



# Powering a Climate Resilient Economy

AGL's approach to  
climate-related financial risk

August 2018



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## About this report

In July 2017, the Task Force on Climate-Related Financial Disclosures (TCFD) released its final recommendations, under the mandate of the G20 Financial Stability Board. These recommendations outline a voluntary framework to promote better disclosure of climate-related financial risks. The TCFD underscored that increasing transparency makes markets more efficient and economies more stable and resilient.

The TCFD highlighted that climate change is one of the most significant and perhaps most misunderstood risks that organisations face today. The financial impacts of climate-related risks are often overlooked because of challenges that can be faced in measuring these risks.

AGL believes that the TCFD framework enables market participants to disclose clear, comparable, and consistent information about the risks and opportunities climate change poses. This will assist AGL's investors, lenders, insurers, and other stakeholders to better understand how AGL is managing this issue.

This report combines previously disclosed work on scenario analysis along with additional discussion of the key risks and opportunities in a way that follows the key recommendations of the TCFD.

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## CEO statement

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**Andrew Vesey**  
Managing Director and  
Chief Executive Officer

“AGL acknowledges and accepts the scientific consensus on climate change and notes that to stay within concentrations consistent with two degrees of warming or less, a gradual decarbonisation of the electricity generation sector is likely required by 2050.

As one of Australia’s leading integrated energy companies, and Australia’s largest greenhouse gas emitter, we have a responsibility to be transparent about climate change, and the risks and opportunities it poses to our business. We believe the TCFD-recommended framework allows us to do just that in a way that is clear for our stakeholders to understand.”

# 1. Executive summary

## Climate change and transitioning to a low carbon future

In recent years, AGL has sought to play a leading role in the way business engages on the important issue of climate change. AGL has given serious consideration to the physical and transitional risks and opportunities associated with climate change and the transition towards a low-carbon economy. Decarbonisation is a fundamental imperative that will drive the future of energy.

## What AGL is doing to prepare for risks and opportunities?

This report represents the evolution of AGL's approach to climate change, as AGL continues to adapt to the reality of a carbon constrained future. It sets out AGL's current understanding of the climate-related financial risks and opportunities to its business.

In 2015, AGL released its Greenhouse Gas Policy<sup>1</sup>, outlining the company's commitment to a range of measures that will drive the decarbonisation of Australia's energy sector while continuing to focus on customer affordability and system reliability. The same year, AGL adopted three core commitments under the 'We Mean Business' Coalition:

- Responsible corporate engagement on climate policy
- Reporting climate change information in mainstream corporate reports as a fiduciary duty, and
- Aligning with the UN Global Compact's Business Leadership Criteria on Carbon Pricing.

AGL supported the Australian Government's commitment to work towards a global agreement to limit global warming to less than 2°C above pre-industrial levels, which was reflected in the historic Paris Agreement.

In 2016, AGL developed and released a market-leading scenario analysis of AGL's operations within a carbon constrained future to understand better the long-term viability of its generation fleet across a range of potential scenarios. This was released in AGL's Carbon Constrained Future report.

AGL employs a multifaceted approach to climate change. It encompasses corporate strategy, governance structures, financial planning, risk management, operations and public policy.

AGL also employs a range of climate-related financial metrics and targets to measure its performance and outlook in addition to targeting a 10% reduction in the emissions intensity of its operated generation by FY24.

## What's in this report?

This report outlines AGL's approach to climate-related financial risk.

Section 2 outlines **AGL's strategy on climate change**, summarising AGL's views on Australia's energy market transformation and the ways in which AGL is positioned to ensure the company's long-term sustainability. This section also elaborates AGL's approach to scenario analysis.

Section 3 outlines **AGL's approach to corporate governance over climate-related financial risk**, including Board, Committee, and management oversight.

Section 4 discusses **material risks and opportunities to AGL's business**. While AGL anticipates some financial implications from the physical risks associated with climate change, it is the transitional risks associated with Australia's energy market transformation and transition to a low-carbon economy that present the most material risks to AGL's business.

Section 5 articulates **AGL's key metrics and targets on climate change** including its greenhouse gas footprints, thermal generation closure program, and emissions intensity target.

