACT government has announced that Neon and Global Power Generation will build two large scale battery storage systems in the ACT. The two companies were the winners of the ACT's fifth renewable reverse auction.

The Neoen battery has enough storage to power around 15,000 typical homes for an hour in the event of a blackout.

The batteries will support the ACT's electricity consumers by providing power to help avoid blackouts during periods of high demand and if large fossil fuel generators fail in extreme heat conditions.

The locations of these batteries are to be determined.

Source: https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/barr/2020/big-batteries-part-of-canberras-next-renewable-energy-plan

Pumped hydroelectricity technology

Pumped hydroelectricity projects pump water into a raised reservoir using low-cost surplus off-peak electricity power. The stored water is then released to produce electricity through turbines during periods of high electricity prices. This technology has been in operation in Australia for some time. However, advances in technology and demand to fill the supply gaps created by wind and solar plants are providing opportunities to use this technology at a larger scale. This technology is the basis of the proposed Snowy 2.0 and Battery of the Nation projects in NSW and Tasmania respectively.[24]

[20] https://www.minister.industry.gov.au/ministers/taylor/media-releases/energy-reliability-increased-south-australias-yorke-peninsula
[21] https://www.infigenenergy.com/our-assets/firming-assets/
[22] https://www.energy.vic.gov.au/batteries-and-energy-storage
[23] https://www.cleanenergycouncil.org.au/resources/technologies/energy-storage
[24] AER 2020a

2.2 Drivers of the wholesale energy market transition

The transition in the wholesale market has been driven by several factors including incentives provided by Australian governments to generate energy from renewable sources, ageing fossil fuel plants, technological and cost changes in electricity generation, and environmental concerns about carbon emissions.

2.2.1 Incentives from Australian governments to promote renewable energy

Australian governments have taken a range of initiatives to encourage energy generation from renewable sources. A key initiative by the Australian Government is the Renewable Energy Target Scheme which encourages additional generation of electricity from renewable sources to reduce greenhouse gas emissions in the electricity sector. The Renewable Energy Target scheme has two schemes: the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). The LRET is the relevant scheme for the wholesale market. The SRES incentivises households, businesses and the community to install eligible small-scale systems such as rooftop solar panels, solar water heaters, small-scale wind or hydro systems.[25]

The LRET incentivises investment in renewable energy power stations such as wind and solar farms or hydro-electric power stations by introducing a legal requirement for energy businesses (mainly large electricity retailers) to purchase large-scale generation certificates from large-scale renewable generators.[26] Electricity retailers buy and surrender these certificates to the Australian Government's Clean Energy Regulator to demonstrate their compliance with the scheme. These certificates provide the power stations with a source of revenue additional to the sale of the electricity generated, providing incentives to generate more energy from renewable sources.

Several state and territory governments have set renewable energy targets within their states and introduced programs encouraging new renewable energy. For example, the ACT Government has introduced several renewable energy programs such as Solar Auction and Wind Auctions to develop large-scale renewable energy capacity.

The ACT government conducted a solar auction in 2012 and 2013 to develop 40 MW of large-scale solar generation capacity in the ACT.[27] The winners of these auctions were the 20 MW Royalla Solar Farm, the 13 MW Mugga Lane Solar Park, and the 7 MW OneSun Capital Solar Farm – all located within the ACT.[28]

[25] More information about the SRES scheme can be found at http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target/How-the-scheme-works/Small-scale-Renewable-Energy-Scheme.

[26] https://www.industry.gov.au/funding-and-incentives/renewable-energy-target-scheme

[27] https://www.actsmart.act.gov.au/what-is-the-government-doing/energy/renewal-energy-targets

[28] https://www.actsmart.act.gov.au/what-is-the-government-doing/energy/renewal-energy-targets

In 2014 and 2015, the ACT government conducted two wind auctions to develop 400 MW of wind generation capacity.[29] The winners of the wind auctions were the 19.4 MW Coonooer Bridge Wind Farm in Victoria, the 80.5 MW Ararat Wind Farm in Victoria, the 100 MW Hornsdale Stage 1 and the 100 MW Hornsdale Stage2 Wind Farms in South Australia, the 100 MW Sapphire Stage 1 Wind Farm in New South Wales.[30] The ACT's wind auctions are supporting wind power sufficient to supply around 50 per cent of Canberra's electricity needs by 2020.[31]

2.2.2 Ageing coal-fired plants

The age of the coal fired plants in Australia is also a driver behind the energy market transition. Australia's coal-fired generators are old, with a median age of 34 years.[32] Several coal-fired generators were closed in recent years and others are reaching the end of their economic life.

Recently closed coal fired generators include the Northern power station in South Australia (2016) which retired after 31 years of operation[33] and Hazelwood in Victoria (2017) which operated for 50 years.[34] The ageing plants had become increasingly unprofitable due to rising maintenance costs, coal supply issues and increased competition from cheaper renewable energy.[35] Further coal plant closures amounting to two thirds of the existing coal fired generation capacity has been announced (Figure 2.3).

The timeline of the announced coal-fired power plant closures is illustrated in Figure 2.3. The grey coloured bars represent the remaining coal-fired generation capacity in the NEM at the end of each financial year. The names of the power plants that have been announced to be closed during each financial year are labelled. The colour of the label represents the state in which the power plant is located.

