Pathways to 2050

FY20 TCFD Report

agl

Progress for life

Contents

CEO Statement

'As Australia's largest and oldest integrated electricity generator and retailer, as well as the country's largest carbon emitter, we play a vital role in the country's energy transition.'

From lighting Australia's first gas lamp in 1841 to connecting batteries at people's homes and businesses today, we have always been evolving and investing on behalf of our customers and the broader community.

Today, AGL's electricity generation portfolio is broad and diverse, including some of Australia's largest solar and wind farms, the country's largest non-government owned hydropower fleet and modern fast-start gas power. Predominantly, however, our generation base today comprises coal-fired power stations – Loy Yang A in Victoria and Bayswater and Liddell in New South Wales. These power stations, and the people who run them, remain integral to Australia's energy system and AGL's business.

We also believe Australia's energy future will be affordable and smart – delivered from renewable sources that are backed by flexible energy storage technologies which come together to power our homes, businesses and vehicles. Importantly, it will be low emissions based. We know that customer demand, how communities act and how technology evolves will drive this energy transition, and as Australia's largest and oldest integrated electricity generator and retailer, as well as the country's largest carbon emitter, we play a vital role.

Our Climate Statement released in June 2020 provides us with the framework that will guide our actions and set us on the path to achieving net zero emissions by 2050. The Climate Statement is grounded in our belief that the energy transition will be led by customer demand, how communities act, and how technology evolves. It commits AGL to action in five areas: providing carbon neutral products, participating in carbon markets, investing in new energy supply, responsible transition, and transparency.

Our commitment to reporting in line with the Task Force on Climate-related Financial Disclosures (**TCFD**) framework is integral to that focus on transparency: engaging openly with stakeholders and disclosing our carbon emissions, risks and mitigation activities.

Since 2018 we have used the TCFD framework to report on our governance, strategy, risks and opportunities and performance in relation to climate change. As part of this we are committed to using scenario analysis to regularly update our forecasts in relation to the pace of the climate transition and its impacts on our business.

This year, the TCFD report and climate scenario analysis has allowed us to look closely at the possible impacts of climate change on our business out to 2050, and to expand the analysis further to include a scenario in which the full objectives of the Paris Agreement are met.

With AGL's energy portfolio and 180 years of experience the business continues to work towards ensuring that it understands the long-term future of energy.

AGL will continue to work to ensure that energy will be both affordable and smart, and greenhouse gas emissions will be at net zero by 2050, helping us to tackle climate change.

This is an ongoing journey but I am proud of our progress so far and I am excited about the opportunities that are ahead of us.

Brett Redman
Managing Director & CEO

1. Executive Summary

AGL's use of the Task Force on Climate-related Financial Disclosure (**TCFD**) framework to disclose climate-related risks and opportunities as well as the results of climate scenario modelling reflects our commitment to transparency in our Climate Statement.

Released in June 2020, the Climate Statement underpins the range of activities AGL is undertaking to respond to community, customer and technological drivers, create value and ensure resilience as the energy sector decarbonises.

The Climate Statement builds upon AGL's 2015 Greenhouse Gas Policy, which committed AGL to a range of measures including to not extend the life of our coal-fired power stations.

Subsequently, in 2018 AGL was one of the first companies in Australia to commit to making disclosures in accordance with the TCFD framework.

While disclosure in accordance with the framework is currently voluntary in Australia, there is increasing expectation from investors, governments, and communities for businesses to disclose climate-related risks.

There are a range of recommended disclosures set out by the TCFD guidelines, including the formation and analysis of climate change scenarios.

Through our reporting, AGL is seeking to deepen our assessment of climate and carbon-related risk and of how our strategy considers deep decarbonisation scenarios.

This is intended to allow AGL to better understand the impact of climate scenarios on our business, and the resilience of our strategic response.

In FY20 AGL engaged KPMG and Aurora Energy Research to assist with scenario analysis of potential future carbon reduction pathways to understand the long-term implications for AGL's generation fleet, customers, and the National Electricity Market (**NEM**) more broadly.

The following four scenarios have been modelled:

- Scenario A – National Targets: Current industry commitments and policy settings are maintained over the medium to long-term without material change.
- Scenario B – Response 2020: Policies and technology allow for a steady, market led decarbonisation from 2020.
- Scenario C – Response 2030: Limited action over the short to medium term prior to stronger policy intervention for rapid decarbonisation from 2030.
- Scenario D – 1.5 Degree Limit: Coordinated, cooperative and immediate decarbonisation approach with combined government intervention, policy and market approaches to achieve rapid decarbonisation.

In order to define the scenarios modelled, globally-recognised scenarios were used to inform the development of Australian scenarios and carbon budgets, which were then used as input assumptions to inform electricity sector market models. AGL's scenarios were developed through a top-down approach to facilitate comparability with other international global and national scenario modelling and to ensure that the global context of the impacts of climate change was considered. The globally recognised Intergovernmental Panel on Climate Change (**IPCC**) Representative Concentration Pathways (**RCPs**) and Shared Socioeconomic Pathways (**SSPs**) were used, along with the Australian Energy Market Operator (**AEMO**) 2020 Integrated System Plan (**ISP**) scenarios.

The market modelling undertaken utilising these scenario assumptions applied a carbon constraint to the NEM across scenarios B, C and D to ensure a predetermined carbon budget for each scenario was met. The model used was policy agnostic and therefore the carbon constraint was applied in the model by placing a value on carbon, an effective 'price', at the minimum level to drive the decarbonisation required to meet the budget.

> As anticipated, the modelling shows that under all scenarios significant decarbonisation of the Australian electricity sector will be achieved by 2050, with AGL effectively achieving net zero emissions from electricity generation by 2050 or earlier as we have committed to in our Climate Statement. Further, the 1.5-degree scenario would require earlier closure of AGL Loy Yang as well as other non-AGL assets. Under all scenarios AGL's current business strategy allows us to remain resilient and presents AGL with numerous opportunities for investment and growth. Even when considering the deep decarbonisation required under the 1.5-degree scenario, AGL's assets remain viable because of their low cost of operation and efficiency.

The results of the scenario analysis allow AGL to consider a series of options of what might happen over the next three decades. This in turn provides AGL with the ability to adjust our strategy to ensure continued resilience. AGL's commitment to not extend the life of our coal-fired power stations remains unchanged.

Given the recent drought and bushfire crises in Australia, evolving customer and community expectations may precipitate stronger action on climate change. Accordingly, AGL is ensuring that our business is flexible and resilient to change and will ensure that our TCFD analysis continues to evolve and enables us to update our strategy year on year to allow us to make well informed decisions.

It should be noted that AGL's 2020 modelling was undertaken prior to the COVID-19 pandemic. While AGL notes that there are short-term impacts arising across the NEM, due to the long-term nature of the modelling undertaken for the scenario analysis in this report, AGL believes that over the horizon to 2050, the scenarios used represent plausible characterisations of the future electricity market in Australia. For further detail on the impacts of COVID-19 on the scenario modelling see Section 5.1.2. Any longer-term implications of the pandemic will be factored into AGL's 2021 analysis.

2. Background

AGL is a leading integrated energy business and essential services provider that has been operating for more than 180 years. We operate Australia's largest private electricity generation portfolio, with a total capacity of 11,208 MW, which accounts for approximately 20% of the total generation capacity within Australia's NEM. We are also an active participant in gas and electricity wholesale and retail markets, and are expanding our connection with customers with over 3.95 million customer services, including electricity, gas, broadband and mobile.

As Australia's largest electricity generator, we are also Australia's largest greenhouse gas emitter. Our operated scope 1 emissions account for approximately 8% of Australia's total emissions. Over 95% of AGL's emissions come from the combustion of coal for the generation of electricity for our customers. As the global community responds to the risks of climate change, AGL recognises the large part that we must play in the transition to a low carbon economy. AGL accepts the science as outlined by the IPCC and remains committed to the objectives of the Paris Agreement. AGL also notes that we cannot make or alter energy policy unilaterally.

The IPCC's Fifth Assessment Report (**IPCC-AR5**) (released in 2014) identifies the need for the electricity sector to decarbonise, globally, in order to limit atmospheric concentrations of carbon dioxide equivalent (**CO_2e**) to a level consistent with achieving a 66% chance of limiting warming to 2 degrees Celsius or less above pre-industrial levels.

In 2015, the 21st Conference of Parties to the United Nations Framework Convention on Climate Change (**COP21**) was held in Paris. The parties reached an agreement to address climate change, with the central aim of this agreement being to limit warming this century to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit warming even further to 1.5 degrees Celsius above pre-industrial levels (**Paris Agreement**).

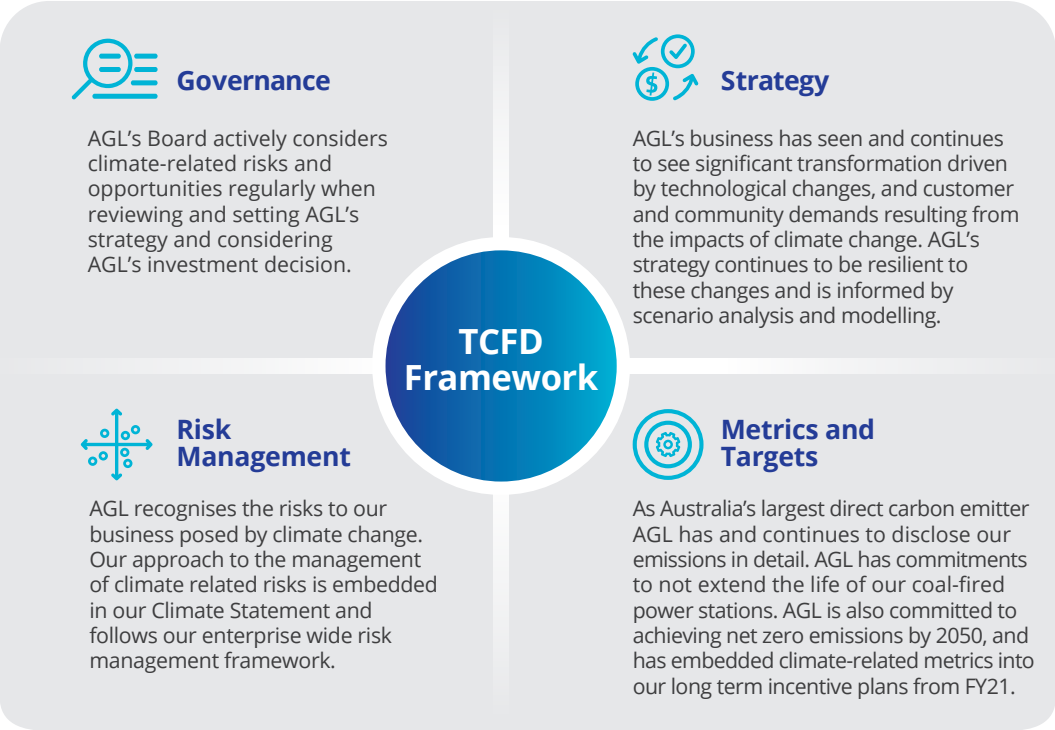
The impacts of climate change, and more broadly, of global responses to climate change, represent material risks and opportunities for AGL. AGL was one of the first companies in Australia to commit to and make its disclosures in accordance with the TCFD framework. While use of the TCFD framework is currently voluntary in Australia, there is an increasing expectation from investors, governments, customers and the community that businesses asses and disclose climate-related risks.

In addition to these expectations, the Australian Securities and Investment Commission (**ASIC**) recognises (through Regulatory Guide RG247 - Effective Disclosure in an Operating and Financial Review) that "*Climate changeis a systemic risk that could have a material impact on the future financial position, performance or prospects of entities.*", and as such, financial disclosures made by listed entities should consider climate as part of the requirement for disclosure of "*risk*[s] *that could affect the entity's achievement of the financial prospects disclosed*."

As a result of these requirements and the ongoing and growing expectations of key stakeholders, AGL is committed to ongoing disclosure of climate risk in accordance with the recommendations of the TCFD framework.

The TCFD framework recommends disclosures in four key areas as shown in Figure 1.

Figure 1: TCFD Framework



2. Background (continued)

As part of the strategy pillar, the TCFD framework recommends the formation and analysis of climate change scenarios to inform how a business is impacted by climate-related risks, and to aid in developing strategies to mitigate this impact. It is additionally recommended that businesses include a scenario which limits warming to 2 degree or less as part of such scenario analysis.

From 2016 onwards, AGL's annual corporate disclosures have incorporated both risk and strategy disclosures. The scenarios and modelling have evolved over time to meet business and stakeholder needs:

- **Carbon Constrained Future report (2016):** This report disclosed the results of modelling a scenario aligned with Australia's Nationally Determined Contribution (**NDC**) under the Paris Agreement, along with a scenario which assumed that emissions were limited to a level consistent with limiting global warming to below 2 degrees Celsius above pre-industrial levels. This report was the first analysis of its kind for an Australian energy company.
- **Powering a Climate Resilient Economy report (2018):** This report detailed AGL's climate-related risks and opportunities, our approach to climate risk management and governance, along with climate-related metrics in alignment with the TCFD recommendations.
- **Carbon Scenario Analysis report (2019):** This report detailed the results of modelling three scenarios aligned with possible electricity policy frameworks:
  - Slow Change Scenario: A slow adaption of the market to carbon constraints
  - State Targets Scenario: A pathway detailing current government policies, and
  - Deep Renewable Scenario: A pathway detailing a 50% renewable energy target by 2030.

Since the release of AGL's 2019 report there has been growing interest from a wide variety of stakeholders to understand more fully how AGL's strategy aligns with different potential climate change scenarios. In AGL's 2019 Annual Report, and at our 2019 Annual General Meeting, we committed to undertake and release the results of modelling a scenario aligned with limiting warming to 1.5 degrees Celsius above pre-industrial levels (Scenario D in this report). The following report outlines the next evolution of AGL's climate change disclosures consistent with these commitments.

3. Governance and Risk Management

3.1 Governance Approach

The AGL Board recognises that strong corporate governance is an integral part of ensuring that the interests of AGL are safeguarded and are fostering sustainable value creation while taking into account the reasonable interests of shareholders, employees, customers, the communities in which AGL operates and other relevant stakeholders.

The Board reviews and approves AGL's strategic direction and provides oversight of management. This includes monitoring AGL's approach to the management of both financial and non-financial risks, such as exposure to environmental risks, safety risks and potential damage to AGL's reputation and the interests of broader stakeholders.

The Board actively considers climate-related risks and opportunities when reviewing and setting AGL's strategy and considering AGL's investment decisions. In April 2015, the Board approved the publication of AGL's Greenhouse Gas Policy, and in April 2020 the AGL Board approved AGL's subsequent Climate Statement.

AGL's Board has established four standing committees of its members: the Audit & Risk Management Committee (**ARMC**); the People & Performance Committee; the Safety, Customer & Corporate Responsibility Committee; and the Nominations Committee.

The committee with the highest level of direct responsibility for climate change is the ARMC, which operates under a formal charter and comprises four non-executive and independent Directors.

The ARMC meets five times per year and its remit includes the responsibility to review and recommend AGL's risk management policies and material strategic risks ('Tier 1 Strategic Risks') to the Board for approval. The ARMC also reviews and monitors the implementation of policies and procedures for identifying, assessing, monitoring and managing risk.

The ARMC also reviews AGL's annual corporate disclosures (including the Annual Report and the climate-related strategies and performance data contained therein). The ARMC has overseen the development of this TCFD report during FY20.

More information about the role of the Board and the ARMC can be found in the **FY20 Corporate Governance Statement**.

As part of AGL's Climate Statement the Board have committed that from FY21 AGL will include carbon transition metrics in AGL's Long Term Incentive Plan (**LTIP**) for its executive key management personnel.

The metrics will include the emissions intensity of AGL's controlled generation fleet, the proportion of controlled renewable and storage electricity capacity, and the share of AGL's total revenue derived from green energy and carbon neutral products and services.

3.2 Risk Management Approach

AGL recognises the risks and opportunities to our business posed by climate change. Our approach to the management of climate-related risks is embedded in our Climate Statement and follows our enterprise wide risk management framework. This risk management framework, which is aligned with the principles and requirements of the international standard for risk management (ISO 31000), is detailed in the FY20 Corporate Governance Statement. Through this framework, we identify factors that are critical to the successful delivery of our strategy and our ability to create value into the future.

AGL's Risk Management Policy, which has been approved by AGL's Board, mandates that management utilise risk management principles in decision-making, and requires all AGL people to consider their functions and roles and how to manage risks arising from their business decisions and activities. AGL's Statement of Risk Appetite, reviewed annually by the ARMC, sets out AGL's risk appetite in relation to strategic, financial, market and operational risks, as well as AGL's risk tolerance (which in turn identifies activities for which AGL has no appetite).

AGL's climate-related risks can be categorised into two main areas: transitional risk and physical risk. Transitional risk is made up of policy and legal risk, technology risk, market risk and reputation risk, while physical risk can be divided into acute and chronic risk. Table 1 outlines AGL's key transitional and physical risks.

Table 1: Summary of climate-related risks

Transitional risk	Physical risk
• Transitional risks include risks in end-of-life asset planning and the rehabilitation of assets. The risk of misalignment of these plans with future scenarios leading to possible stranded assets and revenue loss, and continued policy uncertainty. A further growing transitional risk facing AGL is access to capital from both equity and debt investors.	• Physical risks include increased frequency and severity of extreme weather events resulting in operational disruption, higher average temperatures (causing increases to frequency and magnitude of peak electricity demand and de-rating thermal plant), and precipitation changes impacting upon the efficacy of hydroelectric generation assets.
• Customer response to climate change is a driver of the increasing adoption of decentralised energy services and carbon neutral offers. To mitigate risks posed by changes to the nature of energy demand, we have developed a range of new products and services designed to focus on customers' changing expectations, including developing capabilities to deliver residential battery solutions.	• Operational disruption from severe weather resulting in plant damage or unavailability and associated revenue losses is a risk for which AGL has devised a range of deductive, preventative and corrective management measures.
• Change to peak electricity demand presents risks and opportunities. These changes in demand come from both physical and transitional factors. AGL's battery, hydroelectric and gas peaking assets allow us to rapidly respond to market signals at times of high peak demand. Conversely, as an electricity retailer, we could be exposed to high costs if hedge contracts for supply do not match peakier customer demand.	

3. Governance and Risk Management (continued)

All risks, including climate change risks identified through the AGL risk management framework are ranked in terms of their potential consequence and the likelihood of that consequence occurring, to calculate their inherent risk rating (e.g. extreme, very high, high, moderate, or low).

Any controls, processes, or governance practises in place at AGL that serve to reduce either the likelihood or the severity of consequences (in relation to the above categories) associated with each risk are also assessed, allowing the calculation of the residual risk rating (e.g. extreme, very high, high, moderate, or low).

The appropriateness of the control environment at AGL, and any further actions required, are regularly reviewed and are the subject of monitoring and reporting to AGL management and/or the Board. The determined level of residual risks triggers requirements to notify different levels of management or the Board to the risk – for example, the Board, the ARMC, the relevant Executive General Manager (or delegate), the relevant General Manager (or delegate) or the relevant Manager.

3.2.1 Tier 1 Strategic Risks

AGL undertakes a comprehensive annual process to assess the key risks to achieving our strategic priorities. These are defined as Tier 1 Strategic Risks. To determine the Tier 1 Strategic Risks, an extensive consultation process across each division of AGL is undertaken involving key senior management representatives and operational managers to gain an understanding of strategic risks relevant to each area of business. Risks are assessed through the lens of AGL's strategic priorities of Growth, Transformation and Social Licence.

Tier 1 Strategic Risks undergo a full review annually; material and emerging risks are identified, monitored, and reviewed regularly and proactively, with reporting to the ARMC and Executive Team quarterly. During FY20 there were 11 Tier 1 Strategic Risks under management.

One of the Tier 1 Strategic Risks identified for FY20 was 'Climate change: AGL is unable to meet expectations and/or deliver on its commitments to transition to a low carbon future within an acceptable timeframe'. Climate change has a broad impact on AGL and as such there are climate-related impacts associated with a number of AGL's Tier 1 Strategic Risks, as summarised in Table 2.