<sup>1</sup> See the AGL Greenhouse Gas Policy, available at: [https://content.agl.com.au/wp-content/uploads/2017/04/AGL\\_Greenhouse\\_Gas\\_Policy.pdf](https://content.agl.com.au/wp-content/uploads/2017/04/AGL_Greenhouse_Gas_Policy.pdf)

## 2. AGL's strategy on climate change

AGL is Australia's largest electricity generator and one of Australia's leading electricity and natural gas retailers. AGL's operated scope 1 emissions account for approximately 8% of Australia's total emissions. Over 95% of these emissions come from the combustion of coal for the generation of electricity.

**As the global economy undergoes deep structural change towards low-carbon and climate resilient growth, unprecedented amounts of capital investment will be required.**

This challenge is particularly apparent in the Australian energy sector. The generation mix in the National Electricity Market is emissions intensive by international standards, and 75% of the installed thermal capacity is already operating beyond its original design life. While electricity generation currently accounts for one third of Australia's greenhouse gas emissions, technological substitutes for fossil fuels are available and increasingly cost effective. Electricity generation also has the potential to facilitate emissions reductions in other sectors, notably transport, through electrification.

**Innovation will also play a central role in facilitating the global economy's continued growth in a carbon constrained future.**

Customers are driving a shift away from the traditional, linear electricity supply chain, to a more decentralised and bi-directional market. In addition to up to one in four households across Australia having installed solar PV, a proliferation of more advanced distributed energy resources (for example, digital metering, smart inverters, energy storage, energy management systems, household appliance with smart controls) are now entering the consumer market. These developments are affecting grid utilisation and fundamentally changing the way in which consumers interact with the electricity grid.

**Through its strategic imperatives and key objectives, AGL is positioned to lead Australia's energy market transformation, and the risks and opportunities that climate change presents.**

AGL has two key strategic imperatives: to prosper in a carbon constrained future, and to build customer advocacy. These imperatives drive AGL's four key objectives: to transition from being a mass retailer to a personalised retailer, from being an operator of large assets to an orchestrator of both large and small assets, from coal-fired power to lower emissions technology, and from leading in existing markets to growing into new ones. These objectives are driving AGL's strategy and decision-making as AGL engages in the multi-decade transition of Australia's energy sector. AGL's strategy includes its Greenhouse Gas Policy, which outlines its commitment to a range of measures that will drive the decarbonisation of Australia's energy sector while continuing our focus on customer affordability and system reliability.



### AGL's Greenhouse Gas Policy

AGL's Board-endorsed Greenhouse Gas Policy states its acceptance of the science of climate change and the likely outcome of decarbonisation of both the economy and electricity generation system, and made the following commitments:

- AGL will continue to provide the market with safe, reliable, affordable, and sustainable energy options.
- AGL will not build, finance, or acquire new conventional coal-fired power stations in Australia (i.e. without CCS).
- AGL will not extend the operating life of any of its existing coal-fired power stations.
- By 2050, AGL will close all existing coal-fired power stations in its portfolio.
- AGL will improve the greenhouse gas efficiency of our operations, and those in which we have an influence.
- AGL will continue to invest in new renewable and near-zero emission technologies.
- AGL will make available innovative and cost-effective solutions for our customers such as distributed renewable generation, battery storage, and demand management solutions.
- AGL will incorporate a forecast of future carbon pricing into all generation capital expenditure decisions.
- AGL will continue to be an advocate for effective long-term government policy to reduce Australia's emissions in a manner that is consistent with the long-term interests of consumers and investors.

## 2.1. Scenario analysis of a carbon-constrained future

Some aspects of Australia's transition to a low carbon economy are subject to considerable uncertainty. For instance, changes to government policy, consumer take up of new technologies, and the outlook for energy demand.

In addition to embedded risk management procedures, AGL also employs a comprehensive scenario analysis approach to its business strategy. Using this framework, AGL analyses uncertainty in areas critical to its business and develops several possible 'future states' that could result from different combinations of events and outcomes.