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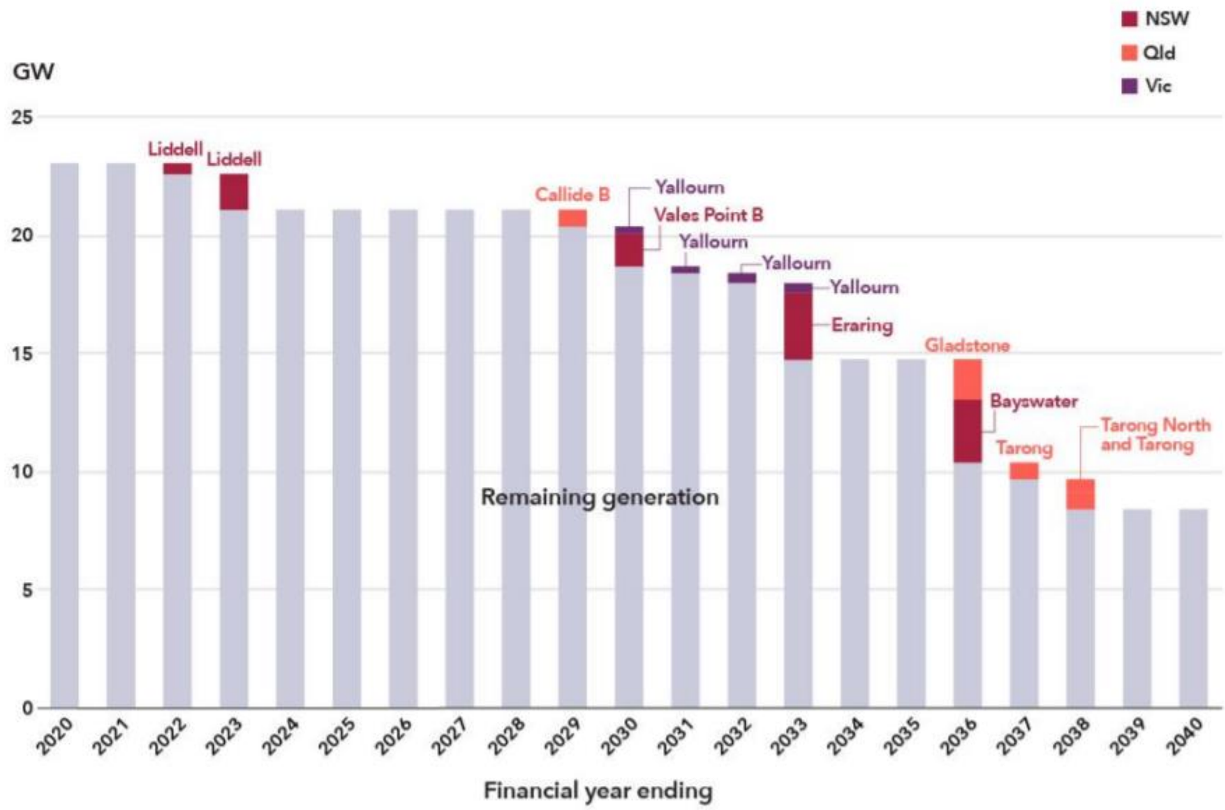
[29] https://www.actsmart.act.gov.au/what-is-the-government-doing/energy/renewal-energy-targets
[30] https://www.actsmart.act.gov.au/what-is-the-government-doing/energy/renewal-energy-targets
[31] https://www.environment.act.gov.au/energy
[32] AER 2020a.
[33] https://www.awesomeadelaide.com/disused-abandoned-buildings-ruins/urban-exploring-port-augusta-northern-power-station/
[34] https://www.abc.net.au/news/2017-03-30/hazelwood-power-plant-shutdown-explained/8379756
[35] AER 2020a.

Figure 2.3 Timeline of announced coal-fired power plant closures



Source: AEMO 2019

For example, AGL has announced the closure of its Liddell power station in NSW in stages between 2022 and 2023.[36] In late 2019, CS Energy informed the AEMO that its forecast closure date for Callide B coal generator in Queensland is 2028 (calendar year) as it is the end of the technical life of the generator (40 years).[37]

2.2.3 Technological and cost changes in energy generation

Technological and cost changes in renewable energy generation technologies have been significant factors behind the energy market transition. The cost of building renewable plants has declined substantially over recent years providing incentives for businesses to build large-scale renewable generators and consumers to install small-scale renewable systems.[38] Advancements in renewable technologies coupled with economies of scale from a growing market for renewable energy contributed to the accelerated decline in costs related to renewable generation.[39]

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[36] AGL 2019.
[37] CS Energy 2019.
[38] AER 2020a.
[39] AER 2020a.

The cost of renewable energy generation is likely to fall further in the future. According to the GenCost 2018 report prepared by Commonwealth Scientific and Industrial Research Organisation (CSIRO) in collaboration with AEMO, the cost of renewable generation will continue to fall over the next three decades.[40] The report noted that these cost reductions are forecast to be driven by a fall in cost of large-scale solar PV which is forecast to fall by almost half between 2020 and 2050. The report also noted that the cost of wind technologies has been forecast to fall over the same period.

Battery costs have also fallen due to technological improvements in recent years. For example, Bloomberg estimated that Lithium Ion battery pack prices fell by around 85 per cent between 2010 and 2018.[41] The GenCost 2018 report forecast that the cost of batteries will continue to fall in the long run, particularly with the potential rise in global battery manufacturing capacity to meet the demand for electric vehicles.

2.3 Wholesale electricity prices

The developments in the wholesale market discussed so far have had direct impacts on wholesale electricity prices. As discussed in section 2.2.3, technological changes in energy generation have lowered the cost of energy generation from renewable sources.

Reflecting the increased supply of renewable energy, wholesale electricity prices in the NEM have been decreasing over the past few years. Prices averaged around $69 per MWh in 2020 compared to $85 per MWh in 2017 across the NEM.[42] Figure 2.1 shows that electricity spot prices in NSW have decreased from $82 in January 2017 to $42 in September 2020.