Table 2: Relationship between Tier 1 Strategic Risks and climate change

Tier 1 strategic risk	Climate change link	TCFD risk type
Market disruption: AGL does not (or cannot) adequately or appropriately respond to changing customer expectations and preferences regarding energy sources, prices and related products and services.	Climate change may increase customer demand for renewable energy, rooftop solar and behind-the-meter batteries. **Mitigation:** AGL will offer carbon neutral products and continue to develop innovative behind the meter products for customers.	Transitional – technology risk
Government intervention: AGL is not able to effectively anticipate, plan or respond to an increasing uncertainty regarding government policy.	Governments may intervene in energy markets to limit the impact of climate change through a carbon constraint or other policy. **Mitigation:** AGL continues to engage productively and transparently with all levels of government on energy and climate policy.	Transitional – policy and legal risk
Regulatory intervention: AGL is not able to effectively anticipate or plan for regulatory intervention, or added restrictions and diversion of resource puts wider business objectives at risk.	Possibility of increased regulatory compliance obligations and limitations on greenhouse gas emissions. **Mitigation:** AGL continues to engage productively and transparently with all regulatory bodies on energy and climate policy and regulations.	Transitional – policy and legal risk
Climate change: AGL is unable to meet expectations and/or deliver on its commitments to transition to a low carbon future within an acceptable timeframe.	Inherent climate change risk. **Mitigation:** AGL's 2020 Climate Statement commits the business to continue to work towards a goal of net zero emissions by 2050.	Transitional – reputation risk Transitional – market risk
Investment decisions: AGL's major investment decisions do not deliver on their intended benefits or outcomes for shareholders, customers and the community.	Climate change may alter NEM demand profile. **Mitigation:** AGL continues to monitor and assess the requirements of the NEM and make appropriate investment decisions.	Transitional – technology risk
Stakeholder trust: AGL's strategy to deliver on its social licence to all stakeholders is unclear, inconsistent, and/or poorly executed.	AGL's position on climate change is a component of how all stakeholders including customers perceive AGL. **Mitigation:** AGL continues to engage with stakeholders on climate change in a transparent manner. Transparency is one of the central tenets of AGL's Climate Statement.	Transitional – reputation risk
Customer privacy: AGL does not obtain, handle, process and store customer data in an appropriate, compliant, transparent or secure manner.	N/A	N/A
Organisational culture: AGL is unable to foster a resilient and agile organisational culture that is built on strong and ethical behaviours, talented people, a focus on safety, and a customer-centric mindset.	AGL's culture is based upon our values and climate change is a material component of the ethical nature of our business. **Mitigation:** AGL continues to engage with our people on climate change.	Transitional – reputation risk

3. Governance and Risk Management (continued)

Tier 1 strategic risk	Climate change link	TCFD risk type
Resilience of generation: AGL is unable to generate and maintain a resilient energy supply.	The physical impacts of climate change may affect the operations of AGL's generation facilities. **Mitigation:** AGL is undertaking analysis of the main physical impacts of climate change on our business to ensure reliability of our generation assets.	Physical risk
Wholesale market pricing and volatility: AGL is unable to effectively mitigate the volatility of the wholesale market.	The rapid transition towards renewable energy in order to reduce carbon emissions may lead to wholesale market volatility. **Mitigation:** AGL continues to invest in storage and firming capacity to ensure limited volatility in the wholesale market.	Transitional – market risk Physical risk
Access to gas: AGL is unable to source sufficient quantities of gas to meet its future demand.	Climate change may lead to increased gas demand in the short term as a transition fuel. **Mitigation:** AGL continues to explore opportunities to secure gas supply in Australia including through the potential import of liquified natural gas.	Transitional – market risk
Cybersecurity: AGL's critical systems, platforms and technology infrastructure are compromised by a cyber event.	N/A	N/A
COVID-19 operational response	N/A	N/A

During FY20, as part of the annual review, climate change was confirmed as a continuing Tier 1 Strategic Risk and will continue to be monitored and actively managed during FY21.

In addition to the Tier 1 Strategic Risk process, AGL identifies and reviews its characterisation of climate change risks and opportunities in response to government policy and legislation/regulation, energy market conditions, public sentiment and information concerning the physical impacts of climate change on AGL's assets and the energy supply chain, as well as when AGL is making acquisitions and divestments. Opportunities and risks are assessed at the asset and portfolio level, with related demand and price scenarios modelled and built into earnings forecasts.

3.2.2 Physical Impacts

The analysis of physical risks, including both long-term chronic physical impacts such as temperature increases, and acute physical impacts such as storms or bushfires, has been addressed through qualitative consideration in the scenario narratives. In this respect the electricity sector modelling performed has not considered physical impacts on AGL or NEM assets or indirect impacts of physical risk on overall demand beyond what has been considered in the AEOM 2020 Draft ISP modelling.

It is anticipated that electricity sector modelling derived from the work currently being undertaken jointly by AEMO, the Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation will assist with market modelling in future scenario analysis. This joint work is intended to improve climate and extreme weather information for the electricity sector in order to improve long-term operational and strategic planning for electricity infrastructure.

AGL is resilient to direct physical risks in part through our geographically distributed electricity generation portfolio allowing for AGL to mitigate the impact of location specific acute impacts. In addition, AGL's significant water rights and supply security allows for certainty even in extensive drought conditions.

Our generation fleet is technologically diverse, which provides increased resilience to the impact of temperature increases on thermal generation efficiency. AGL anticipates that as our thermal plant capacity decreases under all scenarios our portfolio growth will be in various renewable and storage technologies thus reducing the impacts of lowered thermal efficiencies.

The long-term material physical risks AGL faces under the scenarios increase in severity as the temperature outcomes increase. As a result, the scenario under which the greatest physical impacts would occur is Scenario A.

In the first decade under Scenario A climate impacts may increase the frequency of acute impacts (e.g. from increased bushfires), increasing the risk of disruption to transmission infrastructure in the NEM, and indirectly impacting the ability of AGL to export electricity into the wholesale market and supply electricity to customers.

In the decade to 2040 it is anticipated that, under Scenario A, droughts may become more severe and last longer across the country, leading to access to water for large thermal generators emerging as a potential risk, in terms of reputation and availability.

The final decade under Scenario A may see severe weather events such as extreme droughts become more frequent as well as material average temperature increases. These changes may lead to lowered efficiency for thermal generators and increased transmission outages.

In the near term a key physical risk for AGL is water security at our thermal generation assets. AGL maintains significant water rights at our coal fired power stations which are required for the ongoing operation of those assets.

At AGL Loy Yang it is not anticipated there will be an issue with water supply, however there remains a water security risk. This risk is mitigated through two key elements.

3. Governance and Risk Management (continued)

1. AGL Loy Yang has significant bulk water entitlements which ensures the reliability and resilience of the facility to water stress.
2. Mitigation strategies such as the increasing of cycles of concentration of cooling towers can be implemented when required to reduce water requirements at the site.

AGL Macquarie is in an area which is at risk of drought, however AGL modelling has calculated a 99% chance that there will be no affect to generation from water supply due to drought over the next five years even in the worst-case scenario.

AGL Macquarie has some of the most secure water in the Hunter Valley. Under the Hunter Valley water sharing plan, the major utility licences have the highest security. This security level is shared with basic stock and land holder rights, major utility (town domestic supply), and environmental water.

AGL Macquarie is working with WaterNSW to add to its model of the Hunter River regulated system to improve and provide greater clarity of our operation and operational impact on the system.

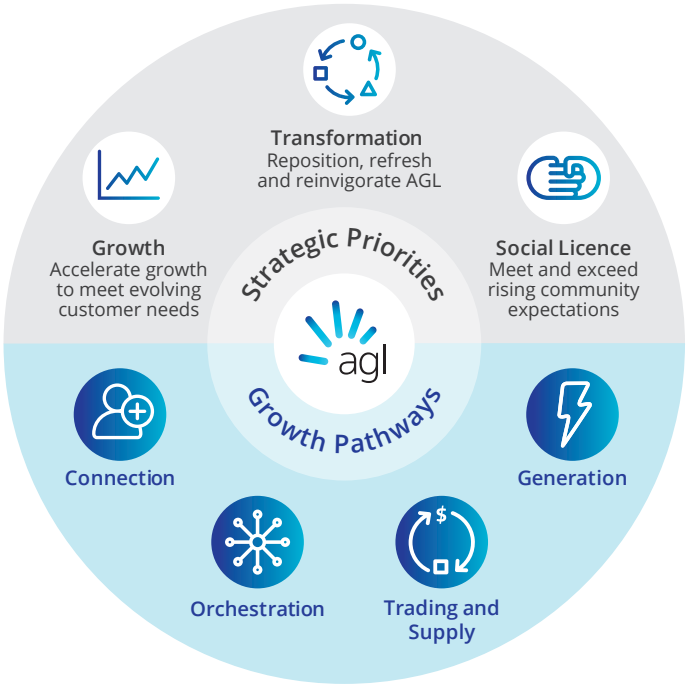
There are a number of other specific physical risks which arise under each scenario and these are discussed in further detail in Section 7.

4. Strategy

4.1 AGL's Strategic Priorities

As shown in Figure 2, AGL has three strategic priorities: Growth, Transformation and Social Licence. To deliver on the priorities of Growth, AGL is focused on exploring four key growth pathways.

Figure 2: Strategic priorities



4.2 Policies and Commitments

AGL's business has seen and continues to see significant transformation driven by technological evolution as well as customer and community demands resulting from the impacts of, and response to, climate change. AGL's response to climate change is a key focus which underpins the range of activities AGL is undertaking to operate and create value within a low carbon future.

As we work towards the closure of our coal-fired power plants and the Australian economy transitions toward full decarbonisation by 2050, we have expanded our climate commitments. AGL's Climate Statement, released in June 2020, builds upon AGL's Greenhouse Gas Policy (2015), and reaffirms AGL's acceptance of the climate science and our commitment to pursue the goal of having net zero emissions by 2050. AGL believes that by 2050 Australia has the opportunity to be carbon neutral and an energy superpower and recognises that the pace and path of the transition to this low-carbon economy will be driven by three major forces: customer demand, how communities act, and how technology evolves.

In addition to the goal of having net zero emissions by 2050, the **2020 Climate Statement** commits AGL to the following five actions:

1. **Offer customers the option of carbon neutral prices across all our products.** Our customers' demand for carbon neutral products is a significant force for accelerating the decarbonisation of the energy system. We will seek to match this with viable carbon-neutral supply options for households, business and wholesale customers.
2. **Support the evolution of Australia's voluntary carbon markets.** We will seek to supply tradeable products to underpin delivery of the carbon neutral services our customers require. This will include certifiable investments in carbon reduction in our own operations, complemented with enhanced trading capability.
3. **Continue investing in new sources of electricity supply.** Both through direct investment and offtake agreements, we will use our balance sheet to support the development of the new renewable energy sources and flexible generation capacity the market needs to support greater penetration of intermittent renewable energy.
4. **Responsibly transition our energy portfolio.** While transitioning our energy portfolio, we will continue to run our coal-fired power stations responsibly and safely to supply affordable and reliable electricity, and we will continue supplying gas to our customers. We will support our people and local communities through change and remain flexible to how customers, community and technology shape the pace of the energy transition.
5. **Be transparent.** We will engage openly with stakeholders and be transparent in disclosing our carbon emissions, risks and mitigation activities as we deliver upon the transition. Using scenario analysis, we will regularly update our forecasts for the pace and impacts on our business of this transition.

4. Strategy (continued)

The AGL Climate Statement focuses on our commitments to our customers and the communities in which we operate as well as technological drivers, and as such the analysis of risks and opportunities associated with each of the scenarios which we have modelled have been framed in this context (Section 7).

4.3 Actions in Response to Climate Change

AGL has heavily invested and continues to invest in renewable energy generation. In the past decade AGL has increased its renewable energy generation fourfold to over 4.4 TWh. This includes launching in 2016, the Powering Australia Renewables Fund to invest in approximately 1,000 MW of utility-scale renewable projects. Figure 3 shows how AGL's investment in wind and solar in particular has contributed to the growth in our operated renewable generation portfolio. The dip in FY17 is associated with weather patterns producing variations in wind patterns and water availability which affected the assets' generation capacity factors.

Figure 3: AGL-operated renewable energy generation output by source

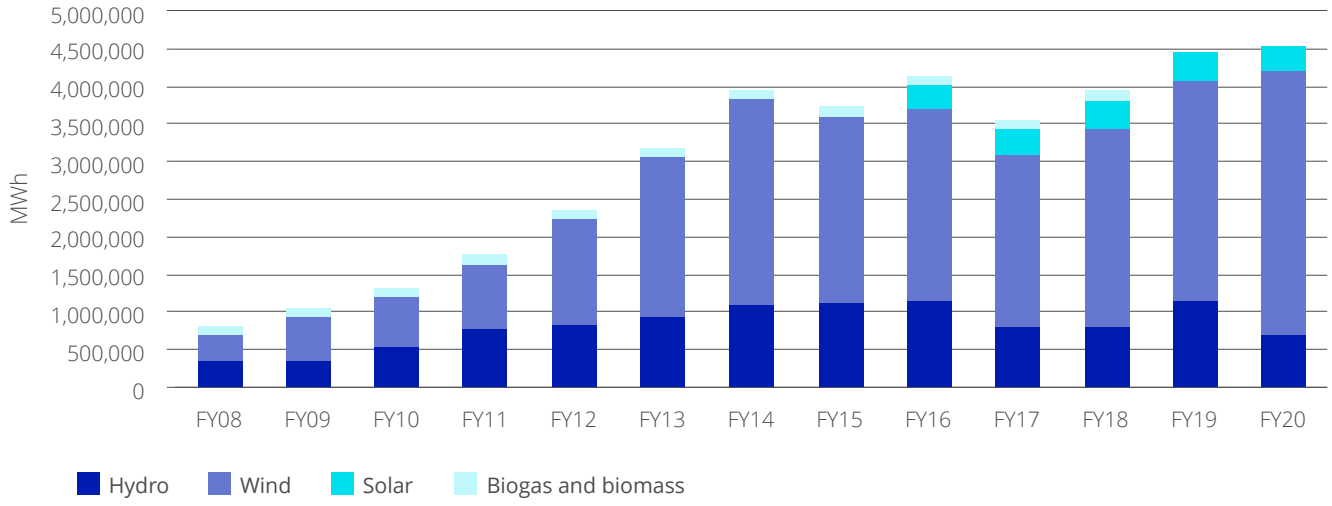
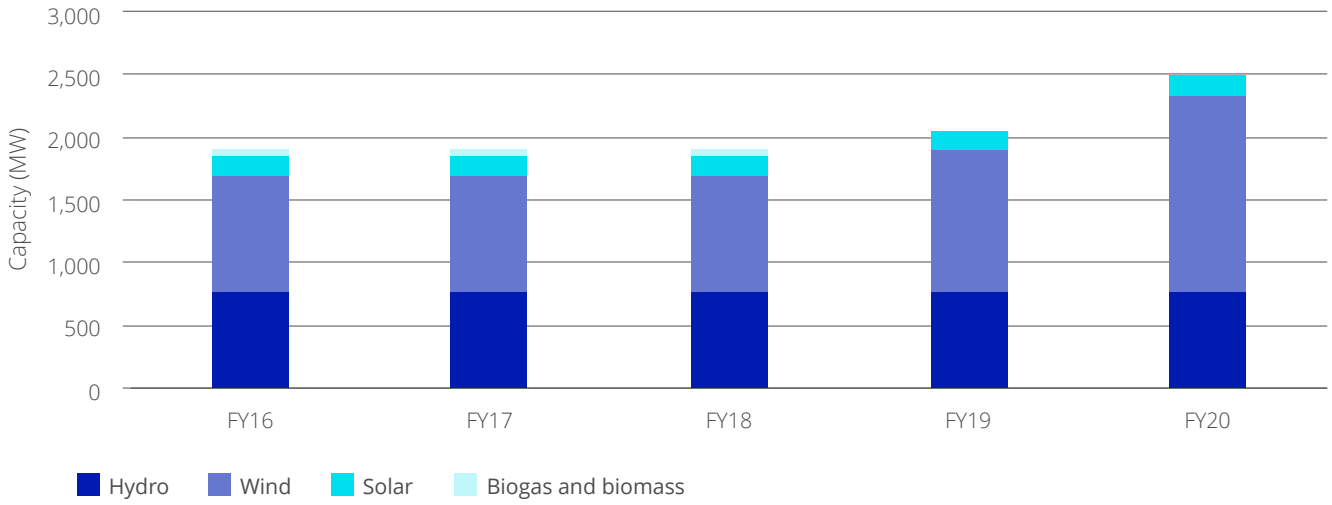


Figure 4 outlines the capacity of renewable energy generators which AGL operates. As AGL continues to invest in renewable energy generation, this will continue to increase.

Figure 4: AGL-operated renewable energy capacity



In addition to the development of renewable assets, AGL has been developing clean firming capacity in the form of utility-scale batteries to ensure grid stability and mitigate risks associated with greater penetration of renewables in the NEM. In FY19 AGL contracted to operate the 30 MW Dalrymple Battery in South Australia. Further, in FY20 AGL signed a 15-year offtake agreement with the 100 MW Wandoan Battery in Queensland to commence in July 2021, in addition to a derivative agreement with the Maoneng Battery in New South Wales. AGL also has potential utility-scale battery development opportunities in our development pipeline including at the Liddell Power Station site.

4. Strategy (continued)

Further key examples of the steps which AGL has taken and is continuing to take in relation to climate-related risks and opportunities are summarised in Table 3.

Table 3: AGL actions

Actions taken
Enhanced climate disclosure: A key step for AGL and our stakeholders to better understand the risks and opportunities of climate change has been to undertake enhanced climate disclosures as outlined in this report.
Energy transition: AGL is conducting ongoing consultation with our key stakeholders, including our workforce, industry groups, local communities and government bodies regarding options for the Liddell Power Station site once it closes. AGL has committed that there will be no forced redundancies associated with the closure of the Liddell Power Station.
Financing: AGL closed its first Sustainability Linked Loan (**SLL**) in September 2019, becoming only the fourth company in Australia to issue a SLL and the first energy company to issue a SLL in the Asia Pacific region. Issuing this SLL demonstrates AGL's commitment to managing the risks that the long-term transition of the energy sector away from high carbon emissions places on AGL's lenders, investors and the economy at large.
Industry association membership: AGL is an active advocate for constructive energy and climate policy within industry associations of which it is a member and undertakes regular reviews of the policy positions of these groups. AGL does not take the view that we should only be a member of associations that agree with us on climate policy, however where there are material differences, we disclose the nature of these differences and ensure continued, constructive dialogue occurs. As part of AGL's broad engagement with advocacy and activist groups, our governance approach to our participation in these bodies is outlined in our FY20 Annual Report **ESG data centre**.
AGL carbon neutral products: As part of AGL's Climate Statement, AGL has committed to offer customers the option of carbon neutral prices across all our products. The first step in this offering is AGL's carbon neutral electricity product in which, for $1 a week for a residential customer and $4 a week for a business customer, all emissions associated with the electricity consumed by the customer is offset. The product is certified by Climate Active and supports projects that genuinely reduce emissions.
Behind-the-meter batteries: In 2016 AGL launched its virtual power plant (VPP) initially installing 1,000 residential batteries into South Australian solar households and connecting them to operate as a 5 MW solar peaking plant feeding energy and frequency services into the grid. After its initial success the program was expanded in July 2019 to allow for customers in Victoria, South Australia, New South Wales and Queensland who already have compatible batteries installed to enter the Virtual Power Plant program.
Rooftop solar: AGL offers a series of behind-the-meter solar rooftop products ranging from large-scale commercial design and installation for business customers to competitive feed-in tariffs for residential customers bringing their own panels. AGL also offers innovative products such as AGL Offsite Solar which allows residential customer without the ability to install panels on their roofs to benefit from savings in the form of solar generation credits.
Energy storage: In FY19 AGL contracted to operate the 30 MW Dalrymple Battery in South Australia. Further, in FY20 AGL signed a 15-year offtake agreement with the 100 MW Wandoan Battery in Queensland to commence in July 2021, in addition to a derivative agreement with the Maoneng Battery in New South Wales. AGL also has potential utility-scale battery development opportunities in our development pipeline including at the Liddell Power Station site. Additionally, in July 2019 AGL signed an agreement to undertake an engineering feasibility study for AGL's proposed 250 MW pumped hydro project at Bells Mountain, near Muswellbrook in New South Wales. The proposed project has the potential to create jobs and provide an efficient source of electrical energy to the Hunter region.
Utility-scale solar: AGL developed and operates under the Powering Australian Renewables Fund the 53 MW Broken Hill and 102 MW Nyngan solar plants, and has entered into a solar offtake agreement with Maoneng to procure up to 300 MW of solar energy from generators including the Sunraysia Solar Farm in Balranald, New South Wales.
Wind: AGL completed construction of the 440 MW Coopers Gap Wind Farm project located approximately 250 km west of Brisbane in FY20 with first generation in August 2019. This project was completed as part of the Powering Australian Renewables Fund. In addition AGL operates wind farms across New South Wales, Victoria and South Australia. Including the Coopers Gap Wind Farm, AGL operates a total of 1,562 MW of wind generation assets.
Peaking plants: In FY20 AGL completed the construction of the 210 MW Barker Inlet Power Station in South Australia. This gas fired power station is comprised of 12 reciprocating engines which can respond quickly to reduced supply from other sources or spikes in demand with lower emissions than baseload power stations. AGL is also actively considering the feasibility of a gas peaking power station in Newcastle, New South Wales.
Demand response: AGL is leading demand response programs to assist with taking pressure off the grid in high demand situations. The Peak Energy Rewards program was originally trialled in New South Wales across 8,000 customers, and was supported by the state government, ARENA and AEMO. The program allows participating customers to voluntarily reduce their energy demand during peak events for a set financial incentive. The success of this program means it will be rolled out across other states in the NEM and up to 1 million customers will be able to access it by summer 2020/21.
Energy efficiency: AGL is investing in upgrades at our Bayswater and Loy Yang A power stations that will improve reliability, flexibility and increase generation capacity but not bring about any increase in carbon emissions.

5. Scenario Analysis: Approach

AGL has developed four scenarios to represent potential future carbon reduction pathways and modelled these to better understand the long-term implications for AGL's generation fleet, customers, and the National Electricity Market more broadly.

Scenario A – National Targets	**Scenario C –** Response 2030
Scenario B – Response 2020	**Scenario D –** 1.5 Degree Limit

The following sections summarise the approach that was taken to determine scenarios and undertake market modelling, and provide specific details, assumptions and limitations associated with each scenario.

5.1 Formulating Climate Scenarios

AGL developed scenarios through a top-down approach to facilitate comparability with other international global and national scenario modelling and to ensure that the global context of the impacts of climate change was taken into account.

The scenarios were developed to be consistent with the scenario development principles outlined in the TCFD framework. Table 4 summaries how the approach taken meets five key principles.

Table 4: Principles used for scenario development

Principle	Application
Plausible	Each scenario has been developed using a range of credible global and domestic sources. The domestic scenarios and modelling rely strongly on scenarios developed by AEMO, as an independent and verifiable source of information. Each scenario utilises relevant and recent data and approaches to describe outcomes assessed as plausible in current global and domestic environments.
Distinctive	The scenarios were developed to test a range of possible, and distinct, future outcomes and trajectories. This is designed to enable an understanding of the specific challenges associated with each trajectory and how these challenges differ between trajectories.
Consistent	The scenarios have been developed using a consistent set of inputs including globally developed Relative Concentration Pathways and Shared Socioeconomic Pathways narratives, aligned with domestic electricity sector input assumptions sourced from Aurora and AEMO. The narratives also internally align with the modelling conducted on each scenario in terms of described trends and results.
Relevant	The scenarios specifically address current challenges and issues being considered by the energy industry and broader economy in Australia. Each scenario provides insight associated with a different rate and/or timing of decarbonisation to facilitate broader consideration by AGL.
Challenging	Each scenario requires different aspects of the scenario to be the material or leading factor in the decarbonisation. Each scenario facilitates insight as to the challenges that would be faced by the organisation and sector as a whole under such circumstance.

