Submission No 244

SUSTAINABILITY OF ENERGY SUPPLY AND RESOURCES IN NSW

Organisation: NSW Government

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NSW Government Submission

Inquiry into sustainability of energy supply and resources in NSW

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1 Introduction

Energy and resources markets are undergoing a period of significant transformation, driven by a range of factors including the economics of energy generation, innovation and technological advancement, government policy and increasing interdependence between the energy, environment and resources sectors.

This submission focuses on key trends in the energy sector that provide opportunities and threats to a reliable, affordable and sustainable energy system and a strong resources industry in NSW. The latter part of the submission highlights the actions the NSW Government is taking to address these key trends.

This submission highlights the significant role regional communities play in domestic energy supply, in both renewable and non-renewable energy supply. The 20 Year Economic Vision for Regional NSW identifies renewable energy, resources and mining as engine industries for regional economic growth and prosperity. Energy production contributes significantly to investment and employment and is a core economic driver of many regional communities. This new investment will ensure that regional NSW continues to grow, thrive and secure NSW energy supply into the future.

2 Trends and forecasts in NSW energy and resources markets

The pace of change in energy and resources markets is rapid and increasing. Key trends include:

- the changing electricity generation mix
- gas and its role in firming generation
- coal production and the mining industry's economic contribution
- the impact of competition on energy prices
- the impact of technological innovation.

2.1 The changing electricity generation mix

Traditionally the electricity system in Australia and NSW has been powered by coal resources. Coal continues to be the primary fuel source for electricity today, both in terms of capacity and output, but the generation mix is changing, in part, as coal-fired power stations reach the end of their technical lives.

As of August 2019, NSW had around 21,100 megawatts (MW) of electricity generation capacity installed, across three main sources: 10,200 MW based on coal, 2,300 MW based on gas and oil, and 8,700 MW of renewables, including Snowy Hydro and rooftop solar photovoltaic (PV) systems.

During periods of peak electricity demand, NSW has access to around 14,400 MW of firm electricity generation capacity. In addition, during peak demand events, NSW can access around 1,700 MW of available electricity through its interconnectors with Queensland and Victoria, on top of NSW's own generation capacity. The breakdown of capacity by type is shown in Figure 1.

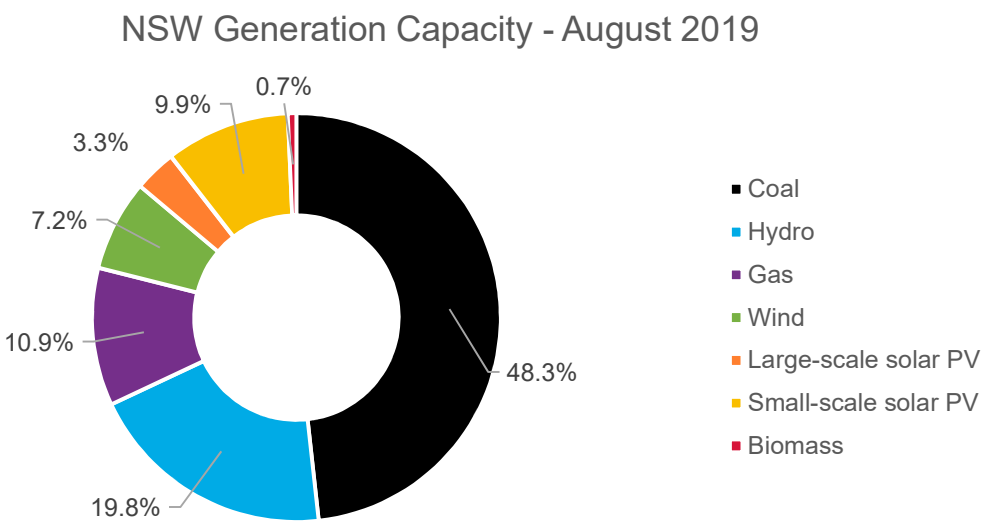

Figure 1. NSW electricity generation mix by nameplate capacity. Source: Department of Planning, Industry and Environment (DPIE) compilation of information from the Australian Energy Market Operator and Australian Photovoltaic Institute.

The generation mix by output looks different, as coal in particular generates a greater proportion of its capacity than other fuel types, as shown in Figure 2. The Federal Department of Environment and Energy's Australian Energy Statistics show that in 2017-18, around 79.5 per cent of total NSW electricity generation came from coal, 6.7 per cent from hydro, 4.8 per cent from gas, 3.4 per cent from wind, 2.9 per cent from rooftop solar, 1.6 per cent from bioenergy and 1 per cent from large-scale solar PV.

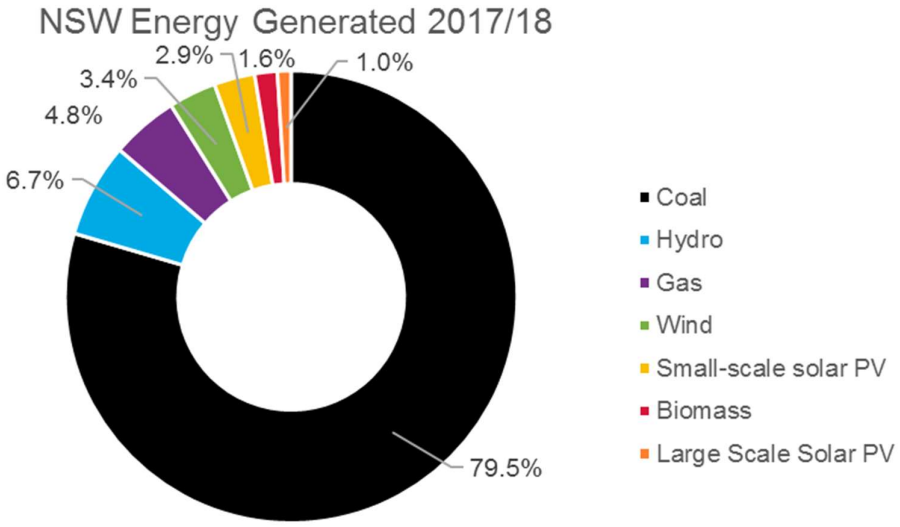

Figure 2. NSW electricity generated in 2017/18. Source: Federal Department of Environment and Energy, 2018 Australian Energy Statistics.

2.1.1 Increased investment in renewables

According to the Australian Energy Regulator's (AER's) State of the Energy Market 2018 report, in the five years from 2012 to 2017, over 90 per cent of investment in new generation capacity in the National Electricity Market (NEM) was in wind and solar.

The share of wind and solar in the NSW electricity generation mix tripled over the five years from 2012-13 to 2017-18. This includes generation from rooftop solar and large-scale solar PV and wind farms. In total, NSW has approximately 8,635 MW of installed renewable energy generation capacity, which is around 41 per cent of total generation capacity in NSW.

Investments in renewable energy generation were, in the first instance, largely driven by the Commonwealth Government's Large-scale Renewable Energy Target (LRET) which is expected to be met before 2020. Despite the end of the LRET, the investment trend in renewable energy generation is expected to continue due to project economics. While wind and solar generation alone provide only intermittent electricity, the electricity system can be firmed by storage technologies such as pumped hydro, batteries and gas-fired generators. A portfolio of firmed renewables operates in the following way: because intermittent renewables generate electricity at a lower marginal cost than other technologies, they would produce electricity when they could (i.e. when the sun is shining or the wind is blowing). When intermittent generators are unable to satisfy demand, other technologies which can provide electricity on demand ("firm generation"), including gas and storage, dispatch electricity. Such a system is able to satisfy electricity demand so long as there is sufficient firm generation capacity.

As shown in Figure 3, wind and solar are cheaper than new coal and gas on a levelised cost of electricity generated basis and appear competitive once incorporating the cost of storage.