Wholesale electricity prices are generally high between January and March when summer demand for air conditioning is highest.[43] In January 2020, wholesale prices in NSW, Victoria and South Australia spiked due to a number of reasons including extremely high temperature on some days which led to very high demand for electricity, a reduction of electricity supply as a result of a plant failure at Victoria's Loy Yang A coal power plant, lower output from wind farms, and a failure at the Heywood transmission infrastructure which links Victoria and South Australia.[44] In February 2017, wholesale prices in NSW spiked due to high temperatures over several consecutive days.[45]

[40] Graham et al 2018.

[41] Bloomberg New Energy Finance 2019.

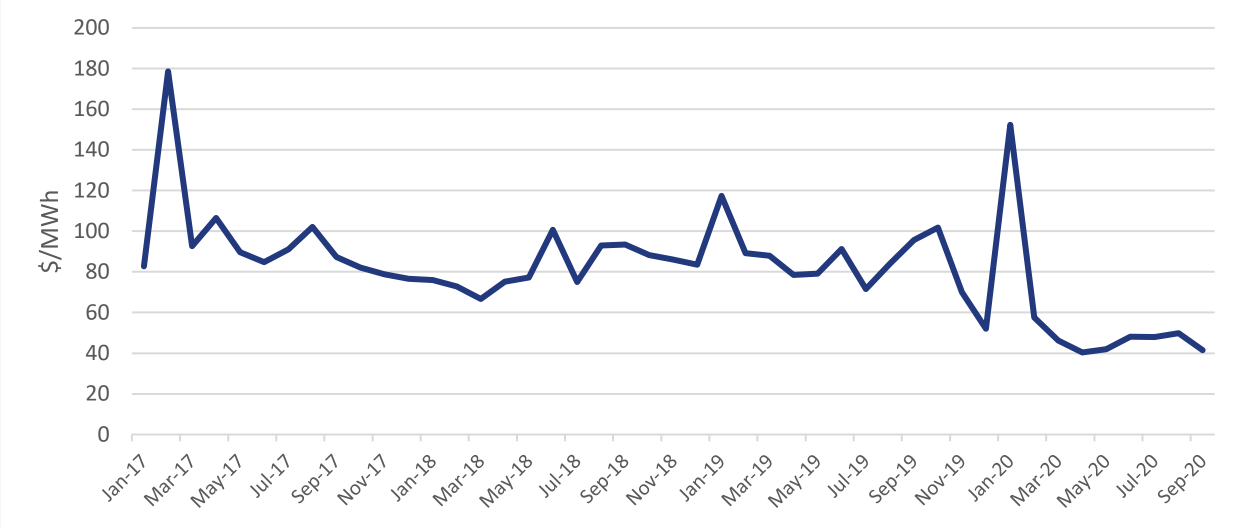
[42] Details at: https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/data-nem/data-dashboard-nem.

[43] AER 2020a.

[44] https://www.aer.gov.au/communication/aer-reports-on-high-wholesale-electricity-prices-in-january-2020

[45] https://www.aer.gov.au/wholesale-markets/performance-reporting/prices-above-5000-mwh-6-february-2017-nsw-and-qld

Figure 2.4 Average wholesale electricity prices in NSW ($ per MWh)



Source: Commission's calculation using AEMO data.

High wholesale prices in South Australia and Victoria have resulted in the average NEM price being higher than prices in other jurisdictions. A supply gap created by the closures of South Australia's Northern coal power plant in mid-2016 and Victoria's Hazelwood plant in early 2017, coupled with existing coal power plant failures during high temperatures, have driven higher prices in South Australia and Victoria.[46]

2.4 Emerging issues in the wholesale market

The transition in the wholesale market has created issues in the energy market. These issues include reliability issues (not having enough generation and network capacity to meet customer demand), security issues (related to safety of electricity users and electricity equipment when there are large fluctuations in electricity supply and demand) and integration issues (related to integrating new generators to the NEM). Each of these issues are discussed in detail in this section.

2.4.1 Reliability issues

A large increase in energy generated through renewable sources such as wind and solar means energy generation is sensitive to weather conditions. As described in section 2.1.2, solar and wind based energy can be generated only when the weather is favourable to do so.

This weather sensitivity of energy generation has affected the reliability of the power system to provide a continuous and stable power supply. In contrast, a feature of well performing fossil fuel power plants is their ability to generate continuous energy irrespective of weather conditions. Therefore, closures of fossil fuel power plants, and their replacement by renewable generators, tends to create reliability issues in the power system.

[46] AER 2020a p 95.

Ageing fossil fuel power plants still in the market are, however, also creating reliability issues because they are more likely to have outages due to their age. These plants are more likely to have unplanned breakdowns and planned, but more frequent and longer, outages due to repairs than a well performing power plant.[47] Reliability concerns are more severe during summer when high temperatures increase the demand for electricity and increase the risk of plant faults.[48] The AER reported that for each of the past four years, brown coal-fired power plants experienced outages more than the long-term average.[49]

The reliability issues mentioned above can be addressed by filling the supply gaps. Grid-scale battery technology is a method that is being used in the market to fill the supply gaps.[50] Batteries can discharge energy quickly when energy is needed.[51] The rapid discharging ability is an advantage of batteries as a solution to fill supply gaps compared to other solutions. For example, coal-fired power plants require a day or more to start up and cannot start producing energy at short notice.[52] Coal-fired plants also have high start-up and shut-down costs.[53] Therefore, it is not economical to use coal fired-plants to fill short term supply gaps.