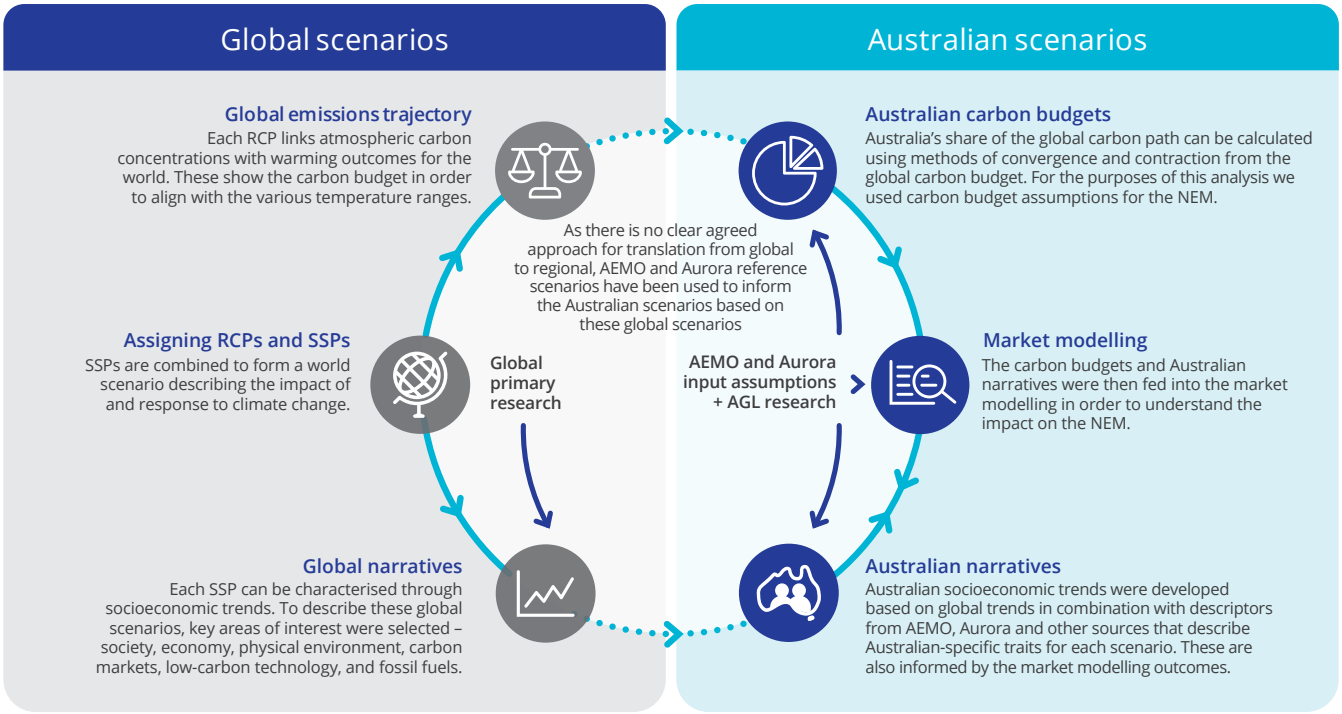
In the development of scenario analyses where there are a significant number of assumptions to be made it is particularly important to remain as objective as possible. To ensure these scenarios provided robust and objective results AGL engaged KPMG and Aurora Energy Research to assist with the scenario development and analysis process. The engagement of the external consultants has allowed AGL to ensure that robust scenarios were developed and that the scenarios represented external expert views in collaboration with AGL rather than being solely reliant on internal AGL positions. KPMG and Aurora are both experts in their respective fields, and this work will allow AGL to build upon these scenarios in the future while maintaining their objective and expert nature.

AGL worked with KPMG to collaboratively develop global scenarios, considering global socioeconomic trends at a sector level. Detailed Australian scenarios were then developed, including electricity sector carbon budgets.

In order to define the scenarios to be modelled, globally recognised scenarios were used to inform the development of Australian scenarios and carbon budgets, which were then used as input assumptions to inform electricity sector market models. Figure 5, shows these interactions.

5. Scenario Analysis: Approach (continued)

Figure 5: Scenario development process



5.1.1 Global Context

The IPCC is the United Nations body created to provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward adaptation and mitigation options. The IPCC publishes assessments through comprehensive Assessment Reports (**AR**), which cover modelling results and outcomes for a range of climate change scenarios.

AR5 is the most recently published set of scenarios (2014). AR5 defines RCPs for each scenario (refer to Table 5). RCPs are concentration pathways for greenhouse gases and aerosols, demonstrating possible future emissions and radiative forcing (i.e. temperature intensity) scenarios for the world until 2100.

Table 5: Representative Concentration Pathways (AR5)

Pathway[1]	Description
RCP8.5	Highest-emission scenario, where there are limited efforts to reduce emissions, which continue to rise throughout the 21st century. This RCP has an associated temperature increase of between 3.2 and 5.4 degrees Celsius above pre-industrial levels by 2100.
RCP6.0	Pathway stabilises total radiative forcing post 2100 by implementing wide range of technologies and strategies for reducing emissions. This RCP has an associated temperature increase of between 2 and 3.7 degrees Celsius above pre-industrial levels by 2100.
RCP4.5	Low-emission pathway in which total radiative forcing is stabilised shortly after 2100. This RCP has an associated temperature increase of between 1.7 and 3.2 degrees Celsius above pre-industrial levels by 2100.
RCP2.6	Ambitious pathway which assumes that global annual emissions peak and decline early, due to active removal of CO_2, requiring early participation by all players. This RCP has an associated temperature increase of between 0.9 and 2.3 degrees Celsius above pre-industrial levels by 2100.

1. Each RCP represents one of many scenarios which may result in a given radiative forcing and emissions profile. Each RCP corresponds to a likely temperature outcome range, indicating the assessed increase in temperature above pre-industrial levels by 2100. The RCPs are denoted by numbers which refer to the radiative forcing that the pathways cause in watts per metre squared (W/m^2) by 2100.

RCPs are widely used in modelling to understand physical impacts of climate change such as temperature increase, impact on ecosystems, carbon concentration, and sea level rise over time. Due to 'locked in warming' from historic emissions there is little significant deviation between the physical impacts of each RCP scenario until 2040.

Following the release of the RCPs through AR5, a set of SSPs were developed and published by the IPCC in 2017, which describe how socioeconomic trends around the world may evolve over time (Table 6). RCPs and SSPs can be used together to design and analyse various climate scenarios for the world.

5. Scenario Analysis: Approach (continued)

Table 6: Shared Socioeconomic Pathways

Pathway	Description
SSP1	**Sustainability – Taking the Green Road** The world shifts gradually, but pervasively, toward a sustainable path.
SSP2	**Middle of the Road** The world follows a path where social, economic, and technological trends do not shift considerably from historical patterns.
SSP3	**Regional Rivalry – A Rocky Road** A nationalist environment with concerns about competitiveness and security, leading to regional conflicts.
SSP4	**Inequality – A Road Divided** Highly unequal investments in human capital, increasing disparities in economic opportunity and political power.
SSP5	**Fossil fuelled development – Taking the Highway** This world places increasing reliance on fossil fuels to drive rapid progress in the economy.

The narratives for the SSPs were developed using large expert teams that aligned with assumptions on socioeconomic drivers and published in 2017[1]. Mitigation is not considered in each SSP, and each scenario describes a "business as usual" pathway with no climate policy. This allows them to be combined with RCPs to form mitigation scenarios for the world.

Mitigation scenarios are developed through combining SSPs and RCPs to form a view on how socioeconomic drivers can result in various emissions pathways. RCPs and SSPs are not mutually exclusive, and some combinations are less probable than others in climate models.

AR6 is currently being developed by the IPCC. While initial modelled results for new scenarios have been created, the narratives have not been fully developed pending publication in 2021/22. It is understood that the RCPs developed in AR5 can be mapped to the scenarios that will be included in AR6. Given the time difference between AR5 and AR6, the same RCP designation will result in a higher temperature range for warming. Since AR6 is still under development, AR5 is still widely used for reference. Consistent with this, AGL is using the AR5 RCPs for this analysis.

In addition to the IPCC scenarios discussed, AGL also considered the Inevitable Policy Response (**IPR**) scenario developed by the United Nations Principles for Responsible Investment (**PRI**). The IPR outlines a scenario in which the default assumption is that governments take no further climate-related action in the near-term, and their current commitments remain insufficient to meet the objectives of the Paris Agreement. The IPR assumes that as the realities of climate change become increasingly apparent, it is inevitable that governments will be forced to act more decisively than they have so far, leading to the need to decarbonise more rapidly.

While not using the PRI-developed IPR scenario, AGL has used a similar principle aligned with appropriate RCPs and SSPs to develop the pathway outlined in Scenario C (i.e. initially no change followed by a more rapid change from 2030). Using the RCPs and SSPs rather than the PRI-developed IPR scenario allows all AGL scenarios to be comparable to existing independent scenarios utilised in the Australian context.

1. O'Neill et. al., The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century (2017).

5. Scenario Analysis: Approach (continued)

5.1.2 Socioeconomic Trends

AGL determined six key socioeconomic areas of interest. Across these key areas, the resulting trends for each scenario have been derived from the SSPs and mapped in Figure 6. This map highlights the differences and similarities between each scenario through to 2050 in qualitative terms.

Figure 6: Key differences between each scenario in relation to key socioeconomic metrics by 2050

Sector	Selected scenario metrics	Scenario A	Scenario B	Scenario C	Scenario D
Society	• Changing rate of population growth (Global)	↘	↘	↘	→
	• Rooftop solar uptake (NEM)	↗	↗	↗	↗
	• Behind-the-meter battery storage uptake (NEM)	↗	↗	↗	↗
	• Electric vehicle uptake (NEM)	↗	↗	↗	↗
Economy	• Changing rate of GDP growth (Global)	↘	↘	↘	→
	• Wholesale electricity prices (NEM)	↗	–	↗	↗
	• Electricity demand growth (NEM)	↗	↗	↗	↗
Physical environment	• Likelihood of hot weather days (Global)	↗	↗	↗	↗
	• Changes in weather patterns (Global)	↗	↗	↗	↗
	• Greenhouse gas emissions (NEM)	↘	↘	↘	↘
Carbon markets	• Carbon constraints on electricity sector (NEM)	–	↗	↗	↗
Low-carbon technology	• Renewables in system (NEM)	↗	↗	↗	↗
	• Fossil fuels in system (NEM)	→	↘	→	↘
Fossil Fuels	• Commodity prices for coal and gas (Global)	–	↘	↘	↘
	• Early closure for generators (NEM)	–	↗	↗	↗

Key ↗ Strong growth ↗ Moderate growth – Stable → Moderate decline ↘ Strong decline

IMPACT OF COVID-19 ON SCENARIO MODELLING OUTCOMES

The scenario analysis described in this report was materially completed prior to the COVID-19 pandemic. In light of the COVID-19 pandemic, AGL, with the assistance of KPMG and Aurora, has considered at a high level the potential impacts that the pandemic may have on the climate scenario analysis.

In the Australian electricity market, we have seen the following impacts as a result of the COVID-19 pandemic, including:

1. Lowered demand for electricity and an adjusting profile for demand due to changing economic conditions in Australia. AGL estimates this to be an approximate 5% decrease in NEM-wide demand in the short-term. This accounts for year-on-year weather variations, and is largely due to economic slowdown.
2. Potential delays to renewable energy projects. Aurora's view is that COVID-19 (when combined with a range of other factors such as grid connection delays and volatile currency) will trigger delays to renewable projects.
3. Oil and gas price reductions in the short to medium-term. While gas prices have fallen sharply, it is assumed that commodity prices will gradually recover to the previous long-term view captured in the TCFD modelling.
4. Increased interest in behind-the-meter technologies such as solar PV and battery storage. While this impact has not been modelled, anecdotal and market evidence has shown there has been increased uptake of consumer technologies given the increased value proposition from higher household energy consumption.

5. Scenario Analysis: Approach (continued)

IMPACT OF COVID-19 ON SCENARIO MODELLING OUTCOMES

While we note that these and other short-term impacts are beginning to arise across the NEM and may have a material impact upon energy market participants, it is too early to be able to assess whether the COVID-19 pandemic will result in any material shift to long-term energy market trends. Broadly, we are currently expecting a return to long-term assumptions over the next 18 to 24 months.

At its core, TCFD reporting is intended to characterise a plausible pathway of the future, in order to inform how a business may perform under various future states. It is not intended to be a forecast, prediction, or sensitivity analysis. For there to be sufficient justification to alter the scenario analysis, the scenarios would need to be rendered implausible over the long-term in light of the pandemic, with evidence of a fundamental shift to socioeconomic trends that persists out to 2050.

As such, we believe that over the long-term horizon to 2050, the scenarios used still represent plausible characterisations of the future electricity market in Australia.

5.1.3 Australian Context

There are a range of publications which include climate transition scenarios for Australia. For the electricity sector, AEMO is considered to provide the most comprehensive reporting on scenarios.

AEMO's 2020 ISP[1], published annually, outlines several scenarios (Table 7) for the development of the electricity sector in Australia. The ISP relies on IPCC data as inputs into the modelling, and the published scenarios align with RCPs and associated levels of warming. RCPs are translated into electricity sector carbon budgets by AEMO using the following methodology:

1. Global emissions trajectories are established based on RCP mapping and are translated into Australian trajectories using methods from literature.[2]
2. The Australian trajectory is adjusted to align with scenario descriptors around the electricity sector's contribution (leading, parallel, lagging) to global emissions reduction.
3. Electrification of other sectors (transport, gas) is assumed to be delivered through "zero-emissions" supply.
4. Trajectories are converted into a cumulative budget.

Table 7: AEMO ISP scenarios

Pathway	Description	Relevant RCP[1]
Slow Change	Scaled back ambition with challenging economic conditions well into the future	RCP8.5
Central	Based on current government policies and key trends, with a transition to renewables led by market forces	RCP7.0
Fast Change	Reduced international barriers, technological improvements, and digitalisation and electrification for consumers	RCP4.5
High DER[2]	Highly digital world with increased adoption of small-scale generation and storage, automation, and consumer control	RCP7.0
Step Change	Climate change risks urgently addressed with domestic and international action, and strong collaboration to meet goals	RCP2.6 and RCP1.9

1. AEMO makes use of IPCC AR5 RCPs, as well as RCP7.0 and RCP1.9 which are sourced from AR6.
2. DER stands for Distributed Energy Resources

Each scenario (aside from the Central scenario) has a designated carbon budget. It is understood that carbon budgets were developed by AEMO based on global RCPs which were subsequently transformed into budgets for the Australia electricity sector based on assumptions around Australia's fair share of global emissions, and the electricity sector's role in the economy.

Given the direct link between AEMO's ISP scenarios and global RCPs, AGL has developed its scenarios to align with the ISP scenarios, enabling modelling of the impact to the NEM arising from meeting various RCPs.

1. AEMO, Draft Integrated System Plan 2020 (2019).
2. Including the Climate Change Authority (2016) and the Garnaut Review (2008).

5. Scenario Analysis: Approach (continued)

5.2 AGL Scenarios

The four scenarios which have been modelled to 2050 are summarised in Table 8.

Table 8: AGL scenarios

Scenario	Description	Decarbonisation pace		Temperature outcome (degrees Celsius warming above pre-Industrial levels)
		Australia v. rest of world	Energy industry v. rest of economy	
Scenario A – National Targets	Current industry commitments and policy settings are maintained over the medium to long-term without material change. This scenario assumes Australia meets its Paris commitments of reducing emissions by 26 to 28% of 2005 levels by 2030.	Not assessed	Not assessed	Not assessed
Scenario B – Response 2020	Policies and technology allow for a steady, market-led decarbonisation.	Parallel	Leading	1.7 – 3.2
Scenario C – Response 2030	Delayed action over the short to medium- term prior to reactionary policy intervention for rapid decarbonisation from 2030.	Parallel then leading post 2030	Leading	1.7 – 3.2
Scenario D – 1.5 Degree Limit	Coordinated, cooperative and immediate decarbonisation approach with combined government intervention, policy and market approaches to achieve rapid decarbonisation.	Leading	Leading	0.9 – 2.3

As outlined in Section 5.1, the four global scenarios were developed using IPCC RCPs and SSPs as reference material in order to frame each scenario to ensure transparency, consistency and comparability. A summary of the alignment between AGL's scenarios and referenceable global and national scenarios is provided in Table 9.

Table 9: Global and Australian reference scenarios

Scenario	Global reference		Australian reference
	RCP (AR5)	SSP	AEMO scenario[1]
Scenario A – National Targets	N/A	SSP3	AEMO Central
Scenario B – Response 2020	RCP4.5	SSP2	AEMO Fast Change
Scenario C – Response 2030	Blended (~RCP4.5)	Blended	Blended
	RCP6.0 (2020-2030) / RCP2.6 (2030-2050)	SSP3 (2020-2030) / SSP1 (2030-2050)	AEMO Central / AEMO Fast Change
Scenario D – 1.5 Degree Limit	RCP2.6	SSP1	AEMO Step Change

1. AGL has used the carbon budgets associated with the AEMO reference scenarios for AGL's scenarios B, C and D. The Fast Change scenario assumes a decarbonisation of the NEM faster than the Australian economy while Australia decarbonises at the same rate as the rest of the world. The Step Change scenario assumes a decarbonisation of the NEM faster than the Australian economy while Australia decarbonises faster than the rest of the world.

5. Scenario Analysis: Approach (continued)

5.3 Market Modelling

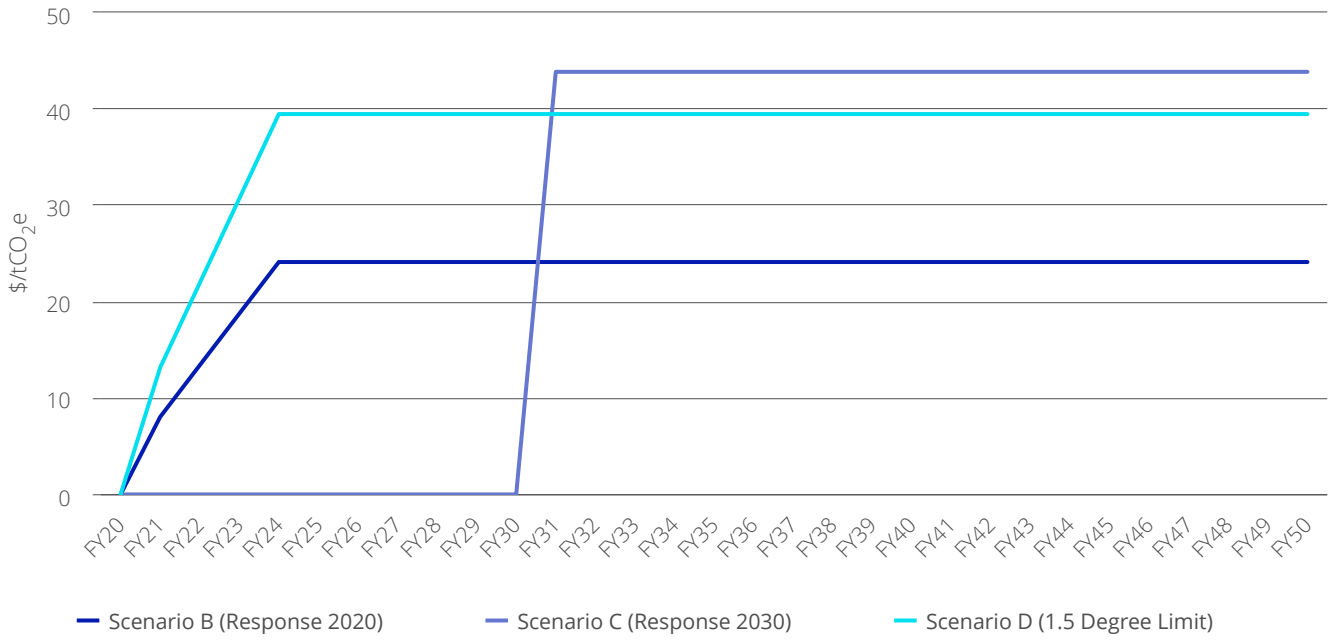
Market modelling of each scenario was undertaken by Aurora, utilising 12 input assumptions to define each climate scenario (Table 10) and returning four key outputs (Table 11). Aurora's model iteratively finds economically consistent outcomes across the wholesale and Frequency Control Ancillary Services (**FCAS**) markets, and for every dispatch decision in each half hour. Generator entry and exit decisions are made based on profit maximisation and to minimise system cost. Aurora only makes input assumptions about core technical parameters and carbon constraint - all other elements of the market (e.g. price shape, capacity mix, technology entry) are dynamically calculated outputs.

The modelling assumes a carbon constraint is applied to the NEM across scenarios B, C and D to ensure the predetermined carbon budget for each scenario (derived from the AEMO ISP and based on the RCPs) is met. The model is policy agnostic and therefore the carbon constraint is applied in the model by placing a value on carbon, an effective 'price', at the minimum level to drive the decarbonisation required to meet the budget. The modelling process used a 'net zero' rather than 'absolute zero' approach to emissions reduction by 2050, resulting in the need for some offsets to be used to meet the carbon budget in 2050.

The carbon constraint is iteratively solved for in the model. Hence the resulting carbon price from the constraint is a fundamental input to the model.

Under scenarios B and D, the carbon constraint was applied by ramping up the constraint over three years from FY20, whereas in Scenario C the constraint was applied in 2031, as shown in Figure 7.

Figure 7: Required carbon price to meet carbon budgets within the NEM



Scenario C requires the greatest constraint to be applied to decarbonise the electricity sector more rapidly in a shorter timeframe than scenarios B and D. While Scenario C has the same carbon budget as Scenario B, the almost doubling of the implied price of the carbon constraint indicates the increased level of difficulty resulting from a delayed action approach.