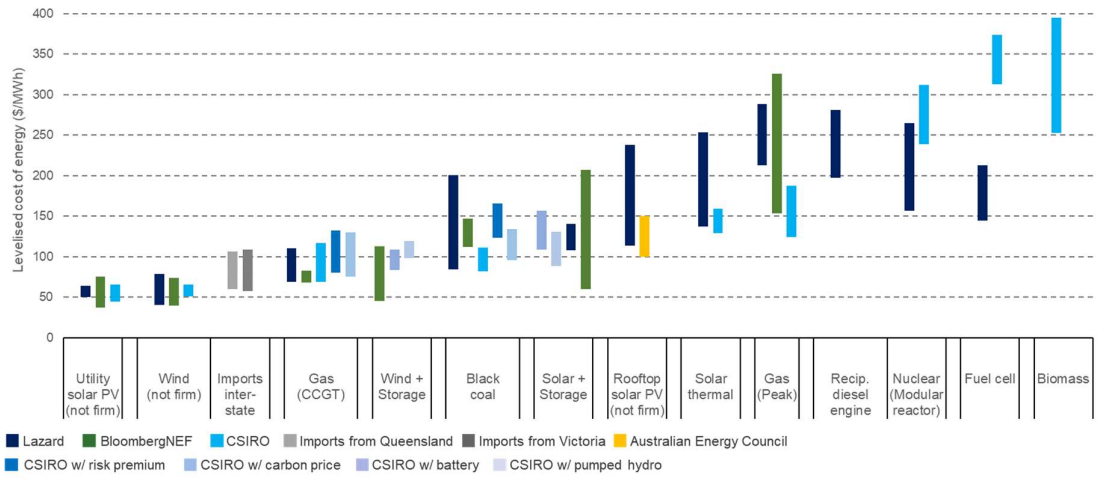

Figure 3. Levelised cost of energy by type. Source: DPIE collation of various reports, including:

- Lazard, 2018, *Levelized Cost of Energy Analysis Version 12* accessed from https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf adjusted using an exchange rate of 1.4 AUD per USD
- BloombergNEF, 2019, *Australian Levelised Cost of Electricity* datasheet
- CSIRO, 2018, *GenCost 2018: Updated Projections of Electricity Generation Technology Costs* accessed at https://www.csiro.au/~/media/News-releases/2018/renewables-cheapest-new-power/GenCost2018.pdf?la=en&hash=9A292E508F96EEC337F1BFFF4ACDB54BC2DA5CEF
- DPIE's analysis of imported electricity from Queensland and Victoria of the 10 percentile and 90 percentile prices across the 2017-18 financial year
- Australian Energy Council, 2019, *Solar Report January 2019*, https://www.energycouncil.com.au/media/15358/australian-energy-council-solar-report_-january-2019.pdf.

The Australian Energy Market Operator (AEMO) develops an Integrated System Plan (ISP) that projects future supply and demand scenarios to identify requirements for investment in the NEM. AEMO's 'neutral' scenario assumes mid-point projections of economic growth,

demand growth and fuel costs. Under the neutral scenario, the 2018 ISP forecasts that by 2040 the lowest cost replacement for the retiring energy production from existing generation in the NEM will be a portfolio of resources including about 28 gigawatts (GW) of large-scale solar generation, 10.5 GW of wind generation and 17 GW of storage capacity, complemented by 500 MW of flexible gas plant and transmission investment. The ISP states that this energy generation portfolio in total can produce 90 terawatt hours (net) of energy per annum, more than offsetting the energy lost from retiring generation.

The ongoing role of coal-fired power stations

Coal will continue to play a role in NSW's energy security. AEMO's ISP forecasts that operating existing coal-fired generation up to the end of its technical life would lead to lower overall system costs (excluding externalities) due to the high capital costs of investing in new generation compared to continuing to operate existing generation.

All five operating NSW coal power stations are scheduled for retirement between 2022 and 2043 (based on assumed 50-year technical life) beginning with Liddell Power Station in 2023. Three of those generators – Mt Piper, Bayswater and Vales Point – are investing in turbine efficiency upgrades, indicating their owners are confident in their future over the medium to long term.

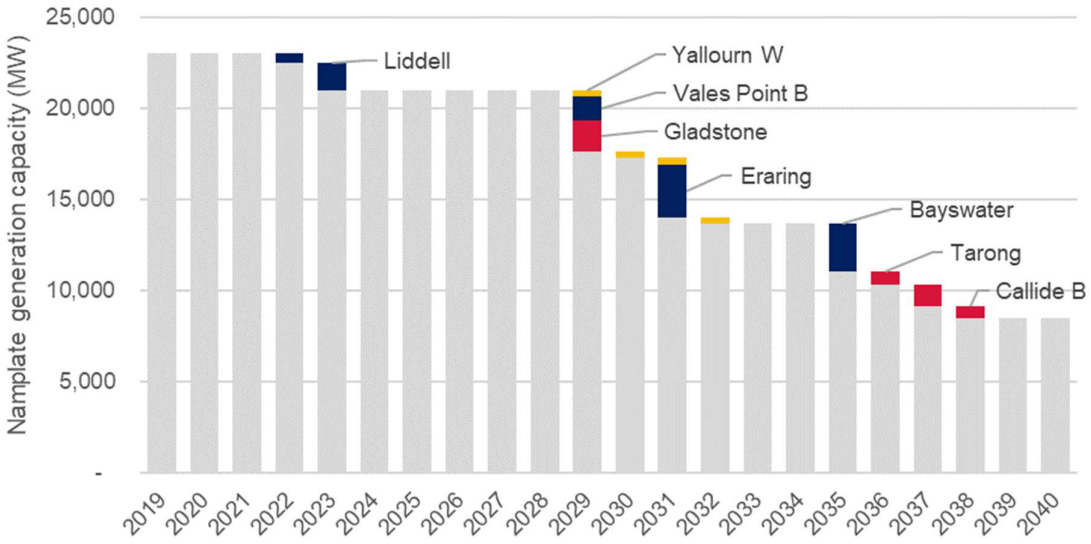

Figure 4. NEM coal-fired generation fleet operating life to 2040, by 50th year from full operation or announced retirement.
Source: AEMO, *Integrated System Plan 2019-20 Assumptions Book as at 8 August 2019.*

2.1.3 Reducing emissions in the electricity sector

As a consequence of the changes outlined above, emission levels from NSW's electricity sector have reduced significantly in recent years. In 2005, the electricity sector emitted 58 million tonnes (Mt) of CO_2e. In 2017, emissions for the sector were at 51 Mt CO_2e.

The trend of reducing emissions is expected to continue. The reduction is due to announced plant closures, increasing energy efficiency and increasing generation from firmed renewable sources.

2.1.4 The need for reliable generation and firm capacity

The growth in wind and solar presents a significant challenge for an electricity system that was built upon centralised thermal generation sources. Variable generation sources such as

wind and solar are not necessarily available at times of peak demand which means other generation sources are required to maintain a reliable electricity supply.

Ensuring that NSW's electricity system continues to provide the same reliable services to customers it has traditionally done is a key objective in this transition. Reliability and firm capacity are key concepts for this discussion. Reliability is about the balance of supply and demand, not network outages or system security. Firm capacity means the output a generator is able to provide at summer reference temperatures and peak times.

Currently, NSW's supply of electricity is reliable. Distribution interruptions, from traditional causes such as falling trees in storms or local breakdowns, are by far the main cause of customer outages. Reliability interruptions, that is, outages that are caused by inadequate supply, are much less than one per cent of all outages.