The scenario analysis process is premised on taking a broad view of possible futures, rather than a narrow forecast, enabling more robust investment and decision making. It captures strategic insight across the business to track leading indicators that suggest that the world may be shifting from one scenario to another, enabling strategy to pivot in response.

AGL's scenario analysis process enables it to maintain a constant and nuanced awareness of competitive pressures in the market, to anticipate changes in the markets in which it operates, and to respond in an agile fashion across its business.

Accordingly, AGL has undertaken scenario analysis of its operations within a carbon constrained future to understand better the long-term viability of AGL's generation fleet in a range of potential scenarios. AGL released the results of the scenario analysis in 2016 in its Carbon Constrained Future report.<sup>2</sup> Utilising modelling software, AGL analysed three scenarios of the National Electricity Market:

- Scenario 1: A carbon constraint that provides a linear pathway from emissions in 2016 to a 26-28% reduction in 2030 (the current Australian nationally determined contribution (NDC))
- Scenario 2: A carbon constraint that represents a carbon budget consistent with limiting climate change to 2 degrees above pre-industrial levels, and
- No carbon constraint.

The first scenario above was developed to reflect the existing Commonwealth Government commitment made through the Intended Nationally Determined Contributions (INDC) process during 2015. This commitment is to reduce emissions by 26-28% of 2005 levels by 2030. This may be seen as the 'minimum' emission reduction that is likely to apply in Australia given the agreement reached in Paris in December 2015 at the 21st Conference of the Parties (COP21) imposes an expectation that emission reduction targets will be 'ratcheted up' over time.

**Table 1: Scenario 1 – current government policy**

Parameter	Emissions (MtCO <sub>2</sub> e)
2005 Australian electricity sector emissions	195
2005 National Electricity Market emissions <sup>3</sup>	175
Target in 2030 (27% less than 2005)	128

Table 1 outlines the key parameters for establishing a National Electricity Market target for 2030. As AGL only operates in this market, it is necessary to adjust emission reductions on a proportional basis between this and other markets (e.g. the South-West Interconnected System in Western Australia). Using this pro-rata methodology yields an emission reduction target of 128 MtCO<sub>2</sub>e in 2030. To give effect to this target, the scenario utilises annual linear reductions in emissions that give effect to a 26-28% reduction by 2030, relative to 2005 levels. Emission reduction targets are not applied until 2020 to reflect the current policy environment.

The second scenario considered was developed based on evidence published by the Intergovernmental Panel on Climate Change (IPCC). Under that scenario, the total global 'carbon budget' that could be emitted between 2000 and 2050 with a view to maintaining a 67% chance of limiting global warming to 2 degrees Celsius is estimated at approximately 1,700 Gt of greenhouse gas emitted. In other words, by limiting emissions to this level, there is a reasonable chance that global temperature increases can be limited to less than 2 degrees Celsius. It is extremely difficult to envisage how a global limitation on emissions would be distributed among individual sovereign nations. Methodologies have been established that would allocate the global budget to individual nations based upon population, economic strength, and historical emissions. However, deriving a carbon budget for Australia is subjective and may be challenged by some stakeholders as either too high or too low.

Accordingly, this report utilises expert advice from the Climate Change Authority. In 2013, the Climate Change Authority stated:<sup>4</sup>

***'The Authority proposes a 'modified contraction and convergence' approach to calculating Australia's fair share of the global emissions budget. The approach is equitable and feasible. It involves a gradual convergence to equal-per-person emissions rights in the future. As a share of the global emissions budget, this implies a national budget of 10.1 Gt CO<sub>2</sub>e for the period 2013 to 2050. This is about 17 years of emissions at current levels and can be met through a mix of domestic and international emissions reductions.'***

Adopting a 10.1 Gt (10,100 Mt) overarching carbon budget for Australia for the period 2013 to 2050, it is possible to derive an emissions reduction trajectory for Australia as a whole, and then subsequently the Australian electricity sector and the National Electricity Market. This is outlined in Table 2.