The AEMO uses the Reliability and Emergency Reserve Trader mechanism to address reliability issues.[54] Under this mechanism, AEMO secures contracts with generators to supply electricity to the grid (emergency reserve) and/or with large customers to reduce their consumption when electricity demand is higher than supply.[55] This mechanism is used by AEMO as a last resort to reduce the likelihood of blackouts, particularly in summer.[56] Extreme heat in summer results in demand peaks for electricity in the NEM due to high usage of air-conditioning. This level of high demand is difficult to meet without using emergency reserves.[57]

In rare occasions there are still supply gaps even after AEMO exhausts all available avenues. On these occasions, AEMO may instruct network businesses to temporarily cut power to consumers, which is called load shedding.[58]

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[47] AER 2020a.
[48] AER 2020a.
[49] AER 2020a.
[50] AER 2020a.
[51] https://arena.gov.au/renewable-energy/battery-storage/
[52] AER 2020a.
[53] AER 2020a.
[54] https://aemo.com.au/en/energy-systems/electricity/emergency-management/reliability-and-emergency-reserve-trader-rert
[55] https://aemo.com.au/en/energy-systems/electricity/emergency-management/reliability-and-emergency-reserve-trader-rert
[56] AER 2020a.
[57] AER 2020a.
[58] https://aemo.com.au/en/newsroom/energy-live/explaining-load-shedding#:~:text=Load%20shedding%20is%20the%20deliberate,and%20the%20supply%2Ddemand%20balance.

2.4.2 Integration issues

Wind and solar farms have been built in areas with the best wind or solar resources. In many cases these are located in regional Australia and are remote from the main grid.[59] Consequently, the connection lines between the new renewable generators and the main grid have capacity constraints on transmitting electricity.[60] As a result, efficient integration of the new solar and wind farms to the main grid has been challenging.

Shortcomings in integrating new renewable electricity generation has resulted in energy losses when transmitting energy from renewable generators to the main grid. When electricity is transported through wires, some of it is lost as heat. These losses increase as more generators locate far from the grid because power has to travel longer distances. Fossil fuel plants in Australia are located close to the main grid so energy losses are lower when energy is transmitted from those plants to the grid.

2.4.3 Security issues

Power system security is the power system's capacity to continue operating within defined technical limits. These technical limits include frequency, voltage stability, system strength, and inertia.[61]

Equipment used by consumers is designed to operate at a specific electric frequency (50Hz in Australia).[62] Therefore, it is important to keep the frequency of the power system at that level to operate equipment safely. Changes in supply and demand for electricity can have a major effect on the frequency of the grid. For instance, if there is more demand for electricity than there is supply, then frequency will fall; if there is too much supply, frequency will rise.[63] The transition in the electricity market has resulted in increased volatility in supply and demand. Higher volatility in supply and demand means higher risk of electricity moving outside the safe range.[64]

Voltage stability in the power system is the ability of a power system to maintain acceptable voltages in the system.[65] Voltage stability is important for safe operation of electrical equipment used by consumers.[66] Voltage stability is affected if there are large fluctuations of the supply and demand for electricity in the grid.[67]

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[59] https://www.abc.net.au/news/2019-09-02/powerline-infrastructure-holding-back-renewable-energy-boom/11457694
[60] https://www.abc.net.au/news/2019-09-02/powerline-infrastructure-holding-back-renewable-energy-boom/11457694
[61] AER 2020a.
[62] https://aemo.com.au/en/newsroom/energy-live/energy-explained-frequency
[63] https://www.e-education.psu.edu/ebf483/node/705
[64] https://aemo.com.au/en/newsroom/energy-live/energy-explained-frequency
[65] https://www.aemo.com.au/newsroom/energy-live/energy-explained-voltage
[66] https://www.aemo.com.au/newsroom/energy-live/energy-explained-voltage
[67] AER 2020a.

Inertia is a property of the electricity system that helps the system continue to supply electricity even if there are short term disturbances in supply.[68] Hydro, coal and gas plants produce inertia but existing wind and solar plants generally do not.[69] Therefore, higher inflows of electricity to the grid from wind and solar plants mean higher risk to the system's ability to provide continuous electricity supply.[70]

System strength is the power system's ability to withstand disturbances created by electrical plant malfunctions.[71] When frequency, voltage and inertia are not within the acceptable ranges, system strength reduces.[72] As described above, the transition underway in the energy market has created issues in maintaining frequency, voltage and inertia in the system within acceptable ranges. Therefore, the transition has direct impact on system strength.

An electricity system that operates outside acceptable limits for the above-mentioned parameters may affect the safety of consumers and could damage equipment. Therefore, it is important to address the system security issues that have resulted from the energy market transition.[73]

System security issues can be addressed through a number of ways. As discussed above, security issues have arisen due to wind and solar farms' current inability to provide system security services that fossil fuel plants are capable of.[74] However, the capability of wind and solar farms to provide these security services is now evolving due to advancements in the technology.[75]

Furthermore, there are technologies that can externally provide some system security services when the electricity system needs them. AEMO can procure these services, where available, from service providers in the Australian energy market.[76] If system security services are not available in the market, AEMO may instruct the generator that creates the problem to disconnect from the grid temporarily.[77] Supply gaps created by these disconnections are filled by another generator even though it may not be the cheapest option.[78]

2.5 Longer term strategies to smooth the energy market transition

A number of government bodies including the Council of Australian Government (COAG) Energy Council, Australian Energy Market Operator (AEMO), the Australian Energy Market Commission

[68] https://aemo.com.au/en/newsroom/energy-live/energy-explained-frequency-control
[69] https://aemo.com.au/en/newsroom/energy-live/energy-explained-frequency-control
[70] AER 2020a.
[71] AEMO 2020b.
[72] AER 2020a.
[73] AER 2020a.
[74] AER 2020a.
[75] AER 2020a.
[76] AEMO 2020c.
[77] AER 2020a.
[78] AER 2020a.

(AEMC) and the Energy Securities Board (ESB) are taking a range of coordinated longer term actions to smooth this market transition.

2.5.1 Integrated System Plan

AEMO's Integrated System Plan (ISP) is a key initiative to smooth the energy market transition. The ISP is an engineering plan that forecasts the transmission system requirements for the NEM over the next 20 years. AEMO published the first plan in 2018 and an updated plan in 2020.[79] The plan will be updated every two years.