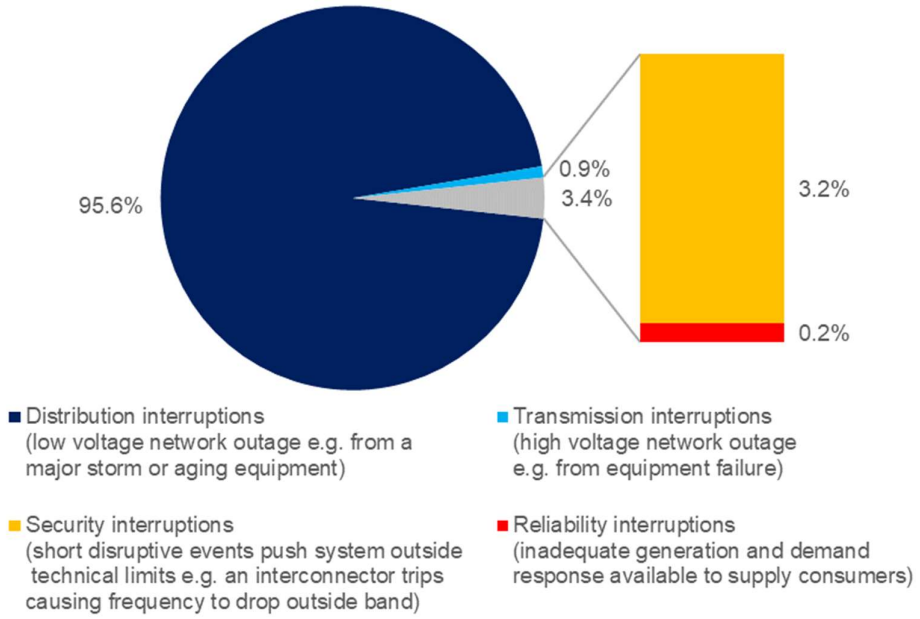

Figure 5: Interruptions to power supply. Source: AEMC's Reliability Panel's 2018 Reliability Standards and Settings Review.

Maintaining reliable sources of electricity supply will continue to be of absolute importance over the coming decades as existing power stations retire. As Figure 6 shows, forecast NSW maximum demand is expected to increase slightly over the next five years. Although NSW has had significant investment in new wind and solar PV, the amount of firm capacity that can be called upon when needed decreased due to existing plants closing and operating at reduced capacities. The existing coal-fired generators will continue to play an important role in providing firm capacity as the energy market transitions.

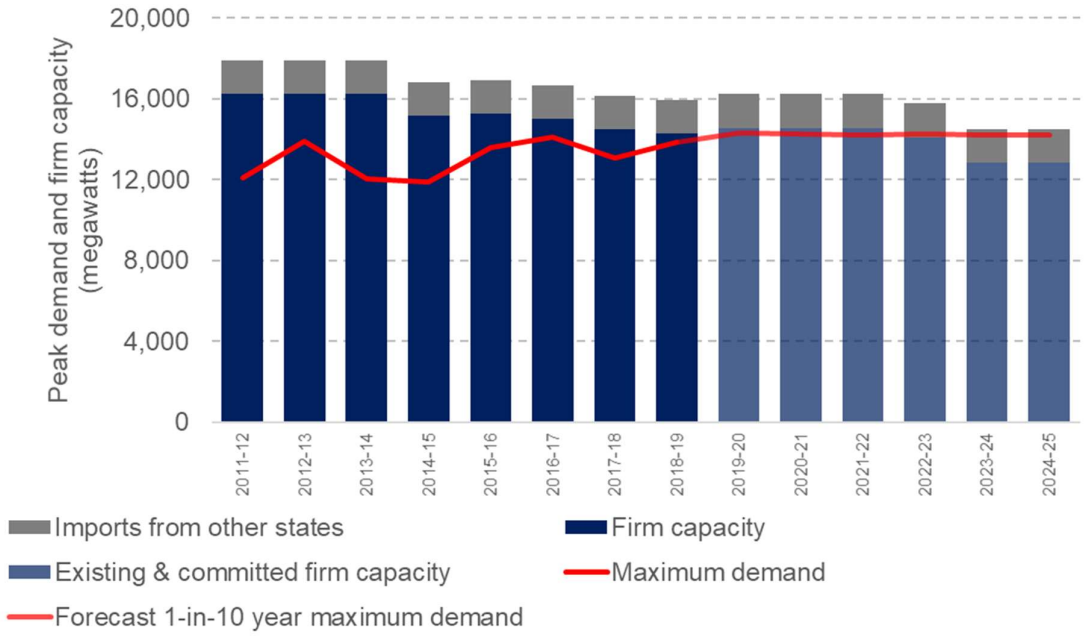

Figure 6: Peak demand and firm capacity. Notes: Historical information and future projections to 2024-25 for firm capacity based on summer firm capacities reported in AEMO's Generation Information Page. Imports based on AEMO nominal capacities for interconnectors with Victoria and Queensland. Maximum demand based on historical actual peak demand events and future POE10, or 1-in-10 year events taken from AEMO's 2019 Electricity Statement of Opportunities.

Each year, AEMO publishes an Electricity Statement of Opportunities (ESOO) with supply and demand projections to indicate what new investment is required. The NEM reliability standard requires supply to meet 99.998 per cent of demand during a year, recognising that no system can be 100 per cent reliable without adding significant costs paid by energy consumers.

AEMO's forecasts indicate that, without new generation, NSW may come close to breaching the reliability standard in the years from 2023-24 to 2028-29 as shown in Figure 7.

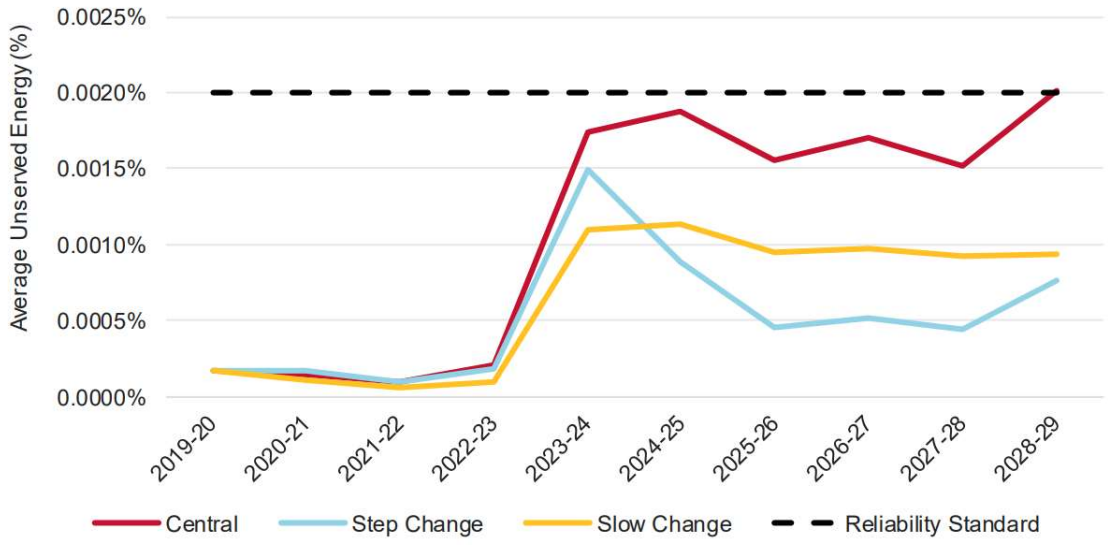

Figure 7. Average unserved energy, NSW. Source: AEMO's 2019 Electricity Statement of Opportunities.

The need for new generation in 2023-24 is largely due to the planned closure of the Liddell power station. AEMO's 2019 ESOO assumes that Liddell has 450 MW available from all four units available until the end of 2022. However, AGL, which owns Liddell, has been running Liddell at 420 MW to prevent breakdowns. The operating capacity of Liddell could lower even further over time.

According to the 2019 ESOO, NSW will need around 375 MW of additional firm capacity in 2023-24 to meet that NEM reliability standard in a 1-in-10 year peak demand event such as a severe heatwave. These forecasts account for the recent announcement by AGL that it will delay the closure of three units of the Liddell power plant until April 2023. The 2019 ESOO forecast does not account for other potential generation and transmission projects that AEMO does not yet consider to be 'committed'.

2.1.5 New electricity generation projects

NSW has a strong pipeline of new private sector generation and storage projects, both recently commissioned and in the planning system, that are expected to contribute to the ongoing reliability of supply in the state. This includes a range of renewable generation projects, additional gas-fired generation and energy storage options such as pumped hydro and batteries.