<sup>2</sup> See AGL, Carbon Constrained Future: AGL's approach to climate change mitigation: a scenario analysis (2016), Available at [http://agl2016.sustainability-report.com.au/files/carbon\\_constrained\\_future.pdf](http://agl2016.sustainability-report.com.au/files/carbon_constrained_future.pdf)

<sup>3</sup> The National Electricity Market's emissions are approximately 90% of total Australian electricity sector emissions

<sup>4</sup> See <http://www.climatechangeauthority.gov.au/reviews/targets-and-progress-review/part-c> for further information

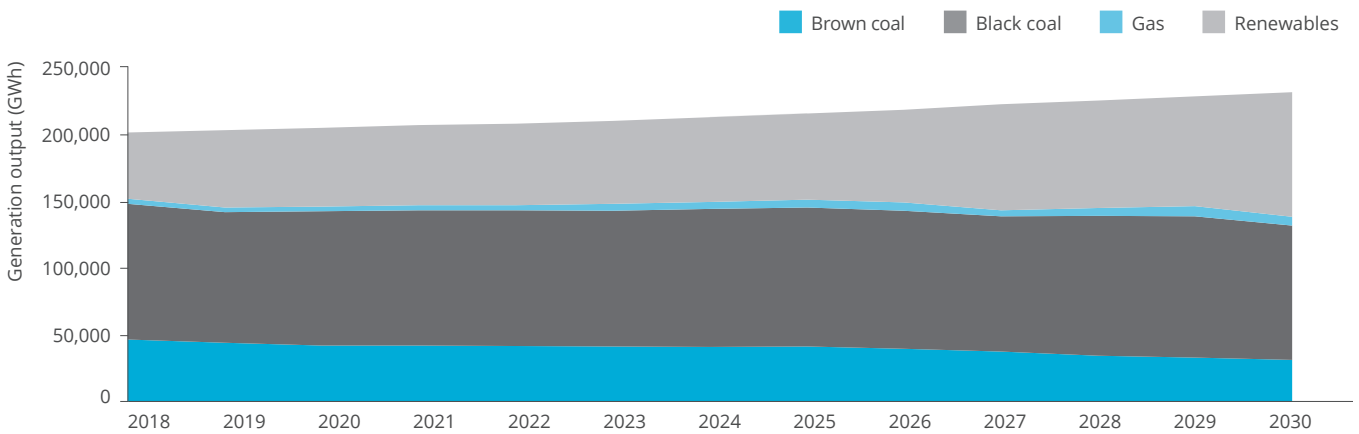
**Table 2: Scenario 2 - two degree; carbon budget**

Parameter	Emissions (MtCO <sub>2</sub> e)
Australian carbon budget (2013-2050)	10,100
Electricity sector share of budget <sup>5</sup>	3,363
National Electricity Market budget <sup>6</sup>	3,026

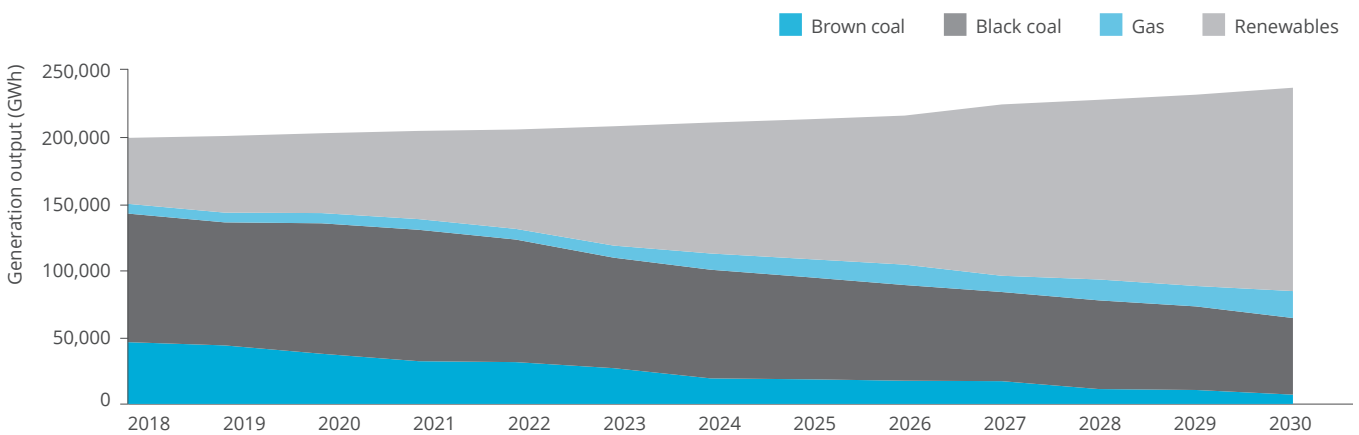
The annual reduction in emissions has been derived linearly from 2020 to reflect the current policy environment. Between 2020 and 2050, emissions are reduced by approximately 7% per annum which results in the sector being materially decarbonised by 2050.