5. Scenario Analysis: Approach (continued)

Table 10: NEM market model: Input assumptions

Input Assumption	Description	Scenario A – National Targets	Scenario B – Response 2020	Scenario C – Response 2030	Scenario D – 1.5 Degree Limit
NEM Carbon budget (2020 2050)	The carbon budget for the NEM from 2020-2050 in $MtCO_2$-e.	N/A	2,208 $MtCO_2e$	2,208 $MtCO_2e$	1,465 $MtCO_2e$
Carbon price start date	The starting financial year for an electricity sector carbon price, and any trajectory (including ramp-up period and long-term shape). The actual carbon price is an output from modelling to meet the intended carbon budget. For Scenario B and Scenario D the constraint ramps up over the first three years of the model. For Scenario C there is an immediate imposition of a carbon constraint from 2030.	N/A	FY21	FY31	FY21
Electric vehicle demand	The demand in TWh per year from electric vehicles connected to the NEM from 2020 to 2050.	Aurora – Central	AEMO – Fast Change	AEMO – Central / Fast Change	AEMO – Step Change
Behind-the-meter rooftop solar uptake	The uptake in GW (and associated GWh) of rooftop solar installations connected to the NEM from 2020-2050.	Aurora – Central	AEMO – Fast Change	AEMO – Central / Fast Change	AEMO – Step Change
Behind-the-meter battery uptake	The uptake in GW of behind-the-meter batteries connected to the NEM from 2020-2050 and associated behaviour.	Aurora – Central	AEMO – Fast Change	AEMO – Central / Fast Change	AEMO – Step Change
Underlying electricity demand	The underlying electricity demand in TWh (operational demand plus generation from behind-the-meter) in the NEM from 2020-2050.	Aurora – Central	AEMO – Fast Change	AEMO – Fast Change	AEMO – Step Change
Pumped hydro projects	The location, capacity in MW, and activation date of prospective pumped hydro projects in the NEM from 2020-2050.	Aurora – Central	Aurora - Central with SA projects and BOTN[1]	Aurora - Central with SA projects and BOTN[1]	Aurora - Central with SA projects, BOTN[1], Kidston, Iron Duchess and Shoalhaven expansion
Level of international trading	The level of carbon emissions sourced via international offsets in order to meet the carbon budget for the NEM from 2020-2050.	Domestic abatement only	Domestic abatement only	Domestic abatement only	Domestic abatement only
Commodity prices	The prices in $/GJ for thermal coal and LNG supplied to generators in the NEM from 2020-2050.	AEMO 2020 ISP	AEMO 2020 ISP	AEMO 2020 ISP	AEMO 2020 ISP
Interconnection build-out	The location, capacity (forward and reverse) in MW, and activation date of new or upgraded interconnectors in the NEM from 2020-2050.	5 additional interconnectors as per AEMO ISP 2020	7 additional interconnectors as per AEMO ISP 2020	7 additional interconnectors as per AEMO ISP 2020	7 additional interconnectors as per AEMO ISP 2020
Policy settings	The inclusion of currently committed policies in the NEM, including state-based and Federal targets and funding schemes. This does not include assumptions regarding introduction of future policies or carbon pricing mechanisms.	AEMO - Central	AEMO - Central	AEMO - Central	AEMO - Central
Asset closure schedule	The date of scheduled closure for assets in the NEM (as of 2020) under a business-as-usual scenario with no external forcing mechanism.	AEMO closure schedule per ISP 2020	Output from modelling	Output from modelling	Output from modelling

1. BOTN (Battery of the Nation) is the development of opportunities to expand the Tasmanian hydropower system including with pumped hydro.

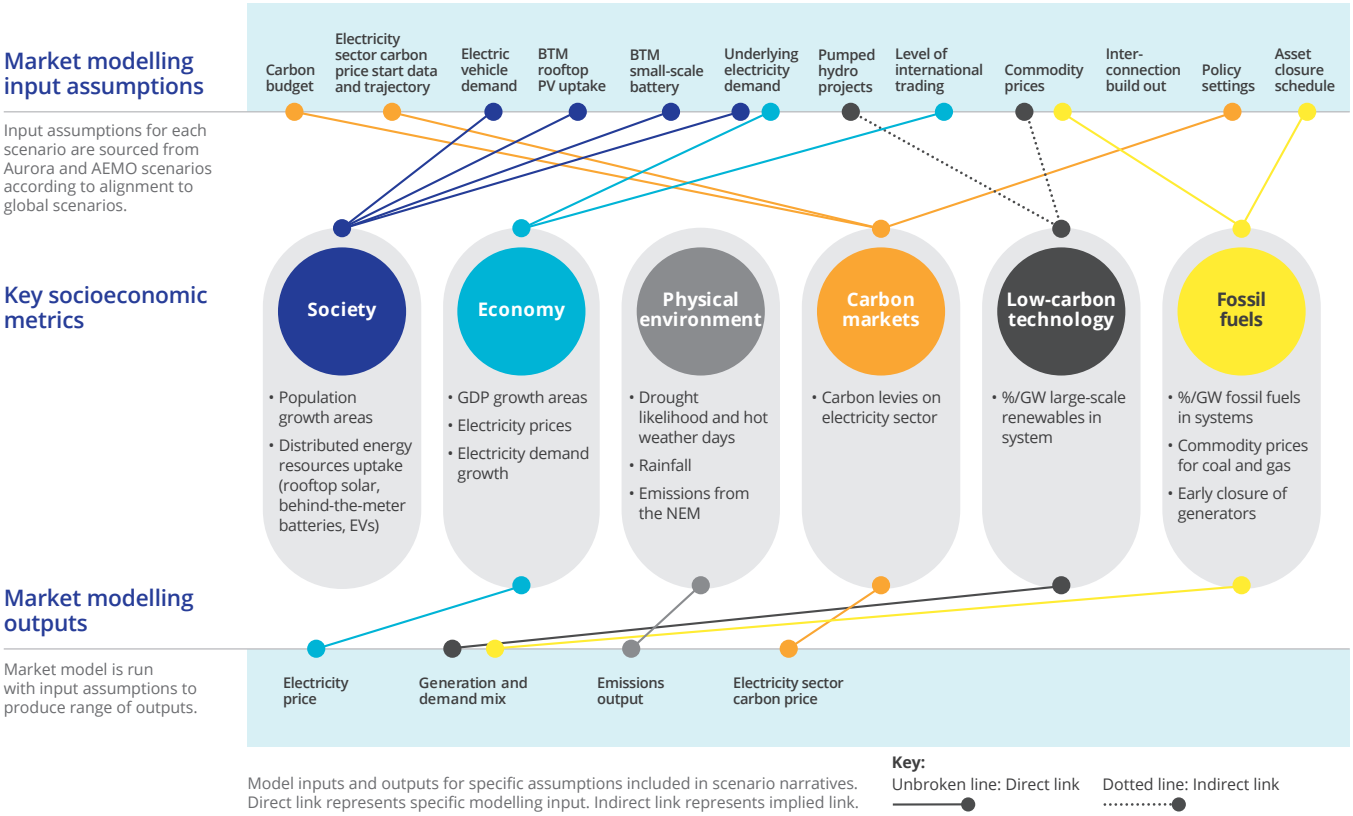
Table 11: Key market modelling outputs

Output	Description
Electricity price	Wholesale electricity prices and dispatch-weighted curves in the NEM (and for AGL assets) from 2020-2050.
Generation and demand mix	Generation and demand per technology in the NEM (and for AGL assets) from 2020-2050.
Emissions output	Annual emissions trajectory for the NEM from 2020-2050.
Electricity sector carbon constraint	Trajectory and price for the carbon constraint imposed on the NEM from 2020-2050 in order to meet the NEM carbon budget.

5. Scenario Analysis: Approach (continued)

The inputs and outputs from the modelling are used throughout the scenario narratives (as outlined in Section 7) in order to supplement the qualitative descriptors and ensure that there is internal consistency between the narratives and the modelling. Figure 8 outlines these relationships.

Figure 8: Relationship between modelling inputs, outputs and scenario narratives



Model inputs and outputs for specific assumptions included in scenario narratives. Direct link represents specific modelling input. Indirect link represents implied link.

5. Scenario Analysis: Approach (continued)

5.4 Scenario and Modelling Limitations

Table 12 outlines the key assumptions and limitations within this report and scenario analysis which underpin the scenario narratives and results presented.

Table 12: Scenario and modelling assumptions and limitations

Alignment of scenarios to RCPs	Climate change science, outcomes and policy responses are dynamic in nature as they respond to new and developing events, findings and socio-economic conditions. AR6 is still under development by the IPCC. While various working group reports for AR6 have been published no detailed scenario descriptions have been released and the results are therefore not widely adopted in scenario analysis.
	The narratives for this report draw from AR5 (as AR6 narratives have not been fully developed). However, Scenario A predominantly utilises AEMO's Central scenario input assumptions for modelling purposes (which AEMO notes in the ISP best aligns with emerging RCP7.0 results from AR6), while AR5's RCP6.0 has been used for narrative development as the closest equivalent to RCP7.0. Key attributes should be refreshed on a periodic basis as climate change science evolves.
Translating global emissions trajectories into Australian carbon budgets	Carbon budgets are a critical input for the modelling. There are a range of methodologies for deriving Australian carbon budgets, e.g. convergence and contraction methodology. For the purposes of our analysis we have relied on AEMO's assumptions for Australia's contribution to global carbon reductions under each relevant RCP. AEMO has stated the relative role of Australia versus other economies (e.g. parallel / leading) in contribution to emissions reduction, however there is no visibility over detailed modelling assumptions.
	There is a risk that other countries may not reduce emissions in line with AEMO assumptions or Australia's share may be in excess of that described by AEMO. This may result in the relevant temperature rise limit not being achieved with a flow through impact to Australia's physical and economic environment. This risk has not been modelled.
	Carbon budgets associated with the AEMO scenarios do not assume the use of Kyoto carryover credits, and as a result this modelling does not assume their use.
Role of other sectors in Australia	The transition to a lower carbon economy (and achievement of a carbon budget) requires a multi-faceted approach with a range of industries and activities contributing to the reduction of emissions. It is widely recognised that the electricity sector is required to be a material contributor to this emissions reduction for a range of reasons, e.g. available technology, potential cost of abatement, and potential for facilitative effects on industry and transport.
	The role of other sectors in contributing to Australia's emissions reduction (including emissions reduction sources, rates, methods of achievement and potential feedback mechanisms) is out of scope. We have relied on AEMO's assumptions for the role of the NEM and have not considered or modelled any mechanisms which may be required for other sectors to decarbonise.
	AEMO's Central scenario assumes that Australia's NDCs are achieved, and NEM decarbonisation is parallel to other sectors (Scenario A). For AEMO Fast Change and Step Change scenarios, AEMO assumes NEM decarbonisation is leading, or ahead of other sectors (scenarios B - D). There is limited visibility of AEMO's assumptions for other sectors, and impact on the electricity sector (e.g. carbon price). No economic modelling or impact of other sectors on the electricity sector has been performed as this is out of scope.
	We note if mechanisms to achieve decarbonisation are required for other Australian sectors, this may have feedback loops and impacts on the wider economy and electricity market assumptions. It is unclear if these impacts have been considered in any input assumptions used by AEMO such as GDP (and by inference in the modelling). There is also a risk that other sectors may not contribute to Australia's emissions reductions in line with AEMO assumptions, which may result in increased physical risks, a lowered carbon budget for the NEM or exposure to a higher economy wide carbon cost, with a flow through impact to both Australia's physical and economic environment. These risks have not been modelled as part of electricity market modelling.
Physical climate change impacts	Quantitative modelling of physical climate change impacts on the electricity sector (and broader economy) is out of scope for the purposes of this report. Physical climate change impacts have been considered qualitatively in Section 3.2.2.
	Chronic physical environmental impacts (e.g. temperature or sea level rise) and acute impacts (e.g. fire or flood), may have material impacts on the NEM electricity market including consumer demand, generator/transmissions efficiency and availability.
	There is limited visibility of the approach taken by AEMO with respect to the impact of physical trends on the electricity sector and broader economy, and it is unclear to what extent these impacts have been considered in any input assumptions used by AEMO.
NEM market structure	The electricity sector market modelling assumes that the market structure for the NEM does not change over the modelling period to 2050 and does not account for the implementation of potential reforms such as the Coordination of Generation and Transmission Investment and post-2025 NEM review outputs. Changes to the market structure for the NEM may change the findings from the electricity sector market modelling.
Refit costs for coal power stations	The market model does not include refit costs for coal fired power stations. While AGL has previously disclosed costs for our assets, it was determined that there was no accurate externally available source to reference for non-AGL assets in the NEM. It was determined that the fairest approach to take in the modelling was to exclude that cost for all generators. It should be noted that these additional costs may, depending on their magnitude, alter the order in which the coal-fired power stations close, however the overall outcome of generation by fuel type in the NEM and NEM capacity would be expected to remain materially consistent across each scenario.

6. Scenario Analysis Overview: Results, Risks and Opportunities

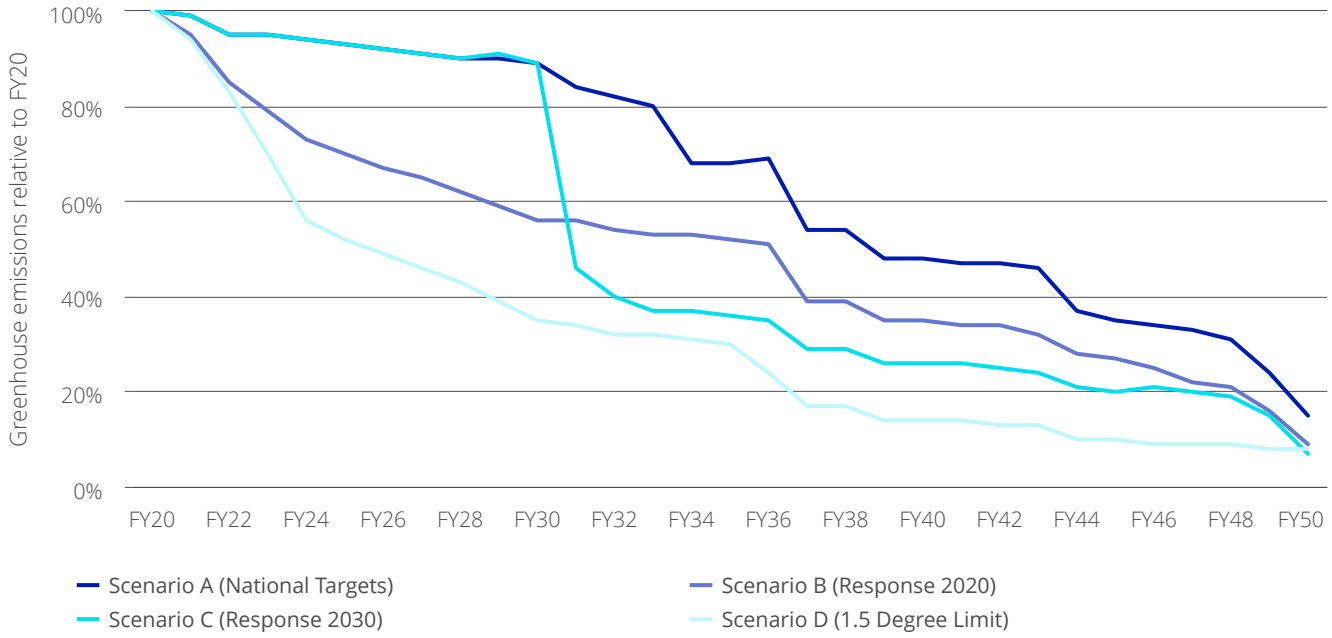
6.1 NEM

6.1.1 NEM Emissions

The modelling results show that progressive decarbonisation of the electricity sector to 2050 occurs under all scenarios, with the electricity sector achieving net zero emissions by 2050 under scenarios B, C and D. The amount of emissions remaining in 2050 under each scenario can be offset using currently available carbon dioxide removal (**CDR**) technologies. The variance in emissions trajectories between each scenario is indicative of the speed at which decarbonisation occurs.

Figure 9 outlines the emissions trajectories from FY20 to FY50. Australia's nationally determined contribution under the Paris Agreement is a 26% to 28% reduction in emissions by 2030 from 2005 levels, and is assumed to have been met under all scenarios.

Figure 9: NEM emissions trajectories, all scenarios



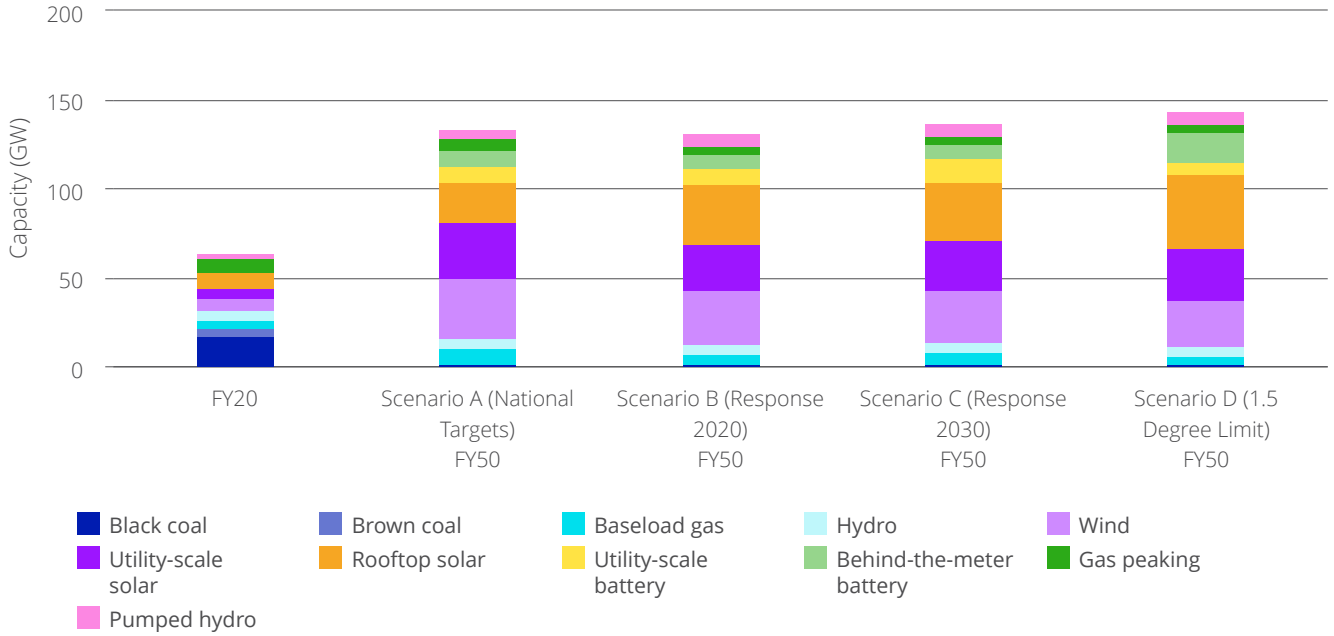
In scenarios B and D, the model shows rapid early decarbonisation, followed by more measured decarbonisation, due to the carbon constraint being implemented in the short term under these scenarios. Scenario C shows forced and rapid decarbonisation in the early 2030s due to the immediate decarbonisation response required by the model in order to reach the carbon budget by 2050.

6. Scenario Analysis Overview: Results, Risks and Opportunities (continued)

6.1.2 NEM Generation

The modelling shows that generation capacity in the NEM changes significantly out to 2050 under all scenarios (Figure 10). Reductions in fossil fuel capacity are offset by large increases in both utility-scale and behind-the-meter renewable capacity.

Figure 10: Installed capacity in the NEM at 2050, all scenarios



In scenarios B, C, and D, there is a lower overall proportion of generation from fossil fuels remaining in 2050, with a lower build-out of baseload gas generation driven by the introduction of a carbon price on electricity.

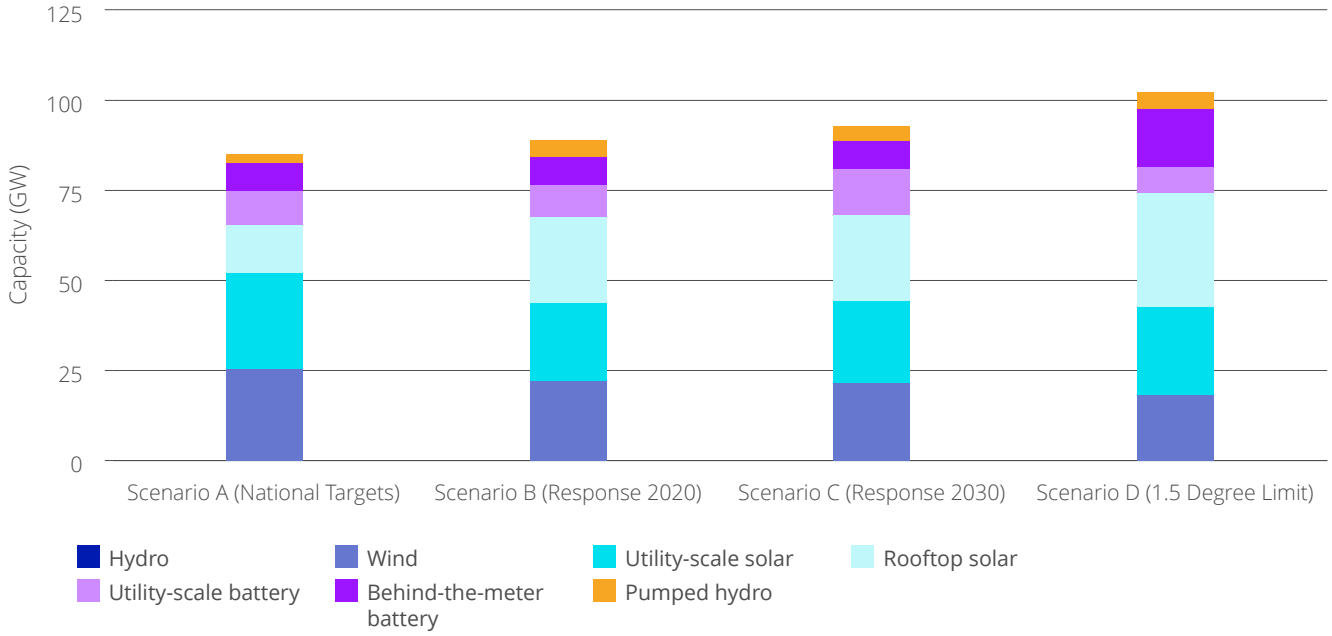
Scenarios B, C and D also have a lower underlying energy demand and a higher uptake of rooftop solar, leading to a lower build-out of utility-scale renewables (wind and solar) compared with Scenario A.