New energy generation projects represent about $30.5 billion in investment, most of which will be in regional areas. This new investment will ensure that regional NSW continues to grow, thrive and secure NSW's energy supply into the future.

2.1.5.1 Recently commissioned projects and projects under construction

As at August 2019, 13 large-scale renewable energy projects have been commissioned in NSW since the start of 2018, amounting to 1,291 MW. Five new wind farms were commissioned, totalling 850 MW. Nine new solar farms have been commissioned, amounting to 441 MW and $782 million in investment.

In addition to recently commissioned projects, there are 14 renewable energy projects totalling approximately 1,900 MW worth about $3 billion under construction in NSW. This includes nine solar farms totalling 1,100 MW and $1.4 billion in investment, four wind farms totalling 650 MW and $1.5 billion in investment and one project using solar, hydro and wind power.

2.1.5.2 Projects in the pipeline

The total pipeline of new generation projects in NSW as of August 2019 amounts to more than 20,500 MW of generation capacity projects that have received planning approval or are currently seeking planning approval, representing about $27.5 billion in investment. This includes both renewable and non-renewable projects.

As at August 2019, there are 18,850 MW of large-scale renewable energy projects that have received planning approval or are progressing through the NSW planning system, which represents about $25.4 billion in investment. This includes approximately 12,500 MW from 83 solar farms worth around $14.7 billion in investment, 3,800 MW from 15 wind farms worth approximately $4.7 billion and 380 MW from three biogas and cogeneration projects worth approximately $1.2 billion. It also includes the Snowy 2.0 Stage 2 Main Works, with potential to deliver 2,000 MW of capacity worth $4.5 billion investment, and the Shoalhaven Scheme expansion, with 235 MW of capacity at $300 million.

In addition to these renewable projects, there are 1,410 MW of large-scale non-renewable energy projects with planning approval, worth around $1.5 billion. This includes 1,250 MW of gas projects, worth $1.25 billion, and 160 MW of coal efficiency upgrades, worth $209 million.

2.2 Gas and its role in firming generation

In eastern Australia, more than 60 per cent of gas produced is converted to liquefied natural gas (LNG) for export, mainly to Asia. The balance is sold into the domestic market.

With domestic users now competing with overseas customers to buy Australian gas, prices in the domestic market have risen to align more closely with international gas prices. Higher gas prices also impact the NEM, which became more reliant on gas powered generation capacity following the closure of several coal fired generators in 2016 and 2017.

2.2.1 The role of gas in electricity generation

Gas generation in NSW accounts for approximately 12.3 per cent of registered generation capacity. However, NSW gas generators supplied approximately 3.2 per cent of the state's energy generated in 2017-18. This is because gas power stations usually operate as 'peaking' generation, contributing mostly to supply at times of high demand, when prices are also high. This generally occurs during evening peaks.

The advantage of the flexibility of gas – its capability to 'ramp up' quickly to provide capacity to the market – means it is likely to continue to fill the need for peaking generation as the market transforms. According to AEMO's ISP, gas generation will play this role increasingly as existing coal generation reaches the end of its technical life and retires.

2.2.2 The 2019 Gas Statement of Opportunities

On 28 March 2019, AEMO released its 2019 Gas Statement of Opportunities (GSOO). The GSOO forecasts gas supply and demand for the east coast of Australia. The 2019 GSOO forecasts no supply shortfalls over the next five years, despite forecasting a slight decline in production.

The GSOO forecasts that there may be a shortfall in gas supply from 2024 unless there is new investment. This is due to a reduction in gas production in Victoria and constraints in existing pipeline infrastructure. Accessing more gas supplies could be done through a combination of establishing LNG import terminals in southern Australia, developing additional gas reserves in southern states, or upgrading pipeline infrastructure.

2.2.3 Proposed new gas projects

The critical role of gas in providing firm support for renewables is reflected in the range of new gas generation proposals. These include EnergyAustralia's Tallawarra B proposal at Lake Illawarra, AGL's proposed 250 MW quick-start gas plant at Newcastle and Australian Industrial Energy's proposed 850 MW gas power station in association with the Port Kembla Gas Terminal discussed below.

In June 2018, the NSW Minister for Planning and Public Spaces declared the proposal for a Port Kembla Gas Terminal to be Critical State Significant Infrastructure. In August 2019, the NSW Minister for Planning declared the proposal for a gas import terminal at Kooragang Island in the Port of Newcastle to be Critical State Significant Infrastructure. These import terminals would facilitate the import and re-gasification of LNG for input into the NSW gas transmission network. The projects could expand the locally available gas supply in NSW by more than 200 petajoules of gas per year, which represents well over 100 per cent of the state's current gas needs.

If it obtains development consent, the proposed Narrabri Gas Project could supply up to 50 per cent of the state's gas supply at peak production. The development application for the project is currently under assessment and the Independent Planning Commission is the consent authority.

2.3 Coal production and the mining industry's economic contribution

Coal mining and the mining industry generally are important to NSW and particularly regional NSW. As at the end of December 2018, the mining industry employed around 29,000 people, and around 115,000 people indirectly through mine and non-mine related services. A significant part of these employment benefits flow to people in regional NSW.

The total value of mining production in 2017-18 in NSW was around $27.3 billion, with the industry contributing around $1.8 billion in royalties in 2017-18. The bulk of this (93 per cent) came from coal mining.

A large proportion of the products mined are exported. With respect to coal, NSW mainly produces export thermal coal with small amounts of domestic and export metallurgical coal (usually around 15 per cent), see Figure 8. Of the 194 million tonnes of coal produced in NSW in 2017-18, 85 per cent was exported at a net export value of over $18.3 billion to four key markets (Japan, China, South Korea and Taiwan). The majority of this was thermal coal accounting for almost 74 per cent of the state's total coal production.

The export value of mineral and processed metal product in 2017-18, including aluminium, was $25.3 billion. This is around 45 per cent of the state's merchandise export revenue.

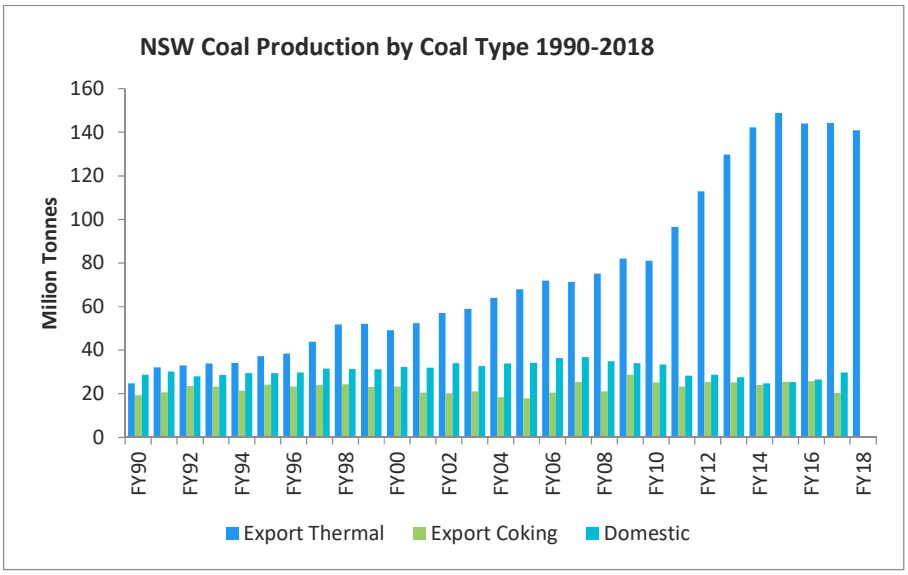

Figure 8. NSW coal production by type from 1990 to 2018.

Domestic thermal coal accounts for around 13 per cent of the state's total coal production. Only two coal mines currently supply their coal exclusively to NSW coal-fired generators (Myuna in the Hunter and Chain Valley in the Central Coast). A further 11 NSW coal mines provide a proportion of their production to the domestic market. Out of these, the largest supplier is the Wilpinjong mine located to the north-east of Mudgee, which supplies around seven million tonnes per year to the AGL-owned Bayswater and Liddell power stations.