The 2020 ISP identified investment needs for the future NEM power system, including energy generation, storage and transmission. The ISP has identified priority, near term and future grid projects, as well as development opportunities in "renewable energy zones". Future grid projects include the Marinus Link project (completion of works on a second and potentially third high-voltage cable connecting Victoria and Tasmania) and upgrades to several sections of the transmission network. The renewable energy zones are areas in the NEM that have been identified in the ISP as clusters where large-scale renewable energy can be efficiently developed in terms of generation and connection to the transmission grid. According to the ISP, the ideal near-term renewable energy zone locations should aim to take advantage of areas with ample renewable resources with strong network infrastructure.

The ISP has considered 35 locations as possible candidates for renewable energy zones after taking into a range of factors.[80] The factors considered include the availability of renewable resources, availability of strong network infrastructure that can transport power efficiently, and ability of the locations to expand the zones to address the future needs of the power system. The ISP has also identified the best renewable generation technology within each of the zones. For example, the candidate renewable energy zone in Roxby Downs in South Australia is considered suitable for solar farms whereas the candidate zone in New England in NSW is suitable for energy generation through wind, solar and pumped hydro.

2.5.2 Energy Security Board initiatives

The Energy Securities Board is undertaking work to implement the Integrated System Plan. The ESB's work intends to integrate the ISP with existing planning processes conducted by transmission network service providers (TNSPs), avoid duplication of planning and modelling by the TNSPs, and streamline the processes for ISP projects.

The ESB is also developing a post-2025 market design for the NEM.[81] As part of this project, the ESB is considering the energy supply chain, all aspects of risks in the energy system and cost recovery arrangements. According to the ESB, the changes occurring in the NEM mean that the

[79] AEMO 2020a.
[80] A map of the renewable energy zones is available in AEMO 2020a p48.
[81] https://esb-post2025-market-design.aemc.gov.au/

current set of systems, tools, market arrangements, and regulatory frameworks is no longer entirely fit for purpose and able to meet the changing needs of the system and customers.[82] Therefore, developing a new market design is warranted.

The ESB released a consultation paper in September 2020.[83] The paper provides information on the work streams the ESB has set up to deliver future market designs and seek feedback on them. The ESB's work streams aim to consider the identified issues in the NEM due to the transition and potential solutions. These work streams include:

- Resource adequacy mechanisms work stream which examines whether the existing mechanisms are enough to support the required new investments in the NEM.
- Ageing thermal generation strategy which explores the solutions to potential issues faced by the NEM when thermal power plants exit the generation system.
- Essential services system work stream which investigates how to provide new essential services to the grid when more renewables come into the system.

2.5.3 Coordination of generation and transmission investment review

The coordination of generation and transmission investment (COGATI) review being undertaken by the AEMC, as requested by the COAG Energy Council, is another initiative to smooth the transition. It aims to identify reforms needed to the Australian power system to accommodate new electricity generation from renewable sources.

The AEMC has a standing terms of reference from the COAG Energy Council to review the regulatory framework for electricity networks. The 2019 review focused on the integration of distributed energy resources into the energy system. This is a pressing issue because networks are increasingly cutting solar PV flows off from the grid when there is excess supply because of the power system's inability to accommodate high level of electricity supply at certain times. .[84]

The review identified several options to address this issue including: implementing cost-reflective network tariffs, improving the visibility of electricity demand and voltages between homes and substations, and considering rule change requests from distribution networks in relation to possible improvements in managing network operational information.[85]

[82] COAG Energy Council 2020.

[83] COAG Energy Council 2020.

[84] https://www.aemc.gov.au/market-reviews-advice/coordination-generation-and-transmission-investment-implementation-access-and#:~:text=The%20inaugural%20COGATI%20review%2C%20completed,to%20conclude%20in%20December%202020.

[85] https://www.aemc.gov.au/market-reviews-advice/coordination-generation-and-transmission-investment-implementation-access-and#:~:text=The%20inaugural%20COGATI%20review%2C%20completed,to%20conclude%20in%20December%202020.

AEMO estimates that if the ISP is properly implemented in that the associated investments and recommended changes to grid infrastructure are made, consumers will gain around $11 billion in net market benefits over the next 20 years.[86]

[86] AEMO 2020, p 9.

3. Developments in the retail market

The retail market is the link between consumers and the wholesale market. As illustrated in chapter 1 (Figure 1.1), retailers buy energy from wholesale markets, pay for network services for transporting energy to final consumers, and offer a range of retail electricity plans that can be purchased by consumers to meet consumer energy needs and consumption patterns.

The retail electricity market in the ACT is undergoing a transition. Retail prices have declined recently reflecting the increase in renewable energy generation as discussed in the preceding chapter. The ACT retail electricity market is seeing an increase in competition and standing offer customers are moving to market offers. Smart meter take-up in the ACT is also increasing following the introduction of the AEMC's Power of Choice reforms. This chapter discusses these developments in detail.