Behind-the-meter uptake for batteries is strongest in Scenario D. This leads to lower build-out of utility-scale batteries, which have the strongest build-out in Scenario C due to a high carbon price drive from 2030 onwards.

As shown in Figure 11, in all scenarios there is a strong uptake in renewable technologies, both utility-scale and behind-the-meter. This provides potential opportunity for future investment in the NEM and highlights the transitionary state of the electricity sector in Australia.

6. Scenario Analysis Overview: Results, Risks and Opportunities (continued)

Figure 11: Additional NEM renewable and storage capacity between 2020 and 2050, all scenarios



The results show that across the modelled scenarios between 86 GW and 102 GW of new-build renewables and storage would be required to enter the NEM between 2020 and 2050 in order to meet demand and/or carbon constraints. This is compared with the current renewable capacity in the grid of around 30 GW (including both behind-the-meter and utility-scale renewable technologies).

While the additional renewable capacity required under scenarios B, C, and D is driven by the carbon constraint on the electricity sector, the modelling also shows significant requirements for new renewables under Scenario A where a carbon constraint is not imposed. This highlights the fundamental transition currently underway in the NEM, with low-cost renewables entering the market in lieu of new fossil-fuel capacity.

Battery storage is an emerging market which sees strong growth across all scenarios, with 18 GW of behind-the-meter and utility-scale storage in Scenario A. This opportunity arises from the need for firming capacity and the smoothing of increasing variable demand and generation in the grid.

Decentralised technologies are increasingly installed across all scenarios, as a result of greater residential demand. The largest growth is seen in Scenario D where in addition to a carbon constraint there is consistent and coordinated societal movement towards low carbon technologies. In Scenario A, 26% of new-build renewables through to 2050 are decentralised. This increases to 46% in Scenario D, which has more than double the growth in rooftop solar compared to Scenario A.

6. Scenario Analysis Overview: Results, Risks and Opportunities (continued)

6.2 AGL

This section considers the implications of the modelling for AGL's owned, operated or controlled assets within the NEM. It is important to note that these results do not include the development or construction of any new assets. Additionally, all contracts (e.g. power purchase agreements) are assumed to cease at current end dates. As such the gap between AGL's generation volumes in each scenario and AGL's customer demand represents opportunities for business investment and growth in both behind-the-meter and centralised generation sources.

6.2.1 AGL Generation

The modelling shows that the generation volumes required from each of AGL's assets under all scenarios would decrease over the modelling period primarily as a result of plant closures across the fleet. Table 13 outlines the resulting closures dates of AGL's coal assets in the NEM under each scenario.

Table 13: Coal closure dates[1]

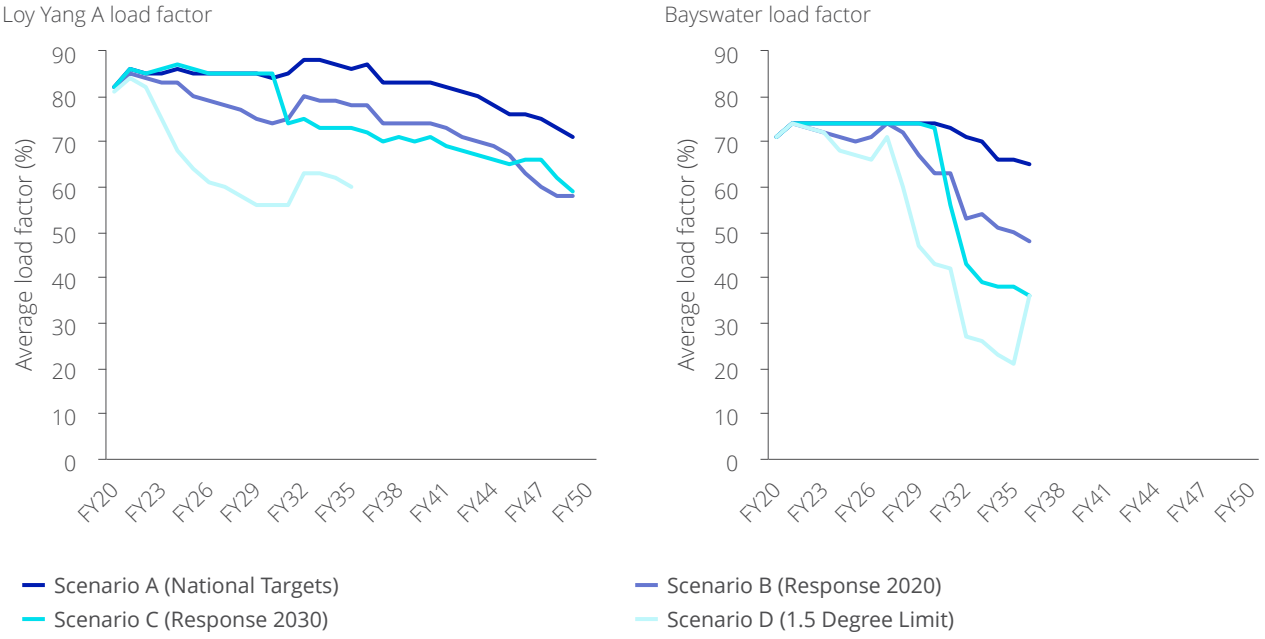
			Closure date required by modelling			
Power station	State	AEMO scheduled closure date	Scenario A	Scenario B	Scenario C	Scenario D
Bayswater	NSW	2035 (FY36)	2035 (FY36)	2035 (FY36)	2035 (FY36)	2035 (FY36)
Liddell	NSW	2023 (FY23)	2023 (FY23)	2023 (FY23)	2023 (FY23)	2023 (FY23)
Loy Yang A	VIC	2048 (FY49)[2]	2048 (FY49)[2]	2048 (FY49)[2]	2048 (FY49)[2]	2035 (FY35)

1. Scenario A represents the closure years as per the AEMO closure list. The financial year stated is the last year in which the station operates.
2. Assumes that one unit is closed each year until final output in year denoted.

The modelling shows that output from Loy Yang A Power Station would be required until its scheduled closure in 2048 under all scenarios except for Scenario D, where the modelling shows retirement in 2035. There is a large decline in Loy Yang A Power Station's load factor (Figure 12) in Scenario C in 2030 as a result of the introduced carbon constraint. A general downwards trend in load factors out to 2050 would be experienced under scenarios A, B and C.

The Bayswater Power Station would experience a decrease in load factor under scenarios B, C, and D (Figure 12), and a large drop under Scenario D. These declines are due to carbon constraints increasing wholesale prices in the NEM and driving uptake of behind-the-meter solar and batteries leading to lower demand for baseload generation. The uplift for Bayswater Power Station at the end of Scenario D results from the retirement of Loy Yang A Power Station in 2035, requiring additional generation from Bayswater Power Station to meet demand prior to its retirement. Under Scenario A there is comparatively little decline.

Figure 12: Load factors for Loy Yang A and Bayswater power stations, all scenarios

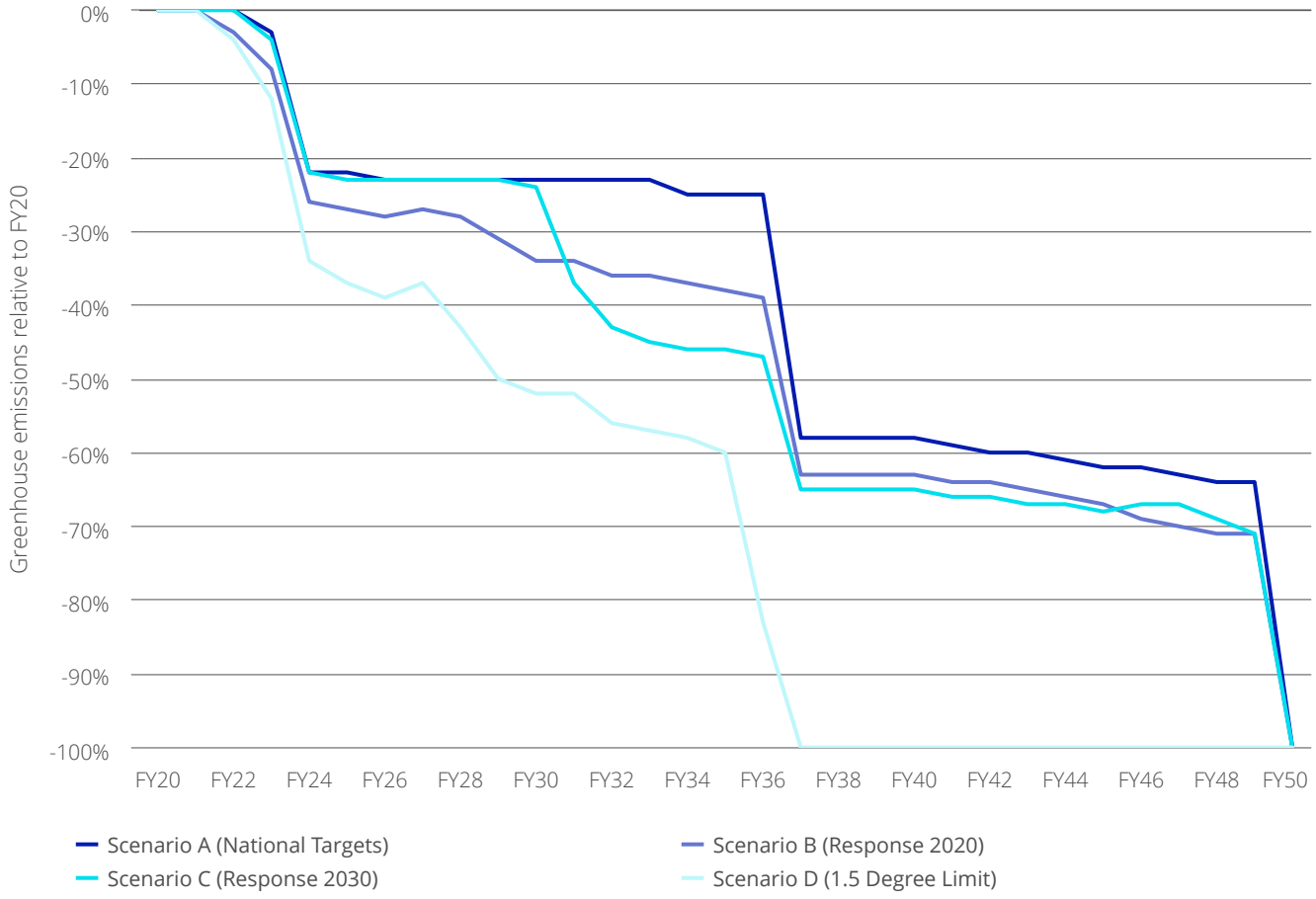


6. Scenario Analysis Overview: Results, Risks and Opportunities (continued)

6.2.2 AGL Emissions

As shown in Figure 13, the emissions trajectories for AGL assets in the NEM would decline under all scenarios. The results of the modelling indicate that that AGL would reach net zero emissions from NEM assets by FY50 as a result of generator retirements.

Figure 13: Emissions trajectories for AGL assets in the NEM by financial year, all scenarios



The modelling results show that emissions from AGL assets in the NEM would decline under all scenarios as a result of lowered capacity factors and asset retirements (either as scheduled or early). There is a significant reduction near the start of the projection in 2024 resulting from the closure of Liddell Power Station.

Under Scenario D, emissions would reduce to near zero in 2036 as a result of the retirement of all AGL's coal assets. A small amount of residual emissions from the Barker Inlet Power Station would be present from 2036 until 2045.

Under scenarios A, B and C, AGL's emissions from 2040 would arise predominantly from Loy Yang A Power Station until its retirement in 2048. The variance in emissions between these scenarios from 2040 arises from varying load factors driven by the carbon prices in each scenario.

6. Scenario Analysis Overview: Results, Risks and Opportunities (continued)

6.2.3 Financial Impacts

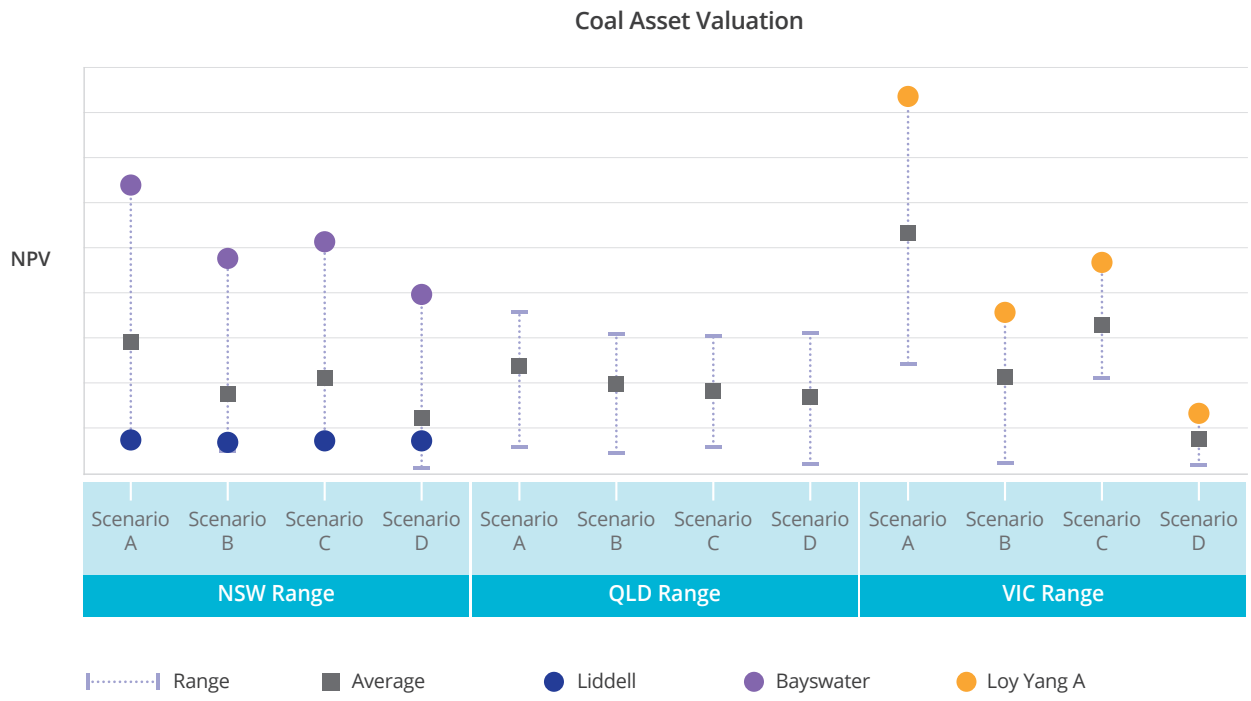
AGL has considered the financial implications of the outcomes of the modelled scenarios in 2050. It is anticipated that the aggregate value of AGL's electricity generation fleet would reduce under scenarios B, C and D.

Should the closure date for Loy Yang A Power Station required under Scenario D arise, this may result in a material reduction to AGL's estimated cash inflows.

While the scenarios discussed represent plausible, distinctive, consistent, relevant and challenging scenarios and are valuable indicative tools for risk and strategic purposes, they do not meet the requirements of value in use impairment testing in accordance with AASB 136 *Impairment of Assets* as the scenarios do not represent a reasonably possible change of a key assumption as at 30 June 2020. As such AGL's assets are not impaired under these scenarios in the context of AASB 136.

Figure 14 outlines the relative impact on the indicative lifetime values of the coal generation assets in the NEM under each scenario.

Figure 14: Impact on overall lifetime value of coal assets in the NEM, all scenarios



AGL anticipates that a rapid transition away from coal generation would place greater reliance on low-cost baseload generators. Accordingly, under all scenarios Bayswater Power Station would remain viable and therefore maintain significant value for AGL to 2035.

The relative values of the assets as outlined in Figure 14 would be dependent on the policy mechanisms which are implemented under each of scenarios B, C and D to achieve the respective carbon constraints. For the purposes of this scenario analysis AGL has intentionally remained policy agnostic utilising a carbon constraint which is manifest as an implied carbon price. However, the specific policy mechanisms that would be applied in order to achieve the modelled trajectories would be likely to materially vary the relative and absolute impacts shown in Figure 14.

6. Scenario Analysis Overview: Results, Risks and Opportunities (continued)

6.2.4 Opportunities Summary

The modelling shows that there would be a significant need for new renewables, storage, and behind-the-meter technologies under each scenario, all of which present potential growth opportunities for AGL. Figure 15 outlines how the opportunities (shown as capacity or demand additional to 2020) under each scenario align to one of AGL's four growth pathways. These opportunities are discussed further in Section 7. It should be noted that some of the additional capacity outlined below has already been committed including 2 GW of pumped hydro capacity in the form of Snowy Hydro 2.0.

Figure 15: NEM growth opportunities

Opportunities	Growth Pathway	2020	Scenario A	Scenario B	Scenario C	Scenario D
Pumped storage	Trading and Supply	2.3 GW	+2 GW	+4 GW	+4 GW	+5 GW
Behind-the-meter batteries	Orchestration	0.3 GW	+8 GW	+8 GW	+8 GW	+16 GW
Utility-scale batteries	Trading and Supply	0.3 GW	+10 GW	+9 GW	+13 GW	+7 GW
Rooftop solar	Orchestration	9 GW	+13 GW	+23 GW	+23 GW	+31 GW
Utility-scale solar	Generation	4.8 GW	+27 GW	+22 GW	+23 GW	+24 GW
Wind	Generation	7.2 GW	+26 GW	+23 GW	+22 GW	+19 GW
Electric vehicles	Orchestration	0 TWh	+41 TWh	+40 TWh	+40 TWh	+42 TWh

Connection | Orchestration | Trading and Supply | Generation

7. Scenario Analysis Detail: Results, Risks and Opportunities

7.1 Scenario A - National Targets

7.1.1 Overview

In Scenario A, it is assumed that global policy and business strategies continue under the current stated or apparent emissions trajectories, with limited regulation or constraining policy being implemented beyond existing commitments.

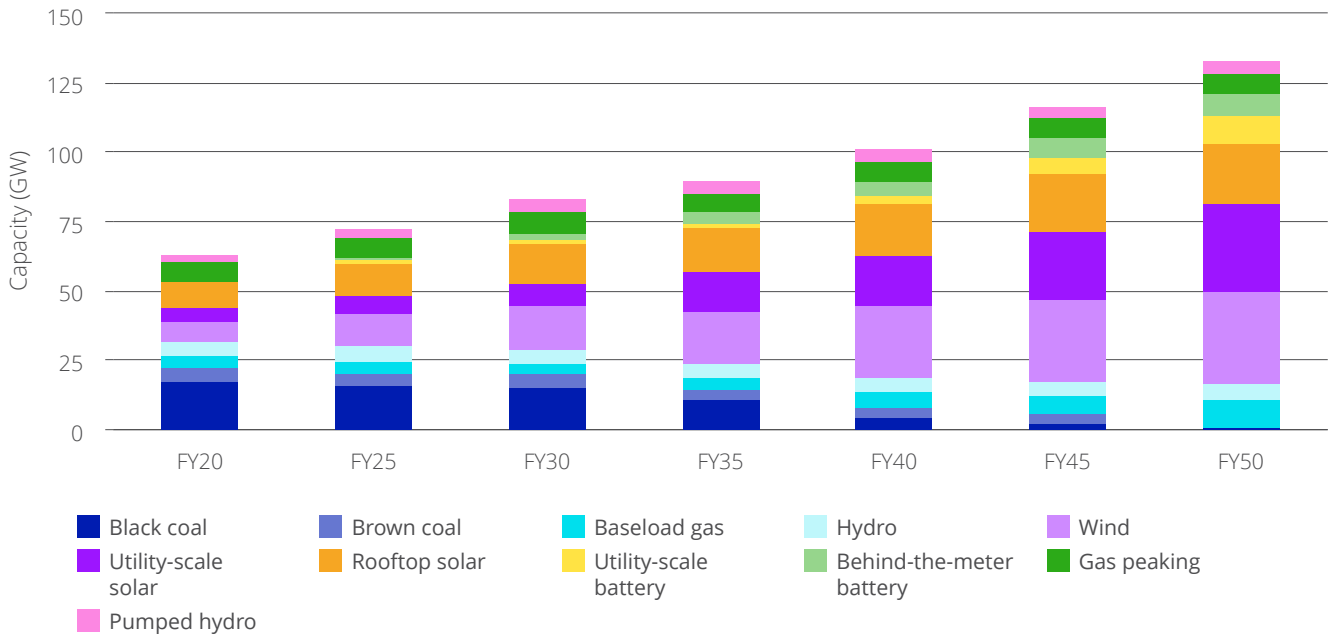
While current NDCs would be met under this scenario, it is assumed that there would be little additional coordinated action on climate change. The scenario assumes that economies would continue to grow in the short-term, and it is anticipated that physical climate change impacts build from 2020 and increase in geopolitical importance from 2035 onwards. Severe weather events in Australia such as extreme drought may also become more frequent. Towards 2050, the physical impacts of climate change may contribute to worsening economic conditions.

Material physical impacts of climate change combined with minimal transition or adaption strategies could result in fast natural resource depletion rates with possible implications on national energy security.

7.1.2 Market Modelling Results

Figure 16 below outlines the modelled generation capacity in the NEM to 2050 under Scenario A, by fuel type.