Based on approved coal projects, the state's coal production will start to significantly decline from around 2030. Even if all coal mining proposals currently in the planning system are approved, the state's coal production will start to significantly decline by the mid-2030s unless new proposals are brought forward and approved.

It is also appropriate to note that the quality of NSW coal means that its burning releases less carbon emissions for the energy produced than that released from coal mined from other locations.

2.3.1 Global coal consumption forecast

Future long-term global coal demand for NSW coal will depend to a large extent on international policies. The International Energy Agency (IEA) has three forecast scenarios for global coal demand:

- The Sustainable Development scenario is based on the assumption that in order to keep average global temperature increase to below two degrees of preindustrial average, global demand for all coal would need to drop by 57 per cent between 2017 and 2040.
- The Current Policies scenario is based on existing global climate change-related laws and regulations as of mid-2018, with no new action taken. In this case global coal demand would be 27 per cent higher by 2040 than in 2017.
- The New Policies scenario is based on the assumption that part of the global climate change policy ambitions announced to date are translated into action. Under this scenario, global coal demand would be broadly unchanged from 2017 in 2040.

The New Policies scenario is the IEA's main scenario.

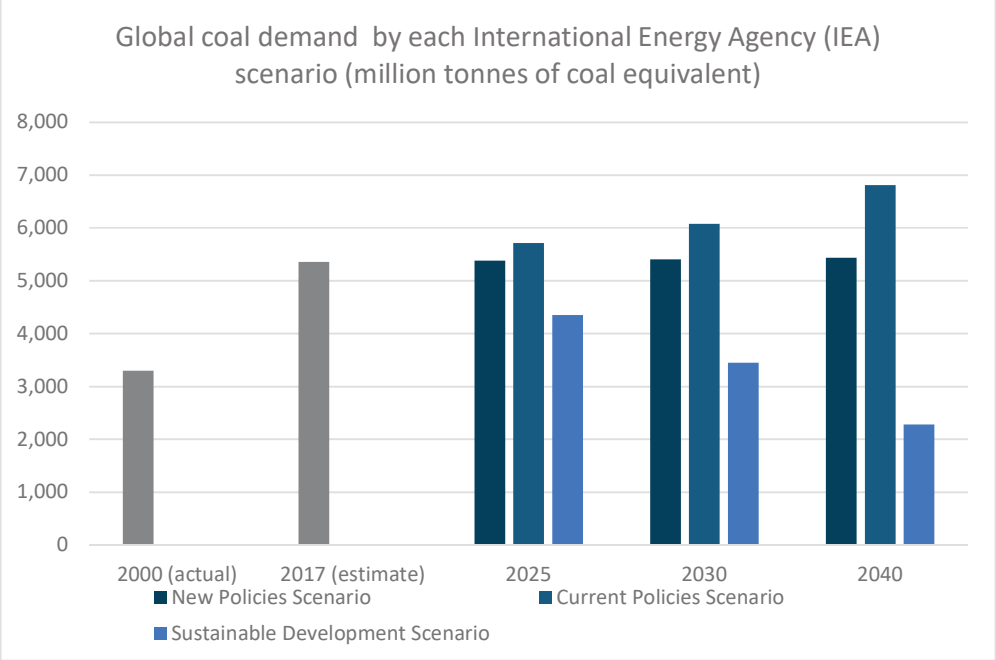

Figure 9. Changes in global coal demand under the IEA's three scenarios Source: DPIE, adapted from IEA's World Energy Outlook (WEO) 2018.

Under the New Policies and Current Policies scenarios, Southeast Asia's and India's share of thermal coal demand continues to increase due to rapid growth in power demand as these economies continue to grow. In contrast, coal consumption for advanced economies such as the US and Europe is expected to decline as these regions switch towards carbon-neutral fuels.

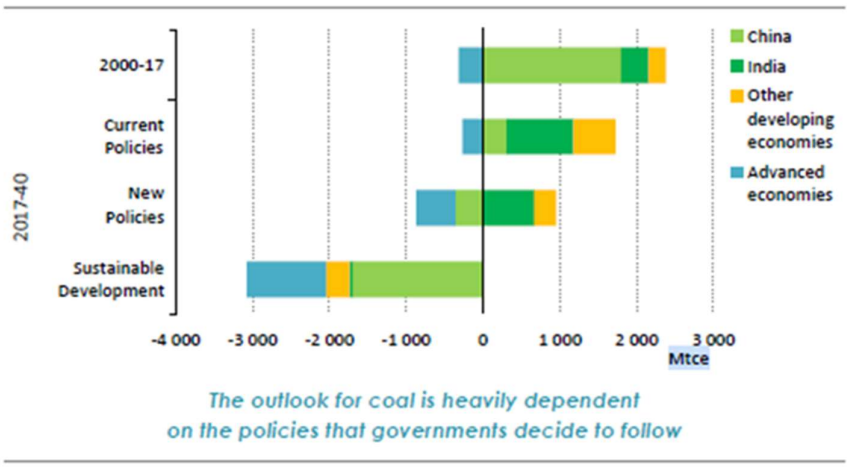

Figure 10. Change in coal demand by region under IEA's three scenario Source: IEA World Energy Outlook, Figure 5.1.

2.4 The impact of competition on energy prices

Retail energy markets have been opened to competition and prices have been deregulated in NSW over the past 15 years. The Independent Pricing and Regulatory Tribunal (IPART) has been given the role of retail electricity market monitor for NSW. In that role, IPART conducts an annual review of the performance and competitiveness of NSW energy retail markets and the changes in retail electricity and gas prices. IPART also sets a benchmark for retailer solar feed-in tariffs paid to households and businesses for excess electricity generated by their solar PV systems and exported to the grid.

IPART's *Review of the performance and competitiveness in the NSW retail energy market* from 1 July 2017 to 30 June 2018 found that competition is delivering benefits to customers and will continue to do so.

According to the review, key indicators suggest competition is increasing. From when deregulation occurred to 2017-18, the number of retailers increased from 11 to 24. The number of gas retail businesses at 30 June 2018 was nine, three more than when gas price deregulation occurred on 1 July 2017. Customer engagement increased in electricity and gas markets, with higher percentages of customers in both markets switching retailers than in the previous year.

IPART found that changes in electricity and gas prices into 2018-19 reflect efficient costs in competitive markets. IPART found that electricity price changes reflect the underlying costs of supply, with retailers smoothing the impact of a large increase in wholesale costs in 2017-18 over two years. Gas price changes also reflect the underlying costs of supply or are becoming cost-reflective as competition increases.

A key finding for customers was that average electricity bills have fallen slightly in real terms since price deregulation in 2014. The bill reduction was driven by a reduction in network costs, particularly in the Essential Energy network area serving much of regional NSW. Across the three network areas, network costs fell by an average of 20 per cent from 2013-14 to 2017-18.

2.5 The impact of technological innovation

Technological change has been a major driver of the changing generation mix and price trends described above as renewable energy technologies have matured.

2.5.1 The growth of rooftop solar

Large and increasing numbers of customers in Australia and NSW are meeting some or all of their power needs from rooftop solar PV. A decade ago, less than 2 per cent of households in NSW had rooftop solar. The number has increased to more than 15 per cent.

By 2018, solar PV systems were meeting 3.4 per cent of the NEM's electricity requirements, according to the AER's *State of the Energy Market 2018.* Total installed capacity of rooftop systems reached 11 per cent of the NEM's total generation capacity by 2018. The growth in rooftop solar is expected to continue.