3.1 Reduction in retail prices

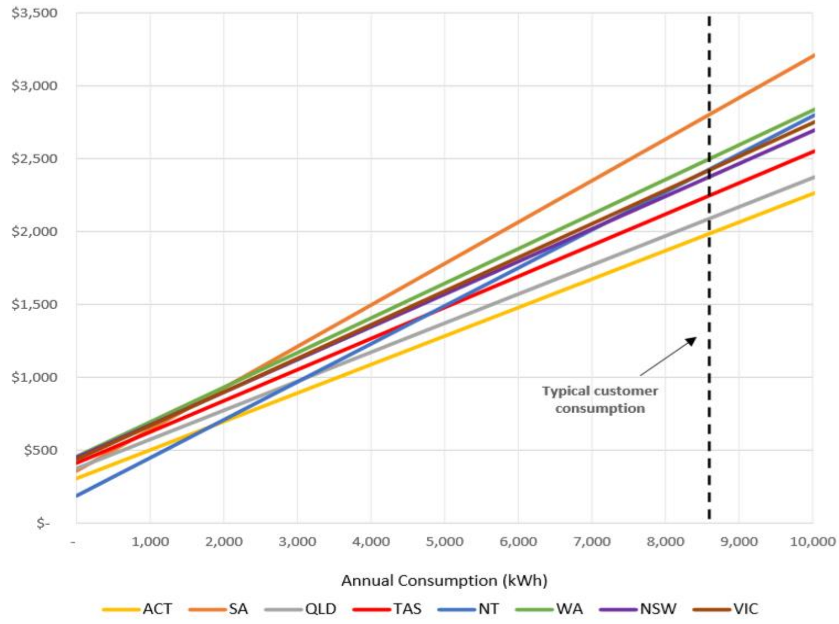
Developments in the wholesale markets discussed in chapter 2 have already had effects on the ACT retail electricity market. The Commission's electricity price determination in June 2020 would result in a typical customer on ActewAGL's standing offer contracts seeing a 2.56 per cent reduction in retail electricity prices in 2020-21. The price reduction reflects increased supply of renewable energy into the power system and improvements in renewable electricity generation technology that have reduced the cost of renewable energy, as discussed in chapter 2.

According to an analysis conducted by the Office of the Tasmanian Economic Regulator (OTTER) in September 2020, retail electricity prices in the ACT are among the lowest in Australia.[87] Figure 3.1 shows the estimated annual electricity bills for residential customers under representative general usage or control load tariffs in each jurisdiction.[88] The OTTER study also showed that the time-of-use tariffs in the ACT are among the lowest in Australia. The analysis is based on commonly available offers in each jurisdiction, including market offers. The ACT's low electricity prices largely reflect retail price regulation by the Commission.

[87] OTTER 2020.

[88] General usage tariffs are usually flat rate tariffs. Customers on general usage/controlled load tariffs do not require a smart meter or interval meter.

Figure 3.1 Estimated annual electricity bills for residential customers under representative general usage/controlled load tariffs in each jurisdiction



Source: OTTER 2020

3.2 Customers shifting from standing offers to market offers

Another recent trend in the ACT retail electricity market is an increasing number of customers moving from standing offers to market offers. Standing offers are 'default' contracts that consumers enter into if they do not select a market offer. The prices of these offers are regulated by the Commission, and minimum terms and conditions for these offers are set by government.[89] These offers provide a safety net for those consumers who do not or cannot shop around for better offers.

Market offer rates can sometimes be more price competitive and generally have terms and conditions that are set by the retailer rather than through regulation. Market offer rates are often discounted compared to the rate for the retailer's corresponding standing offer.

Figure 2.2 (Panel 1) shows how ActewAGL's mix of market offer and standing offer customers has changed over the last few quarters. In the March quarter 2019, nearly 65 per cent of ActewAGL's residential electricity customers were on standing offers. However, within a year, this share had declined to less than 48 per cent.

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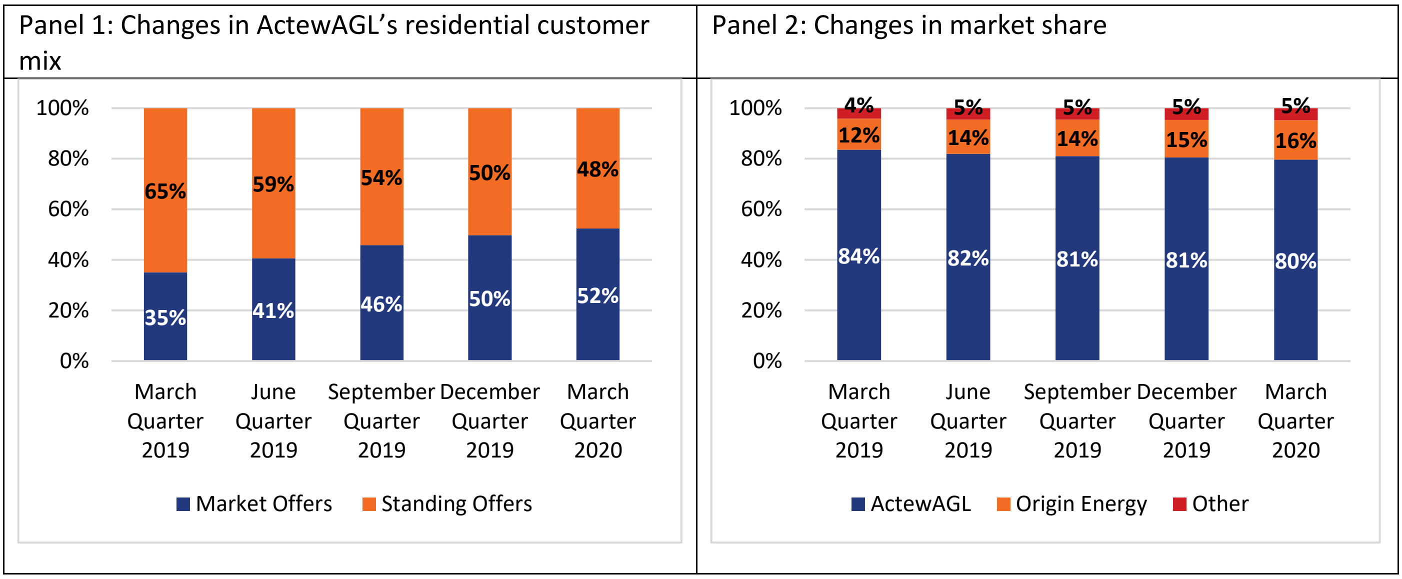
[89] The minimum terms and conditions are set by the National Energy Customer Framework which was developed by State, Territory and Commonwealth Energy Ministers through the COAG Energy Council.