Figure 16: NEM generation capacity by fuel type, Scenario A



In Scenario A, the modelling of the NEM shows that generation from baseload thermal would step down throughout the 2020s primarily due to the closure of the Liddell Power Station, with rising demand being predominantly met by rooftop solar growth during this period. The 2030s would see coal plant retirements driving the reduction in black and brown coal generation which incentivises further build out of baseload gas (and increased generation from baseload gas plants already in the system). With gas generation setting the price in the market more often, wholesale electricity prices rise, accelerating the growth of renewables, particularly wind.

Growth in renewable capacity would continue under Scenario A with battery storage and pumped hydro becoming more prominent from 2035. Coal capacity in the NEM would decrease until the end of the modelled period, with only 1.7 GW left by 2050.

Figure 17 and Figure 18 show AGL's modelled generation mix and associated carbon emissions under Scenario A (considering only currently owned, operated or controlled assets, and not incorporating any future development opportunities).

7. Scenario Analysis Detail: Results, Risks and Opportunities (continued)

Figure 17: AGL generation volumes by fuel type by financial year, Scenario A

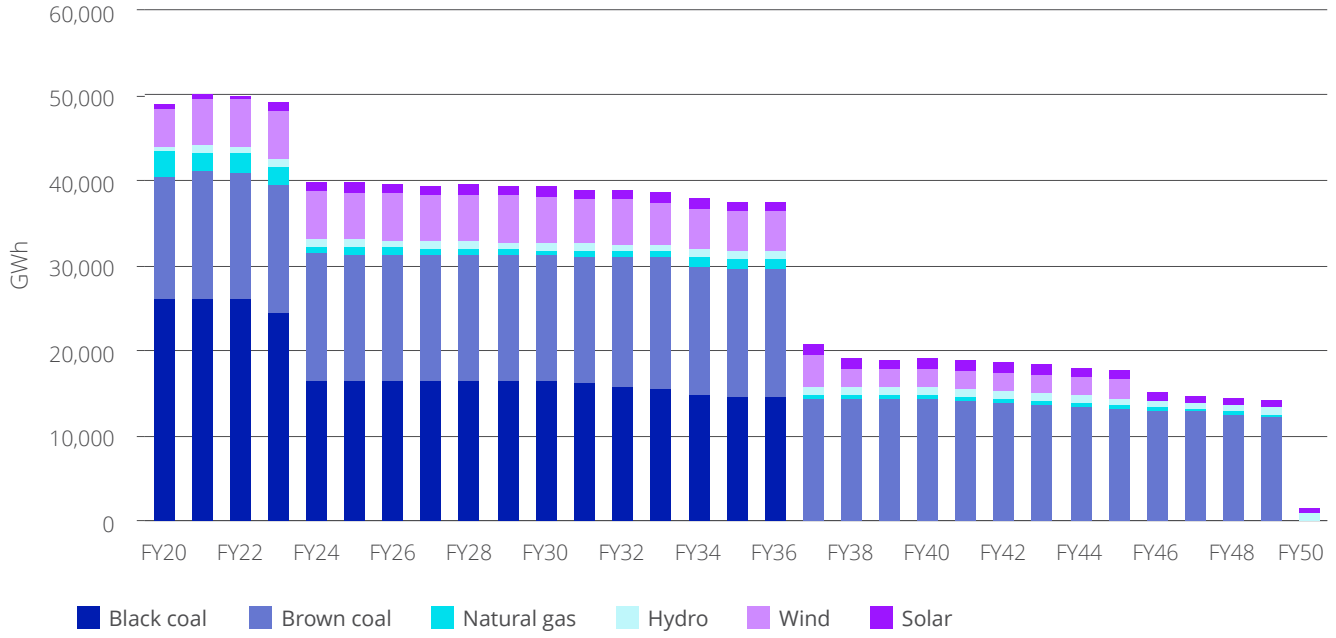
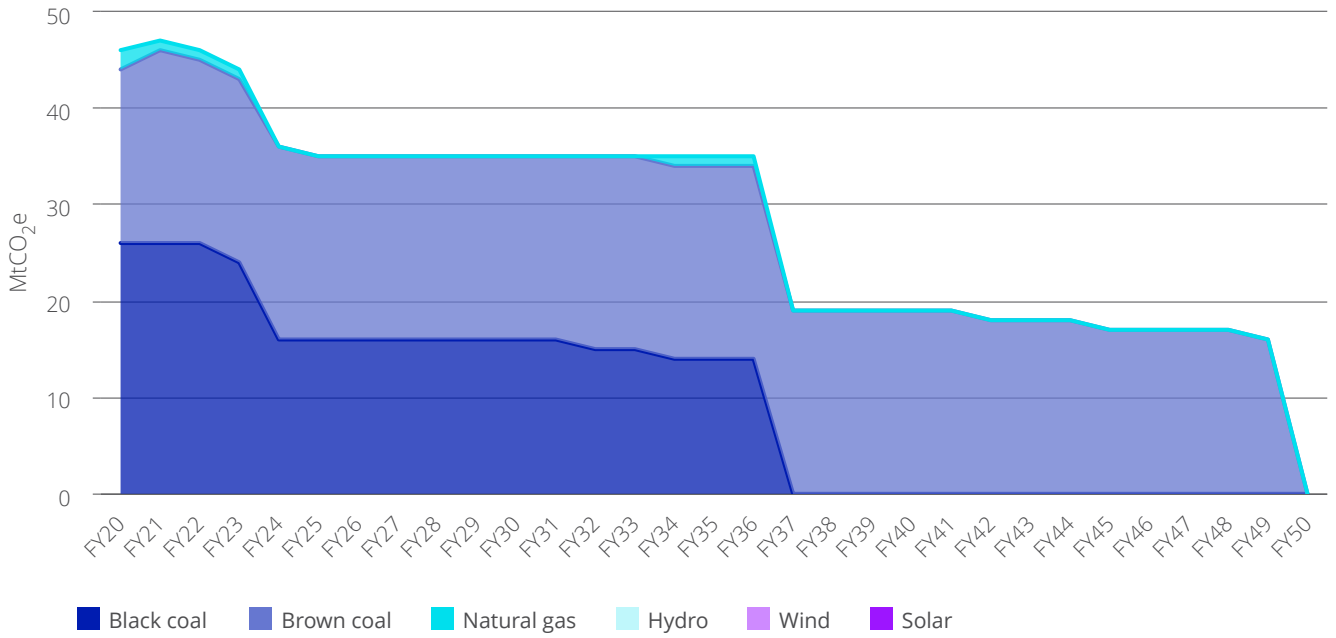


Figure 18: AGL carbon emissions by fuel type by financial year, Scenario A



Under Scenario A, the modelling shows that AGL's coal generation fleet would continue to operate at consistent load factors with slow declines for the Loy Yang A and Bayswater power stations as they approach end of life. There would be no early closure of coal under this scenario and AGL would continue to realise value from these assets.

AGL's emissions profile would be highest under Scenario A, with emissions reducing after the closure of each thermal plant. Measured from an FY20 baseline, this would lead to a 22% reduction in emissions in FY24 post the closure of Liddell Power Station, a 58% reduction in emissions in FY37 post the closure of Bayswater Power Station, and practically 100% reduction in emissions in FY50 post the closure of Loy Yang A Power Station.

7.1.3 Risks and Opportunities

Customer

In Scenario A, which references SSP3, it is assumed that the global population would continue to rise to 2050, while the Australian population growth rate would slowly decline. There would be continued uptake of decentralised energy products at current rates with a strong uptake of electric vehicles by consumers. The market modelling results indicate that there would be an uptake of approximately 8 GW of behind-the-meter battery storage and a demand from electric vehicles of over 40 TWh by 2050 under Scenario A. AGL would see significant opportunities in both these markets. AGL's orchestration growth pathway has been developed to take advantage of behind-the-meter opportunities such as these, and AGL is actively driving opportunities, for example, through our residential battery offerings. Additionally, the modelling indicates there would be an additional 13 GW of rooftop solar installation by 2050. AGL would continue to play a part in this market with residential solar offerings as well as our commercial rooftop solar products.

Community

Under Scenario A there may be increased physical impacts globally with increased severity, frequency and duration of extreme weather events. In Australia drought activity may continue to worsen. Heatwaves may impact generator efficiency and increase peak demand, and water access may become increasingly limited. Storms may become more frequent and severe, impacting transmission infrastructure. These physical risks are more acute for AGL under Scenario A due to the possible exposure of AGL's thermal generation assets to extended drought and heatwaves.

Technology

SSP3 assumes that there would be a continued shift away from manufacturing and mining towards service-led industries, while electricity demand would continue to grow to 2050 led by commercial and residential sectors with low growth in energy efficiency. It is assumed that there would be continued private investment in low carbon technology globally and in Australia. Renewable energy technologies would continue to replace fossil fuel generation due to technology cost declines. This increased demand would continue to be met by growth in renewable generation capacity along with firming technologies. The modelling indicates an opportunity for over 50 GW of new utility-scale renewable capacity required by 2050, split evenly between wind and solar, with an additional 10 GW of utility-scale battery storage capacity.

Under SSP3 fossil fuel trade would continue around the world, driven predominantly by developing countries. This would slow over the period due to increased focus on domestic policies and international tensions. The use and export of fossil fuels would continue, as coal and gas prices would stabilise by 2040. The market model shows that under Scenario A there would be a reduction in coal-fired generation driven by scheduled power station closures, and gas-fired generation would be used to replace capacity shortfalls. Gas peaking capacity would be required by Scenario A at a consistent level to 2050, making gas supply into the market critical. AGL's development of the Crib Point LNG import project would provide an opportunity for gas market trading in this scenario.

Key AGL Opportunities

AGL's opportunities lie in maintaining or gaining market share by developing products and services in the areas of generation, orchestration, connection and trading and supply. In Scenario A, AGL envisages the following opportunities arising assuming AGL retains our current market share:

- Increased opportunities for the development of utility-scale renewable generation, including over 5 GW of utility-scale solar and over 5 GW of wind generation.
- Increased opportunities for low emissions firming capacity including over 2 GW of utility-scale battery capacity.
- The accelerated uptake of home batteries and rooftop solar equating to over 1.5 GW and 2.5 GW of new capacity respectively.
- The accelerated uptake of electric vehicles leading to an additional 8.5 TWh of demand for AGL.

7. Scenario Analysis Detail: Results, Risks and Opportunities (continued)

7.2 Scenario B – Response 2020

7.2.1 Overview

Under Scenario B, increased carbon constraints would be introduced in order to drive a transition away from fossil fuel industries and towards low-carbon technologies. Maintaining the aims of the Paris Agreement and continuing efforts to drive further emissions reductions, governments would increase their commitments from their current NDCs under this scenario.

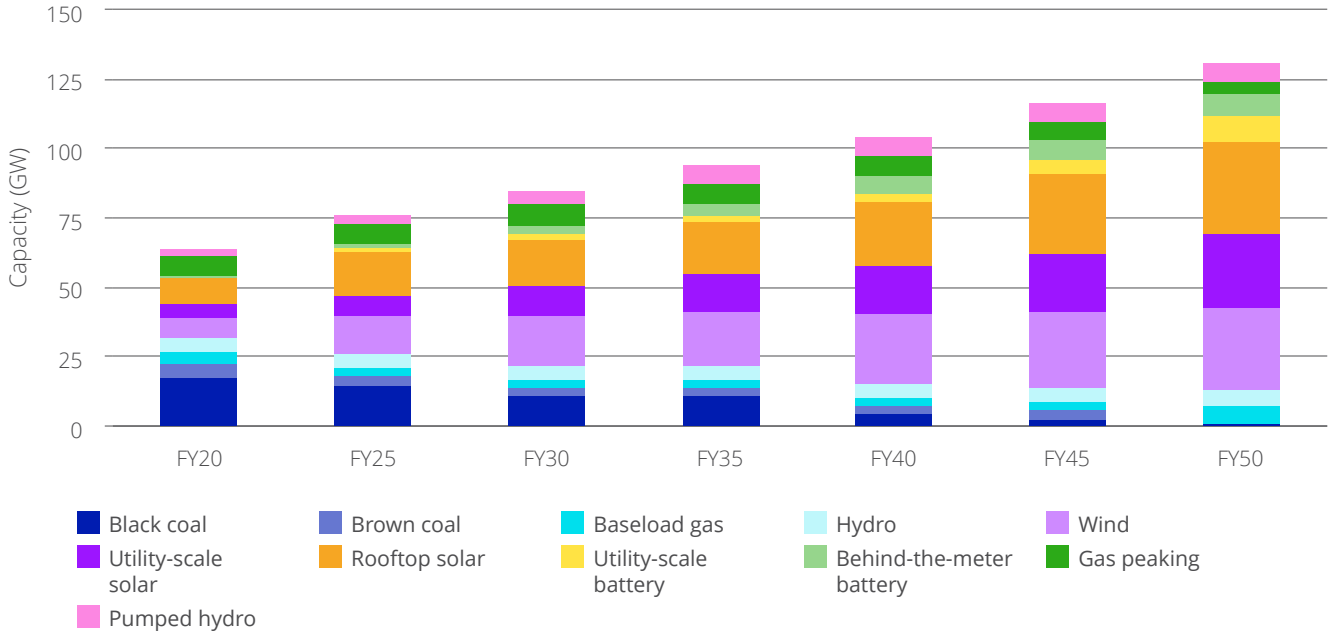
Technology costs for low-carbon technologies are assumed to decline, allowing for a faster decarbonisation than occurs under Scenario A. It is also assumed that there would be a reduction in energy demand from manufacturing and industry, and that businesses would drive "greener growth" which would see new technologies such as green hydrogen slowly begin to emerge. Businesses may focus on environmentally low impact inputs, and global trade could be impacted with some minor tariffs on carbon emitting industries.

Scenario B assumes that Australia would be in line with global efforts to begin decarbonisation and introduce carbon constraints, with the electricity sector playing a leading role.

7.2.2 Market Modelling Results

Figure 19 outlines the modelled generation capacity in the NEM to 2050, by fuel type.

Figure 19: NEM generation capacity by fuel type, Scenario B



Scenario B would see lower coal generation in the NEM in the early years, and less gas generation in the period from 2035 in comparison with Scenario A. The carbon constraint would price out coal initially, and this would result in an increase in wind in the short term with further increases in both rooftop and utility-scale solar from 2035 onwards. Capacity increases by comparison with Scenario A would be seen particularly in rooftop solar and, when combined with lower demand, this would lead to a lower capacity of wind and solar in the last decade of the model compared with Scenario A.

Figure 20 and Figure 21 show AGL's modelled generation mix and associated carbon emissions under Scenario B (considering only currently owned, operated or controlled assets, and not incorporating any future development opportunities).

7. Scenario Analysis Detail: Results, Risks and Opportunities (continued)

Figure 20: AGL generation volumes by fuel type by financial year, Scenario B

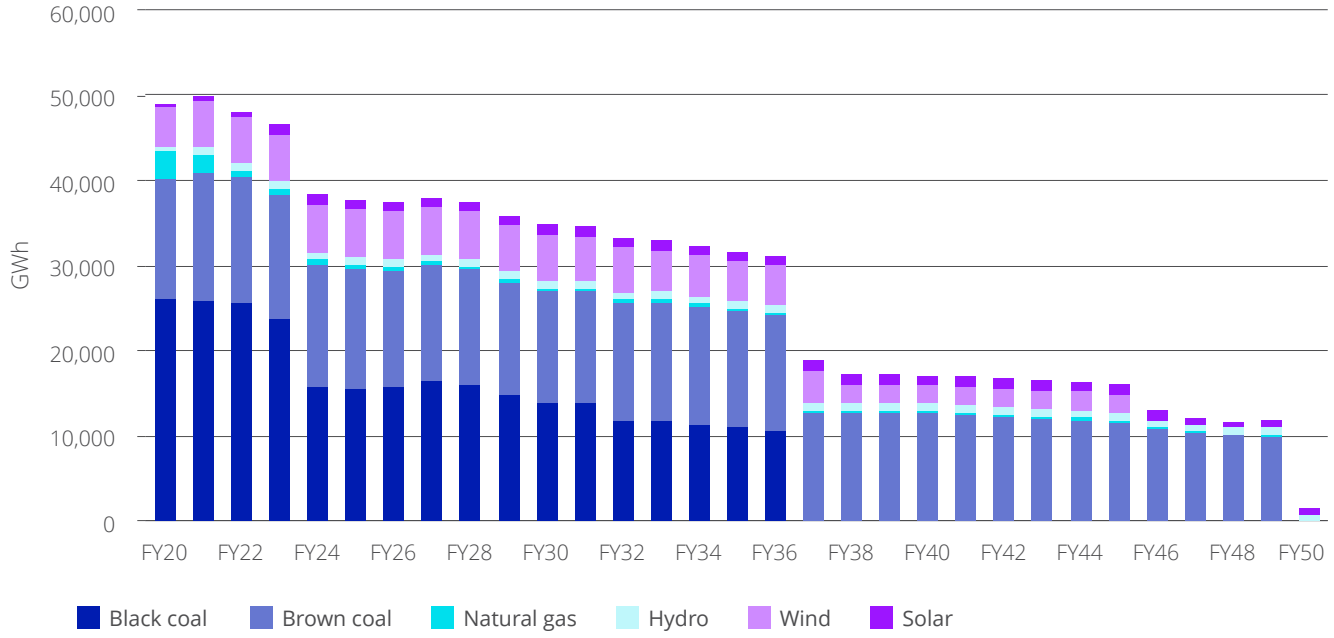
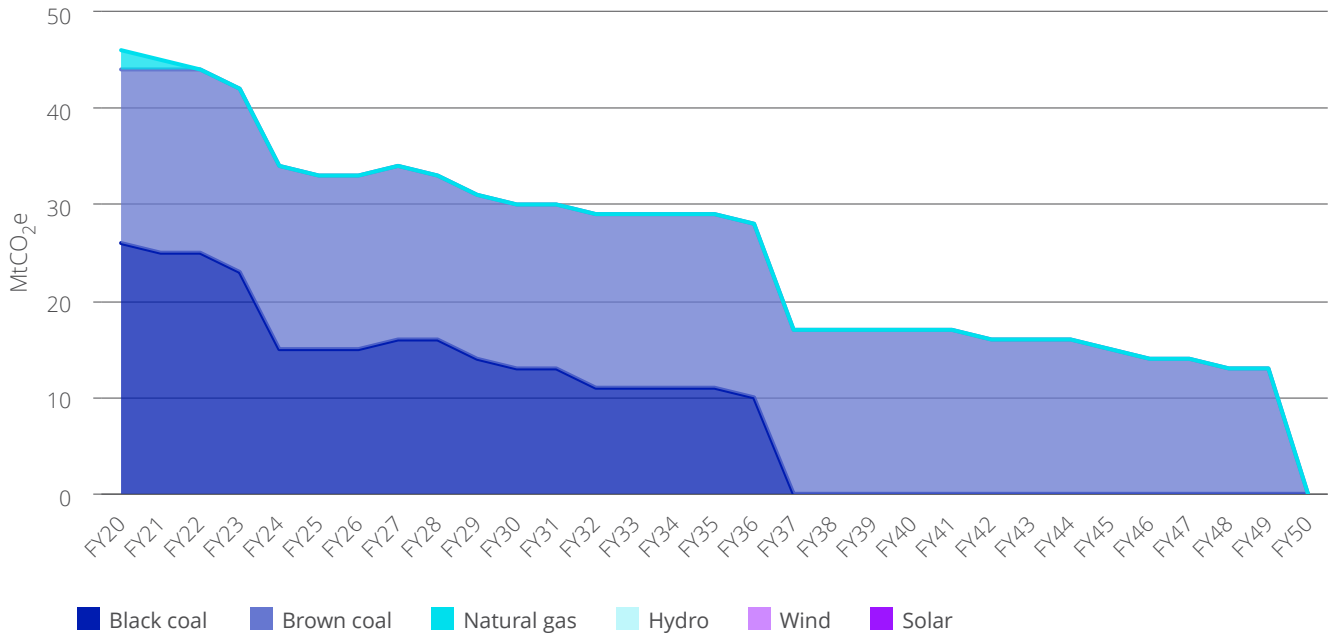


Figure 21: AGL carbon emissions by fuel type by financial year, Scenario B



In this scenario AGL's coal generation fleet would continue to operate to current closure timeframes with reduced generation due to progressively reduced load factors for the Loy Yang A and Bayswater power stations as they reach end of life. There is no early closure of coal under this scenario and AGL would continue to realise value from these assets.

AGL's emissions profile would reduce consistently under this scenario, with significant step changes seen after closure of major thermal plant. In comparison with an FY20 baseline, this would lead to a 26% reduction in emissions in FY24 post closure of Liddell Power Station, a 63% reduction in emissions in FY37 post the closure of Bayswater Power Station, and practically a 100% reduction in emissions in FY50 post the closure of Loy Yang A Power Station.

7.2.3 Risks and Opportunities

Customers

Under Scenario B, SSP2 indicates that global population continues to steadily rise until 2040, and consumption trends begin to shift due to changing attitudes and community demands. This in turn would lead to consumers shifting towards green goods and services in Australia. The modelling shows that there would be significant uptake of decentralised energy driven by technology cost reductions and increased consumer demand. This would lead to increased opportunities for AGL in rooftop solar, batteries, and electric vehicles.

Scenario B requires under SSP2 a global consensus for decarbonisation, which would in turn lead the global community towards implementing carbon constraining policies for high emitting industries leading to a slowing in global GDP growth. The resulting slowing economic growth in Australia would primarily be due to decreased mineral exports and high emissions manufacturing, but would be accompanied by an increase in electrification of the economy. Electricity demand in the NEM would therefore continue to grow despite gains in energy efficiency across the economy.

Community

Scenario B assumes that there would be a continued increase in the frequency and intensity of severe weather events around the world, stabilising towards 2050. Increasing storm activity may result in a lowering of system availability, and access to water may become stricter for thermal generators as a result of increased drought. AGL would continue to manage water risk by ensuring access and availability of supply to our generators and would continue to better understand these risks in the future.