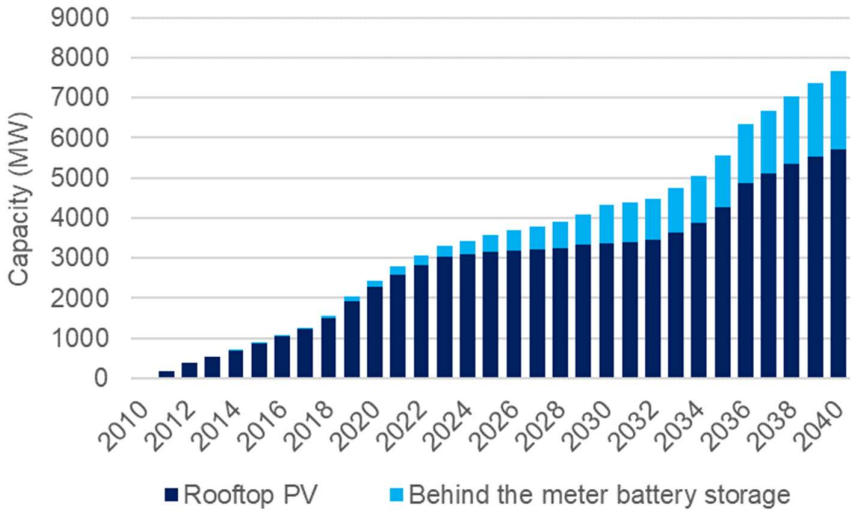

Figure 11. Growth in distributed energy resources. Notes: Historical information based on DPIE collation of data from Australian PV Institute and Clean Energy Regulator. Forecast based on the central scenario from AEMO's 2019-20 ISP Assumptions Book.

2.5.2 Digital meters

A digital meter is a device that digitally measures when and how much electricity is used at a customer's premises. A digital meter can give customers greater visibility over their electricity usage and allow them to better manage their bills. Digital meters are essential for customers with solar panels who want to export electricity to the grid.

In October 2014, the NSW Government announced a voluntary, market-led approach to the rollout of digital meters. Since December 2017, under national rule changes, every new or replacement meter must be digital. Under the rule change, energy retailers are responsible for management, installation and maintenance.

As of July 2019, there were over 465,000 digital meters installed in NSW. This represents approximately 8.5 per cent of all electricity meters for small customers in NSW.

2.5.3 Storage

Technological innovation, the growth of rooftop solar and the changing generation mix towards variable renewables is leading to an increased interest in storage technologies. For owners of rooftop solar, storage offers the opportunity to use the electricity generated onsite when it is needed and enhances their ability to sell excess generation to the grid. On a larger scale, storage offers commercial opportunities. Until recently, battery storage was not commercially viable, but that is changing as innovation reduces costs. According to the

Clean Energy Council's *Clean Energy Australia Report,* Australians had installed 28,000 battery systems as of January 2018, up from 8,000 systems a year earlier.

Pumped hydroelectricity offers additional opportunities for storage, and at scale. Pumped hydro involves pumping water into an elevated reservoir when energy is cheap and releasing it to generate hydroelectricity when prices are high. NSW already has two pumped hydro projects, 240 MW at Shoalhaven and 1,500 MW at Tumut 3. This has the potential to be supplemented by the proposed Snowy 2.0 project at 2,000 MW.

2.5.4 Coordinating distributed energy resources

As increasing numbers of customers purchase systems like rooftop solar and home batteries, as well as install the digital meters required to support those systems, the electricity system is becoming more digitized, interactive and decentralised. Many customers are now producers as well as consumers of electricity, and this is leading them to engage with larger electricity businesses in new ways.

Households and businesses with rooftop solar systems are increasingly able to sell excess electricity back into the grid. Electric vehicles are also forecast to increasingly enter the mix and change the profile for electricity use and the way battery storage is used. An electricity system that was once linear and based on centralised generation must transition to effectively incorporate distributed energy resources.

Distributed energy resources impact the power system in several ways. One is that they shift the demand profile. During the daytime when demand is moderate, rooftop generation is at its highest, reducing demand from the grid. In the evening at peak demand, rooftop generation has tapered off, meaning that rooftop solar has relatively less impact at reducing peak demand pressures on the system.

Distributed energy resources can also result in distribution network congestion, as power is exported back to networks that were not designed for two-way power flow. There are also issues with voltage and frequency control and the ways in which distributed energy responds to system disturbances. Compounding these issues, the market operator does not have 'visibility' of distributed energy resources, meaning AEMO cannot measure the consumption and export from rooftop solar. This makes forecasting demand and balancing the system more difficult.

These impacts make coordinating the integration of distributed energy resources a major challenge of managing the energy transformation.

2.5.5 New fuel sources

The rapid pace of change, the opportunities presented by the retirement of traditional generation sources, and the need for clean, low-emissions generation is raising interest in new fuel types.

2.5.5.1 Hydrogen

Hydrogen can be used to power vehicles, used directly for heating and industrial processes and used to generate electricity.

Established technologies to produce hydrogen include:

- using a fossil fuel feedstock to produce hydrogen, for example steam reformation of natural gas, or coal gasification
- the electrolysis of water using electricity.

The production of hydrogen from renewable sources or from fossil fuels accompanied by carbon capture and storage results in zero or low emissions.

In December 2018, Council of Australian Governments (COAG) Energy Council approved the development of a national hydrogen strategy. The NSW Government is contributing to the development of the strategy and looking for opportunities to capture the economic growth and jobs benefits from emerging technologies such as hydrogen production.

2.5.5.2 Bioenergy

Bioenergy means energy that is transformed from biomass. This is predominantly from waste or low value products in primary industries including agricultural and forestry systems. These feedstocks can be converted to multiple products, including heat and energy for use in domestic or commercial industries. Systems are varied and can include the capture and use of methane from intensive livestock systems, the use of residue and wastes including crop residues and the growth of dedicated crops especially in marginal land.

Bioenergy in Australia makes up around four per cent of total energy consumption. This is low compared to the European Union, where bioenergy is 10 per cent of energy consumption. However, there are more than 50 regionally based industry projects in NSW, including the Broadwater Bioenergy Plant (38 MW), the Condong Bioenergy Plant (30 MW), and the Tumut Visy Paper Bioenergy Facility (32 MW capacity). Significant ethanol production occurs on the South Coast to help supply service stations and meet the obligations of the *Biofuels Act 2007*.

3 NSW Government actions

Both the NSW Government and the private sector have an important role to play in the energy transformation. The NSW Government aims to facilitate private sector investment through supporting market-led solutions which do not distort energy markets, providing a planning and regulatory framework that supports investment, directly investing in energy solutions where appropriate and ensuring that the people of NSW receive the full benefit of the changes afoot.

3.1 Infrastructure

The NSW Government is committed to ensuring that the planning and regulatory framework supports investment in energy infrastructure in NSW, including at a regional level.

3.1.1 The NSW Transmission Infrastructure Strategy

NSW is modernising its transmission grid through the Transmission Infrastructure Strategy. Released in November 2018, the Strategy aims to unlock investment in priority energy infrastructure, which can deliver least-cost energy to customers to 2040 and beyond.

The Strategy's short-term focus is on accelerating priority transmission projects to minimise risks to the state's energy security associated with the closure of Liddell Power Station in April 2023. These projects are:

- an upgrade to the existing Victoria-NSW Interconnector to unlock 170 MW of supply at a capital cost of $28 million (NSW component only) by 2022
- an upgrade to the Queensland-NSW Interconnector to bring 190 MW of supply from Queensland at a capital cost of $142 million by 2022
- a new South Australia-NSW Interconnector to bring up to 800 MW of supply from South Australia at a capital cost of $1.1 billion (NSW component) by the end of 2023
- new transmission from Snowy Hydro to unlock an additional 2,600 MW of supply from the Snowy Scheme at an estimated cost of $1.35 billion. This includes up to

2,000 MW from Snowy 2.0 (once operational), with the remaining capacity contributed by the existing Snowy generators which are currently constrained.

3.1.2 NSW Energy Zones

The Transmission Infrastructure Strategy also prioritises three energy zones identified in New England, the Central West and the South West of NSW. These locations benefit from outstanding energy resources, have reduced environmental and planning constraints, are close to existing transmission and distribution infrastructure and load centres and align with the NSW Government's regional growth priorities.