AGL's analysis found that constraining emissions has a material impact on the generation mix within the National Electricity Market. Specifically, it shows that this would necessitate a reduction in both black and brown coal-fired output and a large increase in renewable energy generation. This is shown in Figure 1 and Figure 2.

**Figure 1: National Electricity Market generation output - scenario 1**



**Figure 2: National Electricity Market generation output - scenario 2**

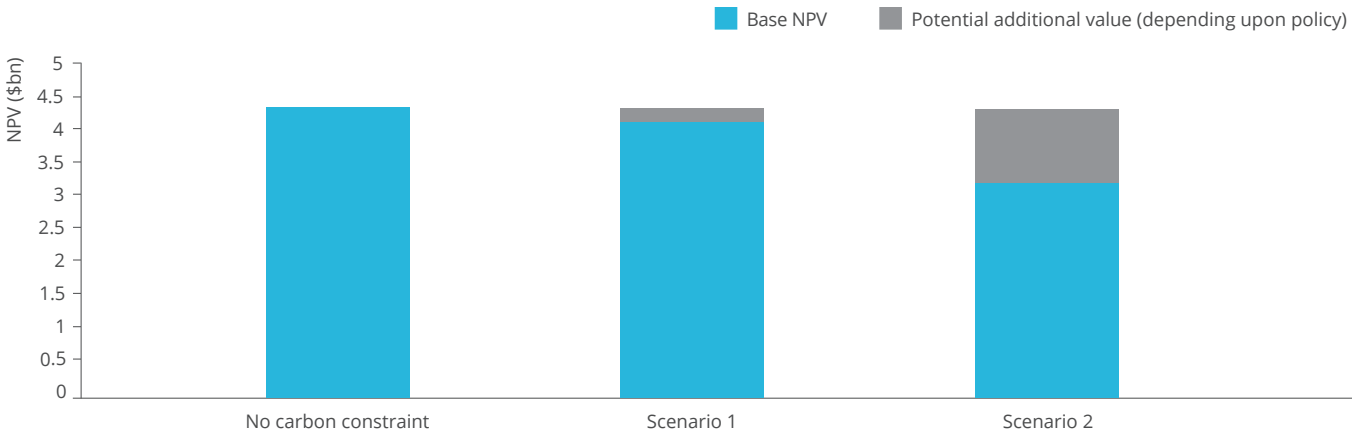


<sup>5</sup> As the electricity sector comprises around one-third of emissions, one-third of the national budget has been allocated to the electricity sector

<sup>6</sup> The National Electricity Market's emissions are approximately 90% of total Australian electricity sector emissions

Under the two scenarios above, when compared with the 'no carbon constraint' scenario, the modelling shows that AGL's power stations are likely to maintain much of their value in the shift to a carbon constrained world due to their relative low-cost and high efficiency, when compared to their peers. This is shown in Figure 3.

**Figure 3: Net present value (NPV) analysis of emission reduction scenarios**



While the modelling is subject to significant uncertainty given the decadal timeframes involved, it is instructive for demonstrating the robustness of AGL's assets across a range of potential outcomes. The results showed that different regions will be impacted in different ways if emissions are reduced in a 'least cost' manner. There is a much greater impact on brown coal-fired generation than black coal-fired generation in Scenario 2.

AGL has re-assessed the assumptions used for this analysis and there have been no material changes, leaving the analysis valid. In coming years, AGL will refresh this scenario analysis to reflect any updates in relation to projected technology costs, revised carbon budgets (in-line with future government commitments) and other updated assumptions.