Technology

Scenario B assumes there would be steady development globally of low-carbon technology to 2030, before a ramp-up in spending on technology development. In Australia, increasing investment in technology development would lead to emerging hydrogen industries beyond 2030, with low-cost, low-carbon technology beginning to dominate the electricity grid, making up 86% of utility-scale capacity by 2050. AGL's continued investment in this space would provide both mitigation of the risk of transition away from conventional generation technology as well as an ability to invest in and benefit from the opportunities available.

Under this scenario there would be a continued reliance on fossil fuels for energy and transport by developing nations, while developed nations would begin to shift away from usage and trade in response to global carbon constraints. This scenario assumes that coal prices in Australia would begin to decline due to lowered global demand, while gas prices would remain high due to fuel switching and international exports. In this scenario AGL's Crib Point LNG import project would play a key part in allowing AGL to remain competitive in the natural gas sector.

Key AGL Opportunities

AGL's opportunities lie in maintaining or gaining market share by developing products and services in the areas of generation, orchestration, connection and trading and supply. In Scenario B, AGL envisages the following opportunities arising assuming AGL retains our current market share:

- Increased opportunities for the development of large-scale renewable generation, including over 4 GW of utility-scale solar and over 4.5 GW of wind generation.
- Increased opportunities for low emissions firming capacity including over 1.5 GW of utility-scale battery capacity.
- The accelerated uptake of home batteries and rooftop solar equating to over 1.5 GW and 4.5 GW of new capacity respectively.
- The accelerated uptake of electric vehicles leading to an additional 8 TWh of demand for AGL.

In addition, the increased natural gas prices under this scenario makes AGL's proposed Crib Point LNG import project key to AGL remaining competitive in the natural gas sector.

7. Scenario Analysis Detail: Results, Risks and Opportunities (continued)

7.3 Scenario C – Response 2030

7.3.1 Overview

Scenario C assumes a lack of coordinated action above and beyond current NDCs until 2030. This would lead to increasing emissions around the world. The scenario assumes that consumers would continue their current trends regarding energy usage until 2030.

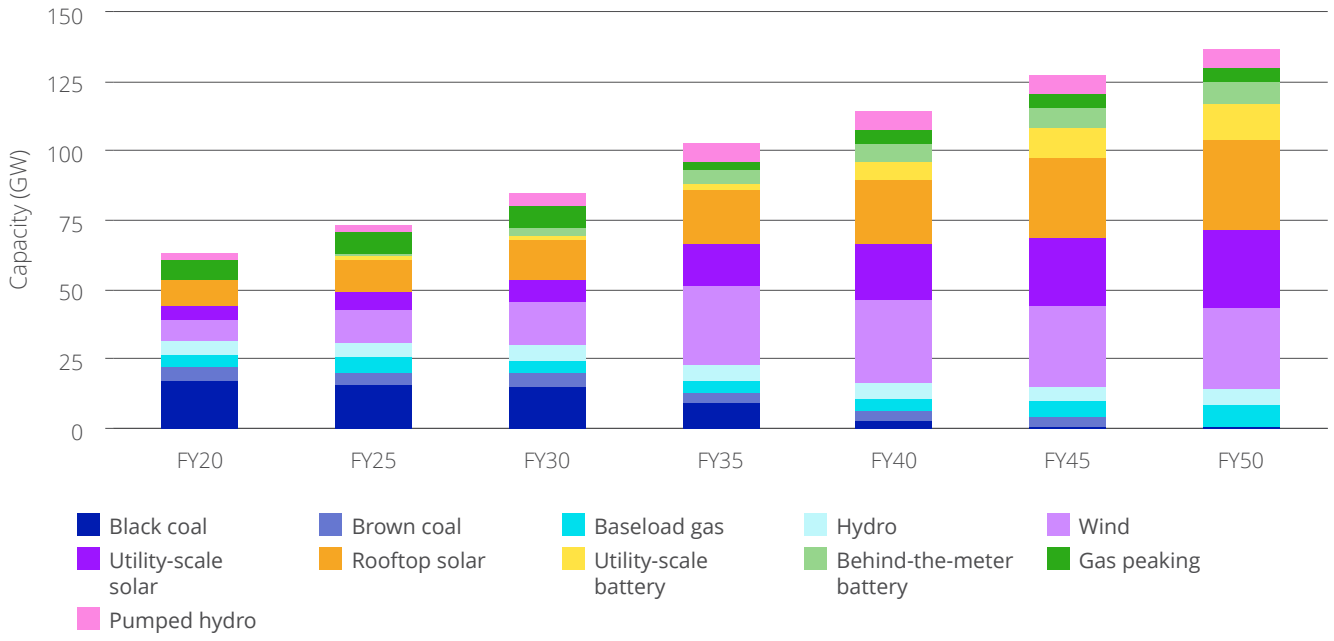
There would be significant physical climate impacts beginning to be felt throughout the 2020s and material impacts would be felt across the economy. In response, Scenario C assumes that global governments intervene dramatically to facilitate a rapid policy response to decarbonise the entire economy. The pace of change would not be economically efficient and would have a major impact on economic growth. The delay in action would also result in the worst physical impacts of climate change being realised in the short term due to locked-in warming. The inevitable policy reaction is assumed to be strong and globally consistent, as governments would attempt to arrest the impact of climate change with large subsidies for low-carbon technologies and strong environmental regulations.

Australia would follow a similar path, with uncoordinated policy succeeded by disruptive and holistic government intervention towards 2030 to drive rapid decarbonisation.

7.3.2 Market Modelling Results

Figure 22 outlines the modelled generation capacity in the NEM to 2050, by fuel type.

Figure 22: NEM generation capacity by fuel type, Scenario C



Scenario C mirrors Scenario A until 2030. The modelling shows a significant increase in wind generation and capacity from 2030 in the NEM, with a corresponding decrease in coal capacity and generation. Rooftop solar and utility-scale battery capacity also increase across the model compared with Scenario A.

Figure 23 and Figure 24 show AGL's modelled generation mix and associated carbon emissions under Scenario C (considering only currently owned, operated or controlled assets, and not incorporating any future development opportunities).

7. Scenario Analysis Detail: Results, Risks and Opportunities (continued)

Figure 23: AGL generation volumes by fuel type by financial year, Scenario C

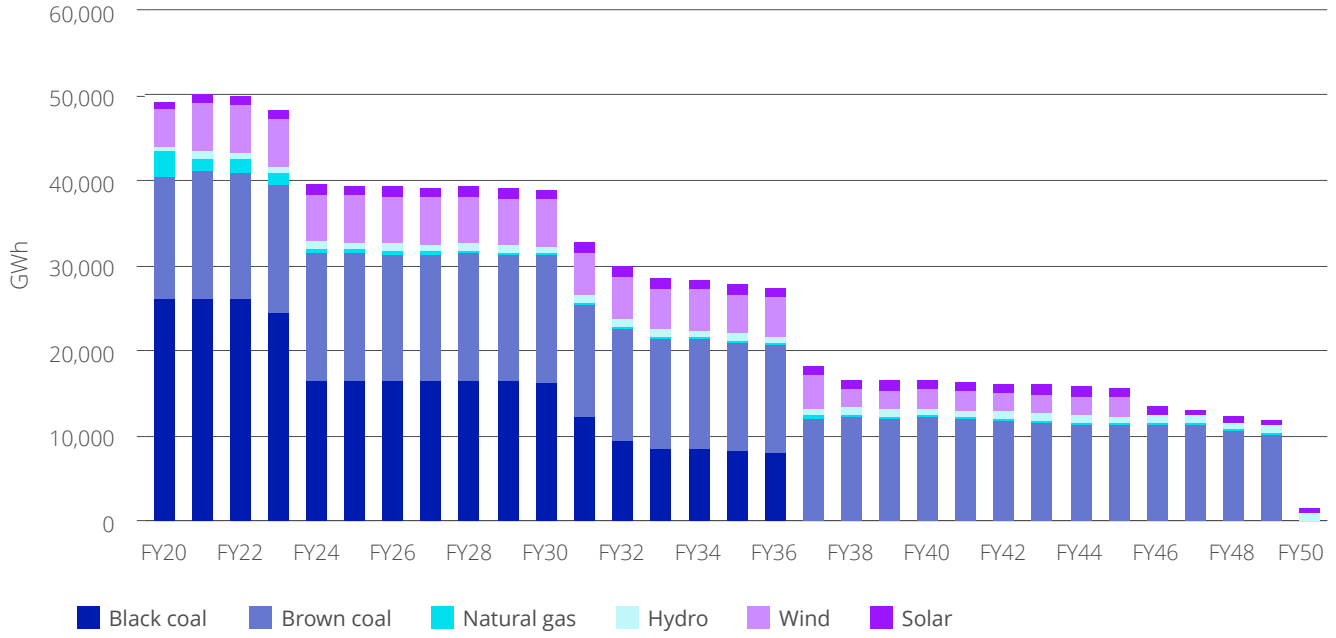
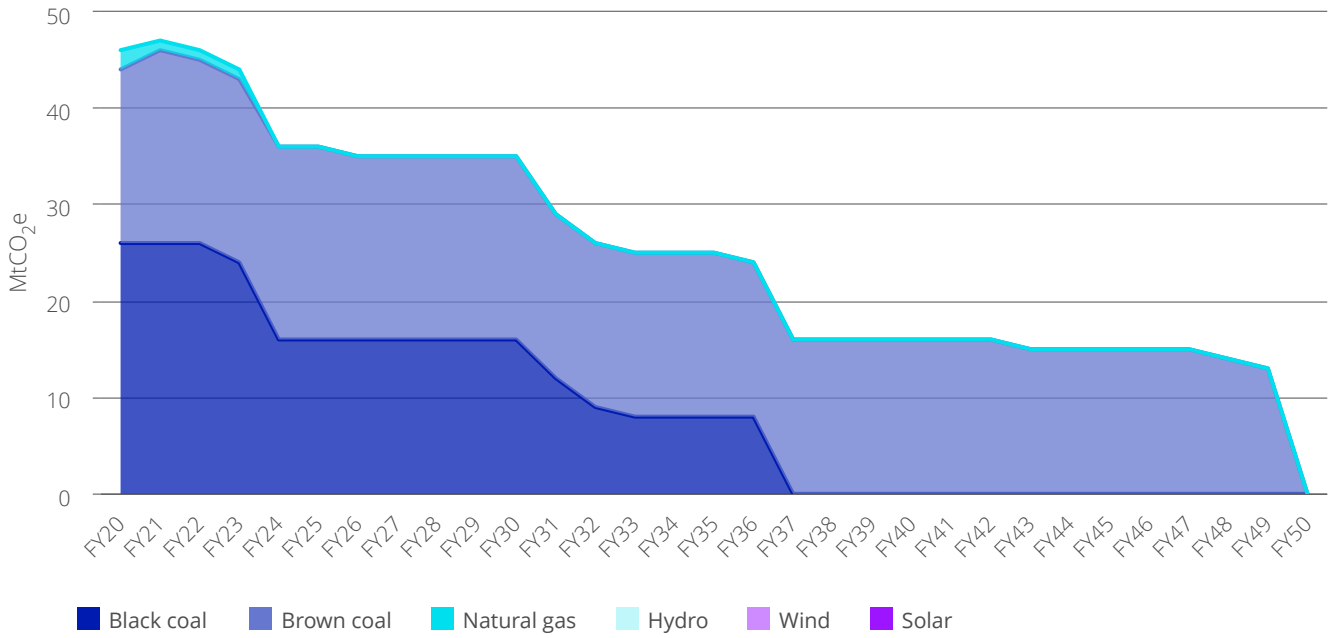


Figure 24: AGL carbon emissions by fuel type by financial year, Scenario C



In Scenario C, AGL's coal generation fleet would continue to operate at a consistent load factor aligning with Scenario A until 2030. From this point the modelled impact of the carbon constraint limits demand and increases costs for high intensity assets, resulting in a significant decrease in generation from higher cost coal assets. Under this scenario there is no early closure of AGL's coal assets, and AGL would continue to realise value from these assets.

AGL's emissions profile would reduce in line with Scenario A followed by a step change post 2030 and with further step changes resulting from scheduled plant closures. In comparison to a FY20 baseline this leads to a 22% reduction in emissions in FY24 post closure of Liddell Power Station, a 65% reduction in emissions in FY37 post the closure of Bayswater Power Station, and practically a 100% reduction in emissions in FY50 post the closure of Loy Yang A Power Station.

7.3.3 Risks and Opportunities

Customers

Scenario C combines global scenario assumptions from SSP3 to 2030 and SSP1 from 2030. Resulting from this, customers would drive trends towards a green and renewable economy in the absence of governmental policy, and decentralised energy resources would increase significantly due to continued technology cost declines in line with what is seen in Scenario A until 2030. Customers would then rapidly shift away from emissions-intensive products due to environmental concerns and climate policies. Distributed energy uptake would increase rapidly in 2030, with 4 GW of rooftop solar installed over three years. Customers would continue to rapidly uptake decentralised energy in response to societal expectations to reduce emissions, including the uptake of electric vehicles alongside 33 GW of rooftop solar by 2050. From 2030 AGL would see significant opportunities in behind-the-meter technologies particularly in the rooftop solar, battery and orchestration space.

Community

Scenario C would see global economies continue to grow, contributing to a 10% increase in electricity demand over the decade to 2030. There would be a large disruption to the global and Australian economy as an immediate climate change policy response is implemented in 2030, leading to significant electricity price increases. Society would need to transition rapidly to a less resource-intense lifestyle and Australian economic growth would decline further, while the carbon constraint would curtail growth in electricity demand despite electrification.

Climate impacts would exacerbate the frequency of natural disasters such as bushfires and floods, increasing the risk of disruption to transmission infrastructure in the NEM. Locked-in warming due to the emissions to 2030 would mean droughts may become more severe and last longer across the country, potentially leading to restrictions on water access for generators. Severe weather events such as extreme droughts may be far more frequent, causing lowered efficiency for thermal generators and additional transmission outages.

Technology

In the near term there would be minimal additional progress in low-carbon technological developments and renewable generation uptake would continue at the current pace to 2030. Post 2030, green financing would increase rapidly in response to regulation and utility-scale renewables would come online rapidly in the NEM. The market modelling shows an additional 31 GW of renewable capacity over the decade from 2030 to 2040, reaching 85% of NEM capacity by 2050. Additionally, in the decade to 2050 it is anticipated that technologies like green hydrogen would be more widely utilised. There would be a significant opportunity under this scenario for AGL to continue to invest in renewable generation in order to offset the risks associated with the lower demand for thermal generation.

Key AGL Opportunities

AGL's opportunities lie in maintaining or gaining market share by developing products and services in the areas of generation, orchestration, connection and trading and supply. In Scenario C AGL envisages the following opportunities arising assuming AGL retains our current market share:

- Increased opportunities for the development of large-scale renewable generation, exceeding 4.5 GW of utility-scale solar and over 4 GW of wind generation.
- Increased opportunities for low emissions firming capacity including over 2 GW of utility-scale battery capacity.
- The accelerated uptake of home batteries and rooftop solar equating to over 1.5 GW and 5 GW of new capacity respectively.
- The accelerated uptake of electric vehicles leading to an additional 8 TWh of demand for AGL.

In addition, it is anticipated that under this scenario there would be an increased demand for alternative energy products such as green hydrogen for uses such as in the production of green steel.

7. Scenario Analysis Detail: Results, Risks and Opportunities (continued)

7.4 Scenario D – 1.5 Degree Limit

7.4.1 Overview

In Scenario D, according to the assumptions under SSP1, governments around the world would quickly act to implement strong and cooperative carbon constraints. There may be a high degree of 'penalty-led' regulation around the world, as polluting industries could incur higher import and export taxes and tariffs based on carbon emissions. There would also be high levels of investment into green and low-carbon technologies such as electric vehicles and hydrogen, driving further change as electricity becomes increasingly renewable.

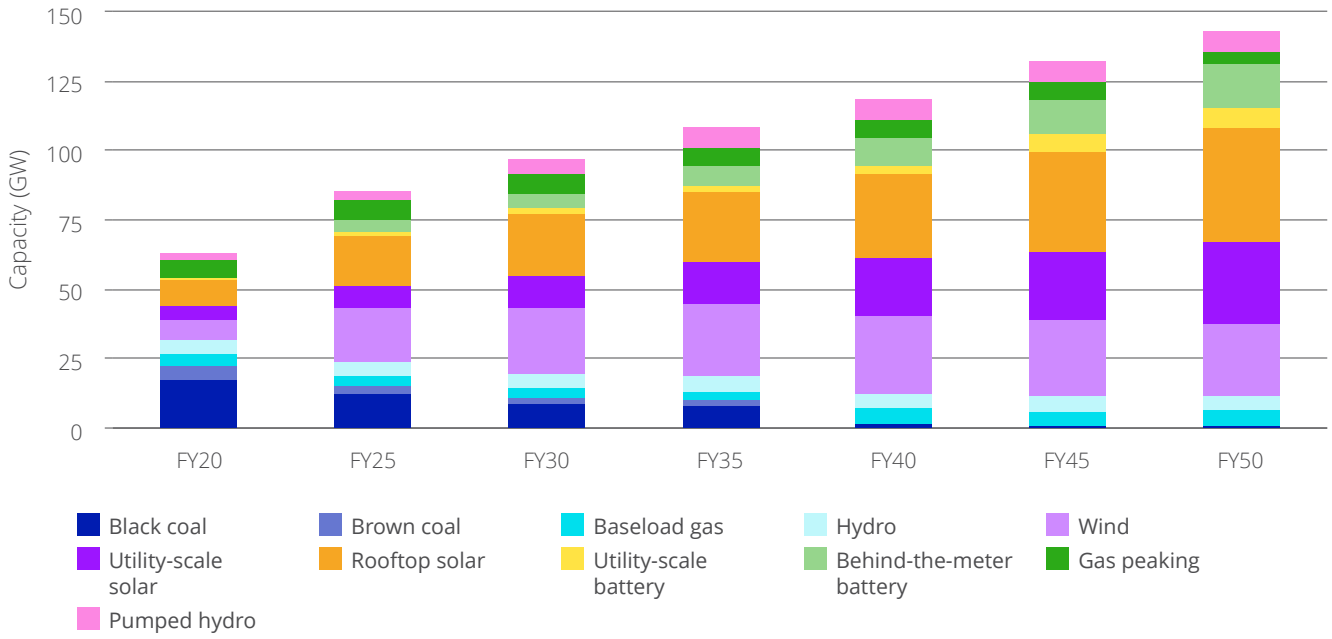
While regional trade may initially be impacted by strict climate constraints, it would rebound due to the development of low-carbon transport and globally coordinated trade markets. The economy would quickly transition towards low-emissions technology and consumers would drive further change in the electricity sector from behind-the-meter to limit their environmental footprint.

In Australia, the government would act as a leader on the world stage with regard to climate policy, introducing economy-wide reforms and leading participation in global trade and carbon markets.

7.4.2 Market Modelling Results

Figure 25 shows the modelled generation capacity in the NEM to 2050, by fuel type under Scenario D.

Figure 25: NEM generation capacity by fuel type, Scenario D



The modelling results show that significantly lower coal generation and capacity would be required across the NEM as well as less gas generation in the period from 2045 in comparison to Scenario A. The carbon constraint would price out coal initially, resulting in an increase in wind in the short term with further increases in both rooftop and utility-scale solar from 2030 onwards. There would also be significant capacity increases in behind-the-meter batteries. In comparison with Scenario A there would be an increase in capacity in rooftop solar in the early years of the model which, when combined with the lower assumed demand in this scenario, leads to a lower growth in wind capacity.

Figure 26 and Figure 27 show AGL's modelled generation mix and associated carbon emissions under Scenario D (considering only currently owned, operated or controlled assets, and not incorporating any future development opportunities).