Strategic infrastructure upgrades to unlock these energy zones will leverage private sector investment opportunities and could support up to 17,700 MW of new electricity generation by 2040, delivering up to 2,000 construction jobs each year and up to $23 billion in investment into regional NSW. The energy zones will reduce emissions and ensure that there are enough new energy projects coming online to support the replacement of power stations as they retire over the next two decades (noting that renewable development will need to be accompanied by firming generation to ensure system reliability).

3.1.3 NSW Pumped Hydro Roadmap

The NSW Government is working with the private sector to develop renewable energy and storage projects on state-owned dams across NSW. WaterNSW has requested full proposals from 24 shortlisted projects. Totalling around 7,000 MW, most of these projects are pumped hydro energy storage schemes. These projects have the potential to complement and firm the state's significant pipeline of solar and wind projects.

3.1.4 Easy to do Business

One of the NSW Government's priorities is to make it as easy as possible to invest in utility scale generation in NSW. Another is to ensure that distributed energy assets are supporting the grid as much as possible. Key stakeholders in the energy industry were recently invited to provide their thoughts on how these objectives may be achieved.

The focus of the Easy to do Business project is to catalyse private sector investment, lower electricity prices and improve the reliability and security of the electricity system at the lowest possible cost to taxpayers and energy consumers. The NSW Department of Planning, Industry and Environment has received responses from the energy market and is currently identifying opportunities to make it as easy as possible to do energy business in NSW.

3.2 NSW Government programs

In 2018, the NSW Government announced a major clean energy package including the following programs.

3.2.1 Emerging Energy Program

The Emerging Energy Program was established to accelerate the development of large scale, low emissions, dispatchable electricity supply. The program provides grants to support a mixture of technologies that will help diversify the NSW energy mix and drive more competition in the market, ultimately lowering prices for consumers.

The program is focused on reducing investment barriers, incentivising innovation and ensuring a cost-effective outcome for the NSW Government. Supporting these projects will set up new supply chains and help these markets mature.

In March 2019, the NSW Government committed an additional $20 million to the program bringing the total program value to $75 million.

3.2.2 Regional Community Energy Program

The $30 million Regional Community Energy program includes three streams to support regional communities:

- grants from the Regional Community Energy Fund for projects that are innovative or generate on-demand renewable energy and provide benefit to the local community
- funding for community energy hubs that improve household and small business access to expert energy advice
- funding for regional and remote communities to install emergency backup systems for key locations to increase disaster resilience.

3.2.3 Smart Batteries for Key Government Buildings

This $20 million program will install battery storage solutions at schools, hospitals and other key government buildings with rooftop solar systems. The batteries will be available to offer up to 13 MW of strategic demand response through a virtual power plant capability. These smart batteries will help agencies reduce operating costs, whilst helping the grid to stay reliable and secure in peak events and energy emergencies.

3.3 Affordability

The NSW Government has implemented an extensive energy affordability package for households and small businesses to help with energy bill pressures.

3.3.1 Empowering Homes

The Empowering Homes program will provide eligible NSW home-owner occupiers access to interest-free loans to purchase a battery or a solar and battery system for their home. The program aims to support the installation of up to 300,000 battery and solar-battery systems across the state over the next 10 years. As a result, the program will unlock up to $3.2 billion in clean energy investment, adding up to 3,000 MW hours of storage into the NSW energy system.

3.3.2 Energy social programs – rebates and emergency assistance

The NSW Government provides a range of financial assistance measures to help more than 900,000 households with their energy bills including:

- the Low-Income Household Rebate to assist eligible low-income households to pay their electricity bills (up to $285 each year)
- the NSW Gas Rebate to assist eligible low-income households to pay their natural gas and LPG bills (up to $110 each year)
- the Family Energy Rebate helps eligible families, particularly those with dependent children to pay their bills (up to $180 each year)
- the Life Support Rebate to help ease the burden of energy bills for those who require energy-intensive medical equipment (the value of the rebate is based on the medical equipment used and can be up to $3.68 per day)
- the Medical Energy Rebate to help reduce energy bills for households that need to use heating and cooling for medical reasons (up to $285 each year)
- the Seniors Energy Rebate to help independent retirees who hold a Commonwealth Seniors Health Card with the cost of energy by providing a rebate of $200 each year
- the Energy Accounts Payment Assistance (EAPA) Scheme to provide emergency financial assistance to those experiencing a short-term financial crisis. Eligible

recipients can receive up to $300 in assistance, twice per year, for both electricity and gas.

3.3.3 Energy Switch

The Energy Switch service allows households and small businesses to find a better deal on their energy bills. This free service analyses a customer's energy usage and searches the market for available plans where savings can be found.

Energy Switch also displays other features of each available plan, such as solar compatibility and a breakdown of retail cost details, including the electricity supply charge and kilowatt hour rate, in cents, for the best plans available.

3.3.4 Network reform

Network costs in NSW make up around 40 per cent of residential electricity bills in NSW. In 2012, the NSW Government introduced a network reform plan with the goal of reducing operating costs for the three NSW distribution network businesses (Ausgrid, Endeavour Energy and Essential Energy). From 2013-14 to 2017-18, network costs fell by an average of 20 per cent across the three networks.

The NSW Government has also introduced the network price guarantee, under which total network charges in the year ending 30 June 2019 were guaranteed to be lower than in the year ending 30 June 2014 for the Ausgrid and Endeavour Energy networks.

3.3.5 Home Energy Action Program

The program is made up of three targeted streams:

- Appliance Replacement Offer – concession card holders can receive up to 50 per cent discount when replacing their old fridge or TV with a new energy efficient model
- Social Housing Upgrades – social housing properties can receive a subsidy of up to 50 per cent for energy efficient property upgrades, including ceiling insulation, solar panels, split-system air conditioners, LED lighting and heat pump hot water systems
- Energy Hardship Assist – a co-funding partnership between the NSW Government, energy retailers and other third-parties, including social housing providers, to provide solar PV systems to energy hardship customers in social housing.

The Home Energy Action Program has provided 28,560 households with assistance as at August 2019.

3.3.6 More efficient homes for low income tenants

This program will provide discounts on energy efficient upgrades for up to 20,000 houses rented by low-income tenants to save on their energy bills by 2022. It also includes guidance to help landlords choose appropriate energy saving technology and how to pass reasonable costs through to tenants.

3.3.7 Solar for Low Income Households Trial

The Solar for Low Income Households Trial will install a 3-kilowatt solar system for eligible households that agree not to receive the Low Income Household Rebate for 10 years. The program is available for up to 3,000 households in five regions and will begin later in 2019.

3.4 Energy efficiency

Energy efficiency measures can be considered as an energy resource as they can reduce the need for additional investment in generation, transmission and distribution assets and place downward pressure on energy customers' bills.

3.4.1 Energy Savings Scheme

The Energy Savings Scheme (ESS) is NSW's largest energy efficiency program. It works by creating financial incentives for households and businesses to be more energy efficient.

In 2018, the scheme delivered energy savings of 2,577 GW hours. This translates to benefits of $231 million in avoided cost of electricity generation and $36.6 million in deferred network investment. By 2028, projects already completed under the ESS will deliver energy bill savings of $6.2 billion, lowering the cost of living and cost of doing business for participants.

3.4.2 Energy efficiency programs funded under the Climate Change Fund

The NSW Government Climate Change Fund provides support for energy efficiency programs covering both electricity and gas efficiency. The programs include the following:

- Discounts for Small Energy Users – provides discounts on high efficiency appliances for small businesses and up to 140,000 households to save on their energy bills. As of August 2019, the program had provided $4.9 million in incentives.
- Energy Management Services – provides training and support for businesses to reduce their energy use and implement energy management projects. The program target is to train 3,700 small businesses and 1,300 larger businesses by 2022.
- More efficient street lighting – funding to accelerate the uptake of energy efficient street lighting by paying out the residual asset value of inefficient lights with a lifespan of more than 4 years and build council capacity to identify and act on future resource efficiency opportunities. It has a target of 60,000 inefficient street lights replaced with LEDs, with 30,000 committed for replacement as of August 2019.
- Energy savings for energy intensive manufacturers – assists manufacturers to improve energy efficiency by co-funding for energy metering systems and energy equipment upgrades. The program will target 250 manufacturers, with 20 per cent in regional NSW, each saving up to $80,000 a year.
- Improved energy efficiency standards for household and business appliances – fast-tracks the development of higher energy efficiency standards for up to 20 household and business appliances.