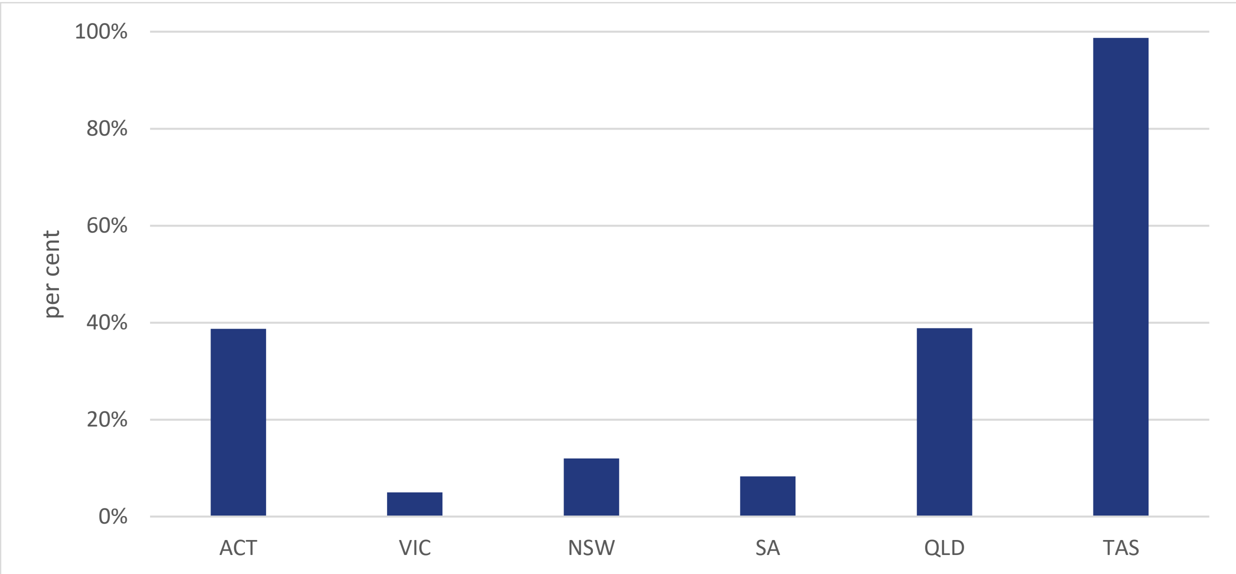
Figure 3.2 Changes in the ACT retail market



Source: AER 2020b

The share of standing offer residential customers in the ACT is still high relative to several other jurisdictions (Figure 3.3). Therefore, there is still potential for many more ACT customers to shift away from standing offers to market offers.

Figure 3.3 Share of standing offer residential customers in each jurisdiction



Source: AER 2020b and ESC 2019

Note: Data is as at March 2020 except for Victoria. Victoria data is for 2018-19 financial year.

The increased take-up of market offers in the ACT reflects a range of factors, including affordability pressures which have encouraged consumers to shop around for better deals, increased competition among retailers, and government calls to shop around for cheaper electricity offers.

3.3 Increased competition

Another recent development in the ACT retail electricity market is an increase in competition. ActewAGL remains the dominant retailer with a high market share. However, based on AER data,[90] its market share declined from nearly 84 per cent in the March quarter 2019 to around 80 per cent in the March quarter 2020. Origin Energy appears to be the main competitor to ActewAGL and increased its market share from around 12 per cent to nearly 16 per cent between the March quarter 2019 and the March quarter 2020. Energy Australia is the other main retailer with around 4 per cent of the market. Increased competition has the potential to put downward pressure on electricity prices in the ACT, particularly on the prices of unregulated market offers.

The market share held by the dominant retailer (ActewAGL) is relatively high in the ACT compared to all other NEM jurisdictions, except Tasmania. In Victoria, the dominant retailer (AGL) only controls around 22 per cent of the residential electricity market.[91] In NSW and Queensland, the dominant retailers (Origin Energy and Ergon Energy respectively) only control around 30 per cent of the respective residential electricity markets.[92] South Australia's dominant retailer (AGL) accounts for around 37 per cent of the market.[93] Tasmania is the only NEM jurisdiction that has a higher market share for the dominant retailer than the ACT. Aurora Energy controls 98.7 per cent of Tasmania's residential electricity market.[94]

3.4 Increase in rooftop solar panels

The availability of rooftop solar PVs and household batteries at more affordable prices has resulted in an increasing number of households and businesses selling excess electricity back to the system at certain times, as well as drawing electricity from the system at other times. This means that households and businesses are not only consumers of electricity but also generators.[95]

Rooftop solar PVs can generate more electricity than the energy used by the household that owns the solar PVs, typically during the middle of the day when the sun is shining. These households sell energy to the power system when they are producing excess electricity. The same household buys electricity at night when its solar PVs are not generating energy and often during the evening peak when solar production is less than household demand.

[90] AER 2020b.
[91] ESC 2019.
[92] AER 2020b.
[93] AER 2020b.
[94] AER 2020b.
[95] AER 2020.