7. Scenario Analysis Detail: Results, Risks and Opportunities (continued)

Figure 26: AGL generation volumes by fuel type and financial year, Scenario D

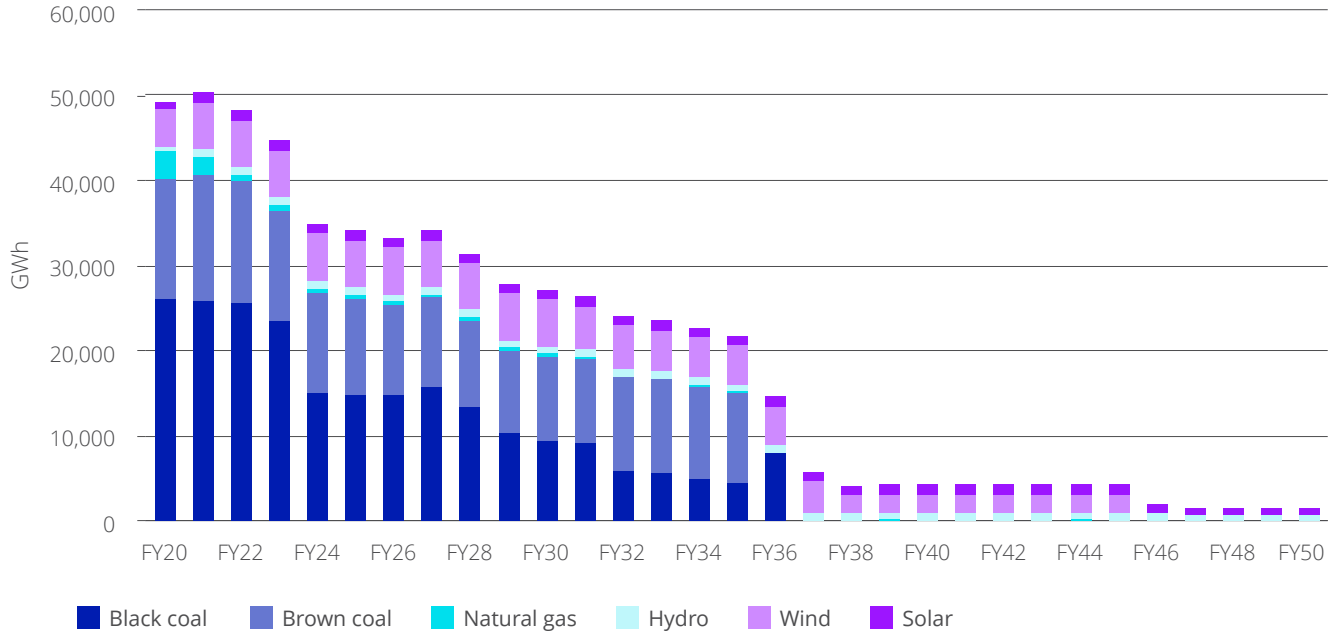
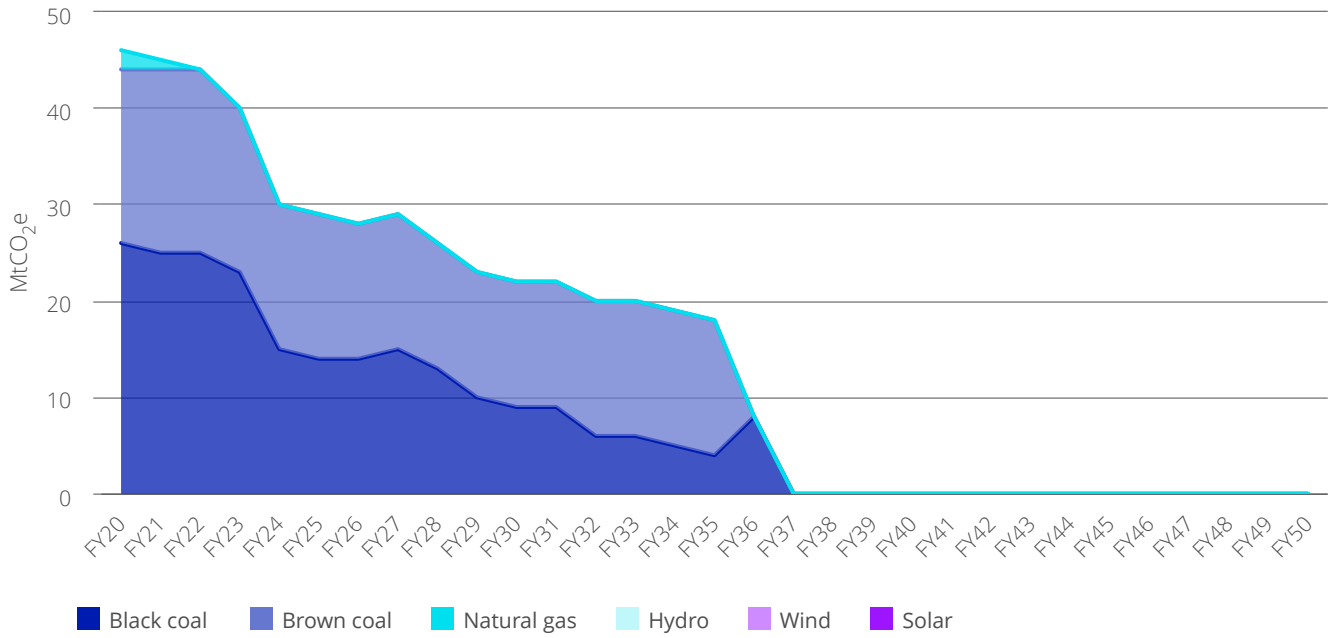


Figure 27: AGL carbon emissions by fuel type by financial year, Scenario D



In Scenario D, AGL's coal generation fleet would experience higher costs due to the imposed carbon constraint, translating into lower generation from these assets. The 2030s would see more renewable generation in the market leading to a decrease in the load factors of AGL's remaining coal assets. This would lead to Loy Yang A Power Station closing in FY35, shortly followed by Bayswater Power Station which would operate at or close to its minimum generation capacity from FY32 until closure.

AGL's emissions profile would reduce in line with coal generation. The emissions profile would see a significant drop after the closure of Liddell Power Station leading to a 34% reduction in emissions in FY24 in comparison to a FY20 baseline. In FY37, post the closure of the Bayswater and Loy Yang A power stations, this scenario results in practically a 100% reduction in emissions from an FY20 baseline.

7.4.3 Risks and Opportunities

Customer

Under Scenario D, the assumptions of SSP1 indicate that global population growth would increase, consumers would trend towards environmental decisions, and there would be a rapid uptake of decentralised energy resources driven by strong government policies. There would also be rapid uptake of electric vehicles by consumers in Australia due to cost reduction and development of charging infrastructure. By the 2040s the modelling shows that electric vehicles would require over 40 TWh of electricity, rooftop solar capacity would be over 40 GW, and household battery storage would make up 16 GW of capacity. This scenario would offer the greatest range of opportunities for AGL in behind-the-meter technologies .

Community

Under Scenario D, the most severe physical climate impacts would be avoided. This scenario would in turn limit AGL's physical risks from climate change. There would however be a continued rise in the frequency and impact of severe weather events globally, and storm activity may lead to increased disruption to transmission and generation infrastructure, while water availability concerns would be lessened through increased recycling and desalination.

Technology

Scenario D would involve increased public and private investment in energy to aid rapid decarbonisation, with the modelling indicating 25 GW of utility-scale renewables would be deployed over the decade to 2030. Investment in low-carbon technologies and energy efficiency would also be up-scaled by a factor of six compared with 2015 and would make up 89% of the generation capacity in the NEM by 2050. AGL would see further opportunities from utility-scale renewable and firming capacity investment in the NEM under this scenario.

Key AGL Opportunities

AGL's opportunities lie in maintaining or gaining market share by developing products and services in the areas of generation, orchestration, connection and trading and supply. In Scenario D, AGL envisages the following opportunities arising assuming AGL retains our current market share:

- Increased opportunities for the development of large-scale renewable generation, including over 4 GW of utility-scale solar and over 3 GW of wind generation.
- Increased opportunities for low emissions firming capacity including over 1 GW of utility-scale battery capacity.
- The accelerated uptake of home batteries and rooftop solar equating to over 3 GW and 6 GW of new capacity respectively.
- The accelerated uptake of electric vehicles leading to an additional 8 TWh of demand for AGL.

In addition, it is anticipated that under this scenario there would be an increased demand for alternative energy products such as green hydrogen for uses such as in the production of green steel.

8. Metrics and Targets

AGL remains committed to transparent disclosure of a range of metrics and targets to ensure investors and other stakeholders are able to better assess our emission and risk exposure profiles as well as our progress in managing or adapting to these issues.

We use a number of metrics to measure our greenhouse gas emissions and impact and disclose publicly to investors and other stakeholders through our **Annual Report**, **ESG data centre**, and by responding to the CDP climate change survey. We also disclose emissions to the Clean Energy Regulator to meet the requirements of Australia's *National Greenhouse and Energy Reporting Act 2007* (NGER Act).

8.1 Operated Scope 1 and 2 Emissions

Of AGL's operated greenhouse emissions, the most material are those arising from the combustion of coal and gas to produce electricity. The scope 1 emissions from AGL's material coal and gas-fired power stations contribute to over 99% of AGL's total scope 1 emissions.

AGL's scope 1 and 2 emissions across the business totalled 42.7 $MtCO_2e$ in FY20, which has decreased from FY19 due to the extended forced outage of Unit 2 at the Loy Yang A Power Station. Total Scope 1 and 2 emissions from AGL's operated facilities as reported under the NGER Act are summarised in Table 14. Further breakdowns of AGL's FY20 emissions will be available in AGL's **ESG data centre** towards the end of 2020.

Table 14: AGL historical emissions by generation source

AGL Total Carbon Emissions	FY19 ($MtCO_2e$)	FY18 ($MtCO_2e$)	FY17 ($MtCO_2e$)	FY16 ($MtCO_2e$)
Scope 1: black coal generation	22.6	21.5	23.0	23.5
Scope 1: brown coal generation	18.5	19.9	18.7	18.1
Scope 1: natural gas generation	1.6	1.7	1.7	1.6
Other scope 1 emissions	0.0	0.1	0.1	0.1
Total scope 1 emissions[1]	42.7	43.1	43.4	43.3
Total scope 2 emissions	0.5	0.5	0.5	0.5
Total scope 1 & 2 emissions[1]	43.2	43.6	43.9	43.8

1. Figures may not sum due to rounding

8.2 Generation Portfolio Metrics

AGL has heavily invested and continues to invest in renewable energy generation. In the past decade AGL has increased its renewable energy generation fourfold to over 4.4 TWh. AGL's percentage of generation from renewables has also grown over this period. Table 15 below outlines the changes in AGL's proportion of generation and capacity from renewables.

Table 15: AGL proportion of generation output and capacity from renewables

Metric	FY 20 (%)	FY19 (%)	FY18 (%)	FY17 (%)	FY16 (%)
Operated renewable energy generation output	10.0%	9.8%	8.8%	7.9%	9.1%
Controlled renewable energy generation putput	10.0%	9.8%	8.8%	7.9%	9.0%
Operated renewable and electricity storage capacity	22.5%	19.9%	18.4%	18.4%	18.4%
Controlled renewable and electricity storage capacity	22.5%	19.6%	18.4%	18.4%	18.4%

8.3 Generation Intensity Metrics

AGL's emissions intensities by generation type and as a whole are shown Table 16.

Table 16: Emissions intensity of AGL assets, AGL and the NEM

	FY20 (tCO_2e/MWh)	FY19 (tCO_2e/MWh)	FY18 (tCO_2e/MWh)	FY17 (tCO_2e/MWh)	FY16 (tCO_2e/MWh)
Operated black coal generation intensity	Not available	0.95	0.95	0.96	0.96
Operated brown coal generation intensity	Not available	1.28	1.30	1.30	1.28
Operated natural gas generation intensity	Not available	0.62	0.61	0.61	0.63
Total operated generation intensity	**0.94[1]**	**0.95**	**0.97**	**0.98**	**0.96**
Total controlled generation intensity	**0.93[1]**	**0.95**	**0.96**	**0.97**	**0.95**
NEM intensity	**0.72**	**0.77**	**0.82**	**0.88**	**0.90**

1. FY20 generation intensity is calculated on measured emissions from material sources and measured electricity generation, with estimates for minior emissions sources. These metrics will be updated later in 2020 and may change.

The intensity of AGL's fossil fuel generation fleet has been generally steady over the last five years, however AGL continues to invest in efficiency projects and upgrades to improve the performance of these assets. AGL's overall operated generation intensity is trending down from a peak of over 1 tCO_2e/MWh in FY13. This is primarily being driven by increased generation volumes from low or zero emissions technologies.

8. Metrics and Targets (continued)

The decrease in intensity in FY20 is due to the reduction in generation from the Loy Yang A Power Station and increased renewable generation from the Silverton and Coopers Gap wind farms.

AGL's controlled intensity includes assets for which AGL has contracted for generation output but does not operate in addition to assets which are operated by AGL. It is anticipated that as AGL continues to contract for new renewable generation, this intensity will diverge from AGL's operated intensity.

8.4 Revenue-related Metrics

The emissions intensity of revenue (Table 17) has been relatively consistent over the past five years, indicating a consistent link between revenue and carbon emissions over this period. As AGL continues to diversify both electricity generation and revenue sources it is anticipated that this metric will decline.

The increase in the intensity in FY20 is due to decreasing wholesale electricity prices driving revenue down .

Table 17: AGL's emissions intensity of revenue

	FY20 ($ktCO_2e/\$m$)	FY19 ($ktCO_2e/\$m$)	FY18 ($ktCO_2e/\$m$)	FY17 ($ktCO_2e/\$m$)	FY16 ($ktCO_2e/\$m$)
Emission intensity of revenue	3.5	3.3	3.4	3.5	3.9

AGL recognises that managing carbon risk is about managing both direct and indirect emissions and that customers will continue to be a key driver in this space. Table 18 outlines the proportion of total revenue derived from green energy and carbon neutral products and services.

Table 18: AGL's proportion of revenue derived from green energy and carbon neutral products and services

	FY20 (%)	FY19 (%)
Revenue from green energy and carbon neutral products and services	11.5%	10.8%

8.5 Scope 3 Emissions

AGL's scope 3 emissions are dominated by the emissions associated with the supply and end use of the products that AGL sells. Table 19 outlines these emissions.

As the energy sector decarbonises, scope 3 emissions from the supply of electricity to customers and the end use of coal sold to the (non-AGL operated) Loy Yang B Power Station will decline. In a fully decarbonised electricity market, these emissions will be reduced to zero. This trend can be seen in Table 19 where AGL's scope 3 emissions from the supply of electricity to customers continues to decrease as our supply to customers remains relatively consistent with last year.

The energy transition is also anticipated to lead to significant electrification and conversion of natural gas users to alternative energy sources (such as renewable hydrogen) over the long-term. As this occurs, AGL's scope 3 emissions from the supply of natural gas to customers and the end use of natural gas will decline.

AGL's material scope 3 emissions for FY20 are in Table 19. Other scope 3 emissions will be available later in 2020.

Table 19: AGL scope 3 emissions

Scope 3 Emissions Source	FY20 ($MtCO_2e$)	FY19 ($MtCO_2e$)	FY18 ($MtCO_2e$)	FY17 ($MtCO_2e$)	FY16 ($MtCO_2e$)
Supply of electricity to customers (emissions associated with the transmission and distribution of electricity as well as from generation where AGL is short, e.g. Queensland)	6.6	7.3	8.0	7.2	8.7
Supply of natural gas to customers (emissions associated with the production, transportation and distribution of natural gas sold)	1.7	2.0	2.0	2.4	2.6
End use of natural gas by customers	6.5	7.0	7.6	10.1	9.8
End use of coal sold to Loy Yang B	10.6	9.7	10.2	9.8	9.8
Other (emissions from staff travel, waste, investments etc.)	Not available	0.3	0.4	0.3	0.5
Total Scope 3 emissions		**26.3**	**28.2**	**29.9**	**31.3**

8. Metrics and Targets (continued)

8.6 Targets

AGL has committed in our 2020 Climate Statement to pursue the goal of net zero emissions by 2050. In addition, we have also committed to including carbon transition metrics in AGL's long-term incentive (**LTI**) plan for our executives from FY21. These metrics comprise the emissions intensity of AGL's controlled generation fleet, the controlled proportion of renewable and electricity storage capacity, and the share of total revenue derived from green energy and carbon neutral products and services.

Table 20 outlines AGL's historical performance on these three metrics. For further details and the associated targets see AGL's Remuneration Report within the FY20 **Annual Report**.

Table 20: Long-term Incentive plan metrics

Metric	FY 20	FY19	FY18	FY17	FY16
Controlled generation intensity (tCO_2e/MWh)	0.93[1]	0.95	0.96	0.97	0.95
Controlled renewable and electricity storage capacity (%)	22.5%	19.6%	18.4%	18.4%	18.4%
Revenue from green energy and carbon neutral products and services (%)	11.5%	10.8%	Not reported	Not reported	Not reported

1. FY20 generation intensity is calculated on measured emissions from material sources and measured electricity generation, with estimates for minior emissions sources. This metric will be updated later in 2020 and may change.

In 2015, AGL committed via our Greenhouse Gas Policy not to extend the life of our coal-fired power plants. The closure of these plants at their end of life will result in significant decreases in AGL's operated scope 1 emissions. The first of these closures will be the closure of the Liddell Power Station in 2023. The closure of Liddell is the equivalent of AGL ceasing to emit approximately 8 $MtCO_2e$ annually. Similarly, the closure of all AGL's coal fired power stations is the equivalent of ceasing to emit over 40 $MtCO_2e$ annually.

Table 21 describes the emissions reduction at key dates under each scenario. These figures help to give context to the metrics discussed in the previous sections and whilst not predictions are indicative of emissions reductions required by AGL to meet each scenario.

Table 21: AGL percentage emissions reduction from FY20 under each scenario.

Scenario	FY30	FY40	FY50
Scenario A (National Targets)	23%	58%	100%
Scenario B (Response 2020)	28%	63%	100%
Scenario C (Response 2030)	23%	65%	100%
Scenario D (1.5 Degree Limit)	39%	100%	100%

AGL operates within a highly regulated environment and our assets are critical to the continued reliability of the NEM in the short to medium term. While we are committed to the decarbonisation of our portfolio and expect the NEM to be at net zero by 2050, AGL is not able to make unilateral commitments to closing power stations in advance of government policy as this may lead to unintended outcomes. As such, AGL considers that setting targets to reduce our operated emissions in alignment with the requirements of the Science Based Target initiative (**SBTi**) is not currently practicable as this framework would require AGL to decarbonise by at least 50% by 2035. A commitment of this scale would require early closure or decreased generation output of part or all of AGL's baseload generation fleet and could not be achieved unilaterally given the current regulatory framework in Australia.

9. The Next Steps

As AGL looks to FY21 we are committed to evolving our reporting under the TCFD framework. AGL was one of the first companies in Australia to disclose in accordance with the TCFD framework and our ongoing TCFD disclosure reflects our commitment to transparency as outlined in our Climate Statement.

In FY21, AGL's TCFD report and scenario analysis will comprise several additional aspects including:

- Climate scenario analysis and outcomes will be further integrated with our commercial portfolio planning processes. This will allow AGL to further integrate the impacts of climate change into ongoing business decision making.
- The impacts of the COVID-19 pandemic on the energy sector will be incorporated to ensure the underlying energy market trends are accounted for.
- Updated and new analysis including the final 2020 AEMO ISP, AEMO Renewable Integration Study and the IPPC Sixth Assessment Report will be considered and incorporated where relevant.
- Additionally, we recognise that our stakeholders are increasingly interested in how the physical impacts of climate change may affect our assets and our scenario outcomes, and we anticipate that physical risk will form a larger component of future reports.

AGL will build upon the engagement and feedback processes undertaken in FY20. We will continue to review and improve on our disclosures and scenario analysis through this continued engagement with our investors and key stakeholders to ensure that our disclosures continue to provide information that is useful to them.

AGL's commitment to action on climate change and the energy transition has been reiterated in our 2020 Climate Statement and with our commitment to a target of achiveing net zero emissions by 2050. The Climate Statement includes five commitments where we are already taking action:

1. **Offer customers option of carbon neutral prices across our products:** AGL has launched a certified carbon neutral electricity product and we have committed to providing our customers with a carbon neutral option across all products by the end of FY21.
2. **Support evolution of Australia's voluntary carbon markets:** AGL will continue to trade in Australian Carbon Credit Units (**ACCUs**) as well as participating in voluntary emissions reduction trading in conjunction with new carbon counterparties.
3. **Continue investing in new sources of electricity supply:** AGL is continuing to invest in firmed renewable generation development, including new gas peaking generators, utility-scale batteries and other energy storage technologies.
4. **Responsibly transition our energy portfolio:** AGL has given long-term notice for the closure of our thermal coal assets, and we will continue to partner with the communities in which we operate to ensure the best outcomes for those communities.
5. **Be transparent:** AGL will continue to engage with stakeholders on climate change issues and disclose under the TCFD framework. We have also incorporated climate metrics into the long-term incentive program to ensure transparent accountability.

AGL understands that the pace and path of this transition will be driven by the forces of customer demand, communities' actions and the evolution of technology, and our Climate Statement ensures we will meet those expectations.

Glossary

AASB	Australian Accounting Standards Board
ACCU	Australian Carbon Ccredit Unit
AEMO	Australian Energy Market Operator
AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change, released in 2014
AR6	Sixth Assessment Report of the Intergovernmental Panel on Climate Change, yet to be released
ARMC	Audit and Risk Management Committee, an AGL Board subcommittee
ASIC	Australian Securities and Investment Commission
BTM	Behind-the-meter
CCGT	Combined cycle gas turbine
CCS	Carbon capture and storage
CDR	Carbon dioxide removal
CO_2e	Carbon dioxide equivalent
Controlled boundary	AGL's controlled boundary includes all electricity assets (generation and/or storage) for which AGL Energy has: ownership; and/or operational control as defined by the National Greenhouse and Energy Reporting Act 2007; and/or contracted rights to control the dispatch of electricity of the asset.
COP21	21st Conference of Parties to the United Nations Framework Convention on Climate Change, held in 2015 in Paris
DER	Distributed energy resources
ESG	Environmental, social and governance
EV	Electric vehicle
FCAS	Frequency Control Ancillary Services
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
IPR	Inevitable Policy Response
ISP	AEMO Draft Integrated System Plan 2020 (2019)
LTI	Long-term incentive
MW, GW, TW	Megawatt, gigawatt, terawatt
MWh, GWh, TWh	Megawatt hours, gigawatt hours, terawatt hours
NDC	Nationally Determined Contribution (under the Paris Agreement)
NEM	National Electricity Market
Net zero	The modelling process used a 'net zero' rather than 'absolute zero' approach to emissions reduction by 2050. For the purposes of this report net zero emissions is the point at which emissions have reached a level where they are able to be offset through existing commercially available technologies.
NGER	National Greenhouse and Energy Reporting Act, 2007
Operated boundary	The AGL operated generation boundary includes electricity assets for which AGL has operational control as defined by the National Greenhouse and Energy Reporting Act, 2007.
PARF	Powering Australia Renewables Fund
Paris Agreement	An agreement made at COP21 to address climate change, with the central aim of this agreement being to limit warming this century to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit warming even further to 1.5 degrees Celsius above pre-industrial levels.
PPA	Power Purchase Agreement
PRI	Principles for Responsible Investment
RCP	Relative Concentration Pathways, concentration pathways for greenhouse gases and aerosols, demonstrating possible future emissions and radiative forcing (i.e. temperature intensity) scenarios for the world until 2100, as defined by the IPCC.
SBTi	Science-Based Targets Initiative
Scope 1 emissions	Direct greenhouse gas emissions
Scope 2 emissions	Indirect greenhouse gas emissions arising from the consumption of purchased electricity, heat or steam
Scope 3 emissions	Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. transportation and distribution losses) not covered in Scope 2, outsourced activities, waste disposal, etc.
SLL	Sustainability Linked Loan
SSP	Shared Socioeconomic Pathways, which describe how socioeconomic trends around the world may evolve over time, as defined by the IPCC (2017).
TCFD	Task Force on Climate-related Financial Disclosures
VPP	Virtual Power Plant