3.5 Working with national forums

The NSW Government continues to participate in national forums, including the COAG Energy Council, to advocate for clear, national, long-term energy policy that will benefit NSW customers and support investment in new generation.

3.5.1 Retailer Reliability Obligation

The Retailer Reliability Obligation (RRO) is a mechanism to ensure adequate levels of dispatchable energy are available to meet peak demand, which began on 1 July 2019. If the RRO is triggered, electricity retailers are required to enter into sufficient contracts to meet their share of expected system peak demand.

Retailers can choose to contract with any form of generation, for example solar, hydro, gas, coal, and batteries. However, the 'firmer' the contracted generation source is, the greater its contribution will be to meeting the obligation.

This will provide an incentive for market participants to invest in the right technologies in regions where it is needed to support reliability in the NEM.

3.5.2 Integrated climate and energy policy

The RRO was originally one component of the National Energy Guarantee (NEG), a nationally coordinated mechanism to integrate climate and energy policy. The second component was a requirement that energy retailers keep their emissions below a specified level.

The NSW Government supports working with other jurisdictions to achieve an integrated climate and energy policy.

3.5.3 Liddell taskforce

On 9 August 2019, the Commonwealth and NSW Government announced the establishment of a taskforce to consider options to deal with Liddell's closure. The taskforce, led by the Commonwealth Government, will look at all potential impacts of the closure, and options to maintain a similar reliability, price and security outcome in NSW and the broader NEM. In developing policy proposals, the taskforce will have due regard to limiting unnecessary financial exposure of taxpayers.

The taskforce will draw on the expertise of the market bodies and industry stakeholders to produce a final report and recommendations by late 2019.

3.5.4 Demand response

The NSW Government is co-funding with the Australian Renewable Energy Agency (ARENA) a $14 million NSW-specific demand response program. Demand response involves paying an incentive for energy users to reduce their power consumption for short periods when electricity reserves reach critically low levels. This program enhanced NSW energy security for the 2017-18 and 2018-19 summers and will run until November 2020.

The Australian Energy Market Commission has also released a draft determination setting out changes to the National Electricity Rules to implement a wholesale demand response mechanism. If the rule is finalised, the mechanism would allow demand response service providers to participate in the wholesale market as a substitute for generation and be paid for providing this demand response service. The NSW Government supports measures to increase competition in the market that will reduce demand in peak times and is monitoring the progress of this draft rule change.

3.6 Supporting technological innovation

The NSW Government is currently conducting a review of ways of supporting technological innovation and ensuring that customers can take advantage of new products and services. It is also supporting the development of low emissions coal technologies.

3.6.1 Improving digital meter service delivery

The NSW Government is working closely with stakeholders to address regulatory barriers to the rollout and full functionality of digital meters. The NSW Department of Planning, Industry and Environment is currently consulting on the prohibition on remote re-energisation and de-energisation of small customers' electricity supply, with the aim of identifying a pathway to deliver the full functionality of digital meters. The NSW Government is also working to

address other potential delays to digital meter installations, particularly in apartment buildings. This will ensure that customers with digital meters are adequately protected and appropriate safety management measures are in place.

3.6.2 Integrating distributed energy systems

AEMO will launch a register of distributed energy resources, such as rooftop solar and home battery systems, on 1 December 2019. This is a core component of the range of work underway to improve the visibility and integration of distributed energy resources into the grid. The NSW Government is exploring ways to support data collection for this register to ensure that it is as useful and accurate as possible.

3.6.3 Distributed energy technology trials

The NSW Government is contributing $2.7 million to support a three-year technology trial to enable households to get more value from their solar, batteries and other smart technologies through virtual power plant and demand aggregation services.

The technology trial will develop systems and capabilities to allow distribution networks to communicate information about the operating capacities of their network to demand aggregation service providers, so that they know how much electricity they can export into the grid in particular areas.

By providing distribution networks and virtual power plant operators with visibility of the 'amount of traffic' in the grid, the trial can identify where the orchestration of these smart technologies can provide the greatest value.

The technology trial is co-funded with ARENA and will be delivered by Zeppelin Bend Pty Ltd and the Battery Storage and Grid Integration Program at The Australian National University in cooperation with all three NSW network operators: Essential Energy, Endeavour Energy and Ausgrid.

3.6.4 Coal Innovation NSW Fund

The NSW Government's Coal Innovation Fund supports the research, development and demonstration of low emissions coal technologies for future commercial application.

The fund provides competitive grants for research and development projects under strict criteria. It leverages federal, university, and industry funding for joint-research initiatives, which support our transition to a low-emissions electricity industry in NSW.

To date, the fund has invested directly in the NSW Carbon Dioxide (CO2) Storage Assessment Program, 28 research and development projects across three rounds, and many other initiatives related to low emissions coal technologies. Further information about the program is available at https://www.resourcesandgeoscience.nsw.gov.au/investors/coal-innovation-nsw.

3.7 Regional communities

Regional communities are at the centre of securing NSW's energy supply, as the majority of energy and resource production takes place in regional areas. The NSW Government is working to support job opportunities and energy security in regional NSW.

3.7.1 Opportunities for regional economic development through new electricity investment

Much of the new investment in energy infrastructure will take place in regional NSW, and several of the NSW Government programs described above will particularly benefit regional communities:

- The NSW Transmission Infrastructure Strategy prioritises three new renewable energy zones in the South-West, Central-West and New England regions of NSW. These energy zones could provide the bulk of the state's future energy supply, with up to 17,700 MW of new generation projects. They would also support up to 2,000 construction jobs each year to 2040 and inject up to $23 billion in investment into regional NSW.
- The $30 million Regional Community Energy Program aims to improve energy security and help NSW regional communities to save money on electricity bills.
- The $75 million Emerging Energy Program aims to support emerging large-scale dispatchable energy and storage projects, predominately in regional NSW.

3.7.2 Bioenergy

Bioenergy systems can have multiple benefits delivering regional opportunities that increase utilisation of low value and waste resources, increase energy supply security and when appropriately managed, significantly reduce carbon emissions. The ability for bioenergy-based systems to provide distributed heat or power at local, often regional, locations contributes to potential employment opportunities.

The NSW Government is supporting several actions to encourage bioenergy, including:

- Leading the NSW component of the Australian Biomass for Bioenergy project. This program will undertake a comprehensive biomass for bioenergy assessment to uncover new opportunities and make it easier to develop biomass generation and bioenergy projects in Australia. The program is carried out by the Rural Industries Research & Development Corporation (called AgriFutures Australia) with $3 million in funding support from ARENA.
- Investigating opportunities for increased use of biomass for electricity generation under the Primary Industries Climate Change Research Strategy. This includes techno-economic assessments of increased rates of biomass co-firing in coal-fired power stations and hybrid solar/biomass options. The Strategy is made up of seven projects across the three key theme areas to deliver benefits and opportunities to primary producers and regional communities.
- Providing support for ARENA investment in various bioenergy-related projects in NSW focussed on areas including: better utilisation of wood waste; development of 'advanced drop-in fuels' (i.e. fuel from non-edible parts of plants); anaerobic digestion (burning of gas from effluent and organic waste at abattoirs) and knowledge transfer (from the international developments in bioenergy).
- Supporting the development of advanced biofuels, including an investment of $4.6 million funded from the NSW Government's Growing Local Economies fund, which

supports projects of economic significance that will deliver new regional economic opportunities.

4 Conclusion

The NSW Government recognises the opportunities and challenges presented by the transformation underway in energy and resources markets. The NSW Government is continuously monitoring market trends and forecasts, working to understand impacts on customers, communities and the industry, and developing policies and programs to address change.