Australia has the highest uptake of solar PVs globally with more than 21 per cent of homes with rooftop solar PVs.[96] As of 31 August 2020, more than 2.53 million rooftop solar power systems have been installed across Australia.[97]

In the ACT, rooftop solar PV uptake has grown significantly over the past few years. In 2018, residential rooftop solar PV capacity grew by 104.4 per cent year-on-year, recording the highest growth rate in Australia.[98] The ACT Government's feed-in tariff schemes encouraged the take-up of solar PVs in the ACT. Even though the ACT Government's feed-in tariff schemes for rooftop solar customers have now closed, rooftop solar panels continue to be installed by ACT households and businesses.[99]

According to the ACT Government,[100] while solar energy technology costs continue to fall, the technical and economic potential of solar for the ACT is limited. This is because energy produced by solar is not continuously available and can be difficult to predict. Ongoing advances in energy storage technologies have the potential to increase rooftop solar PVs' contribution to reducing peak loads on the electricity network. The ACT Government is working with local businesses and leading research organisations to determine how advanced battery storage systems can support much higher penetration of solar on the ACT network.[101]

Households with rooftop solar panels can use batteries to store energy generated from the solar panels. During the day when the weather is sunny, solar panels generate energy. Excess energy generated by rooftop solar panels is stored in the batteries.

The stored energy can be used when households need it most including at night, when the weather is overcast or at peak times when electricity is most expensive to purchase from the network. When installed with solar PV systems, battery storage systems allow customers to reduce the amount of power they need to draw from the network. Customers may also be able to access backup power during an outage depending on the battery storage setup.

The ACT Government is supporting the take up of household batteries through the Next Generation Energy Storage program. Box 3.1 provides details of the program.

[96] https://www.energy.gov.au/households/solar-pv-and-batteries
[97] https://www.energy.gov.au/households/solar-pv-and-batteries
[98] https://www.canberratimes.com.au/story/5997022/act-leads-the-way-in-rooftop-solar-uptake-doubling-capacity-in-2018/
[99] https://www.environment.act.gov.au/energy/cleaner-energy/rooftop_solar
[100] https://www.environment.act.gov.au/energy/cleaner-energy/rooftop_solar
[101] https://www.actsmart.act.gov.au/what-can-i-do/homes/discounted-battery-storage

Box 3.1 Next Generation Energy Storage Program

The Next Generation Energy Storage Program is an ACT Government initiative to support the installation of battery storage systems in ACT homes and businesses. The program is currently subsidising the installation of up to 5,000 battery storage systems. The program is delivered through commercial battery storage providers, chosen by the ACT Government after a competitive selection process.

Under the program, the ACT Government provides a rebate at the rate of $825 per kilowatt up to a maximum of 30 kilowatt per household. This means a standard household with a 5 kilowatt system would typically be eligible for a rebate of around $4,000.

For customers adding a battery storage system to existing rooftop solar panels, a typical residential battery system would cost between $8,000 and $10,000 after the rebate has been applied. For customers who do not already have rooftop solar panels, a typical residential battery system combined with solar panels will cost between $13,000 and $18,000 once the rebate has been applied.

System costs and payback periods vary significantly depending on a range of factors including but not limited to energy usage and electricity prices, technology type, brand and system size.

Source: ACT Government – act smart https://www.actsmart.act.gov.au/what-can-i-do/homes/discounted-battery-storage

3.5 Change in tariff types

A significant number of ACT customers have recently moved from flat rate tariffs to time-of-use and demand tariffs.

Flat rate tariffs have a daily supply charge and a single rate for electricity used irrespective of when the electricity was used. This means flat rate customers pay the same usage rate whatever time of the day or night the electricity is used. Customers on time-of-use tariffs pay a supply charge and different usage rates depending on when the electricity is used. Demand tariffs have a fixed supply charge, a usage charge, and a demand charge based on how much electricity is used within the daily peak time period set by the retailer. A customer's demand charge will be higher when many appliances are used at the same time during the daily peak time period. More information about different tariffs are available on the Australian Government's Energy Made Easy website.[102]

The trend towards moving to time-of-use or demand tariffs is underpinned by an increased take-up of smart meters in the ACT. This is because, upon installation of a smart meter, ActewAGL's standing offer customers were automatically moved to (defaulted to) demand tariffs until 1 July 2020 and are moved to time-of-use tariff from 1 July 2020.[103]

[102] https://www.energymadeeasy.gov.au/article/electricity-tariffs

[103] ActewAGL's schedule of charges from 1 July 219 and 1 July 2020 available at https://www.actewagl.com.au/plans-and-connections/pricing-information/act-home-prices

A smart meter (also known as an advanced meter or 'type 4' meter) measures electricity usage in 30-minute intervals and sends this information electronically to an electricity retailer. Smart meters differ from basic meters (also known as accumulation meters) because they do not require a manual meter read and they provide real time information about electricity usage.

The take-up of smart meters in the ACT has increased due to the Power of Choice reforms introduced by the AEMC in late 2017. The Power of Choice reforms require all new electricity meters for residential and small business customers to be smart meters.[104] Under the Power of Choice reforms, new meters and metering services will be provided competitively by retailers, not by the distributor. This means there is now competition in providing metering services. Prior to the reforms, metering service provision was a responsibility of the distributor and the process was not competitive.

The take-up of rooftop solar PVs has also resulted in more smart meters installed in the ACT. This is because solar panels must be paired with a smart meter that can support two-way electricity flows between the solar panels and the electricity network.[105]

The market developments discussed in this chapter have implications for the network cost component of the Commission's pricing model. These implications are discussed in detail in section 2.3 of the issues paper for the Commission's review of the retail electricity form of price control.[106]

[104] https://aemo.com.au/en/initiatives/major-programs/past-major-programs/nem-power-of-choice
[105] https://energysaver.nsw.gov.au/households/understand-your-usage/smart-meters
[106] ICRC 2020.

Abbreviations and acronyms

ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
COAG	Council of Australian Governments
COGATI	Coordination of Generation and Transmission Investment
Commission	Independent Competition and Regulatory Commission
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ESB	Energy Securities Board
ISP	Integrated System Plan
LRET	Large-scale Renewable Energy Target
MWh	Megawatt hour
NEM	National Electricity Market
OTTER	Office of the Tasmania Economic Regulator
SRES	Small-scale Renewable Energy Scheme
TNSP	Transmission Network Service Providers

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