### 3. Governance

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AGL's highest level of direct responsibility for climate change sits with its Board through its standing committees. In April 2015, the AGL Board approved the publication of AGL's Greenhouse Gas Policy.

The AGL Board has established four standing committees: the Audit & Risk Management Committee; the People & Performance Committee; the Safety, Sustainability & Corporate Responsibility Committee; and the Nominations Committee. These committees meet regularly to oversee key risks affecting AGL's business.

The committee with the highest level of direct responsibility for climate change is the Safety, Sustainability, and Corporate Responsibility Committee (the Committee), which operates under a formal charter and currently comprises four non-executive and independent Directors. This Committee meets quarterly, and assists the Board in:

- reviewing and overseeing the development and implementation of policies and procedures that enable AGL to operate its businesses ethically, responsibly, and sustainably, and
- monitoring the decisions and actions of management in achieving AGL's objective to be a safe, ethical, responsible, and sustainable organisation.

AGL's carbon impact and response to climate change are key areas of focus for the Committee. The Committee reviews AGL's annual Sustainability Report and the greenhouse strategies and performance data contained in it.

As the highest level of management in the organisation, the AGL Executive Team builds sustainability considerations into business strategy and day to day operations. Responsibility for AGL's strategy in relation to climate change issues lies within the Sustainability and Engagement team within the Stakeholder Relations business unit, under the Chief Economist. This team is responsible for the reporting of greenhouse gas emissions and energy, carbon policy and regulation, and carbon modelling and analysis, as well as integrating these into the organisation's sustainability strategy and disclosures.

At a management level, risks associated with carbon, energy efficiency and renewable energy policies are managed as part of AGL's broader interaction with wholesale and retail energy markets, with governance processes in place to monitor and manage policy compliance. Responsibility for reporting and oversight of policy compliance lies with Group Risk and Compliance, ultimately overseen by the Audit & Risk Management Committee.

## 4. Risks and opportunities

### 4.1. Risk management approach

AGL's general risk management methodology is adaptable and can be applied at the enterprise wide level or for a project, business, or asset process. Climate change is managed in the same manner as any risk to which the organisation is exposed to.

AGL's Risk Management Policy, which has been approved by AGL's Board, mandates that management utilise risk management principles in decision-making, requires all AGL employees 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 Audit & Risk Management Committee, sets out AGL's risk appetite in relation to strategic, financial, market and operational risks, as well as AGL's risk tolerance (activities for which AGL has no appetite). A strong risk management culture is critical to enabling AGL to achieve its strategic, operational, and commercial objectives and can also be a source of competitive advantage.

The most significant strategic risks undergo a full review annually; material and emerging risks are identified, monitored, and reviewed continually and proactively, with reporting to the Audit & Risk Management Committee and Executive Team quarterly. The risk management framework also incorporates an escalation process to empower different levels of management to execute decisions, subject to appropriate processes and protocols.

All risks, including climate change risks, identified through the AGL risk management methodology 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). Potential consequences are assessed in relation to the following categories:

- Commercial
- Customer experience
- Regulatory compliance
- Reputation and community
- Environment
- Health and safety, and
- People.

Any controls, processes, or governance practices 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 trigger requirements to notify different levels of management to the risk- for example, the Board, the Audit & Risk Management Committee, the relevant Executive General Manager (or delegate), the relevant General Manager (or delegate) or the relevant Manager.

More specific examples of escalation are conducted using risk cost methodology which adds an additional layer of quantitative analysis to assist in the allocation of capital and operational allocation based on a risk and opportunity analysis.

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.

Climate change risks include both adaptation and mitigation, with risk identification, assessment and review conducted within the framework outlined. Some can be mitigated through physical intervention (e.g. changes in operations or maintenance protocols), while others require hedging, either through integrated portfolio management or using relevant financial instruments (e.g. weather derivatives).

### 4.2. Physical risks and opportunities

#### 4.2.1. Climatic disruption

Climate change has the potential to increase the frequency and severity of extreme weather events in Australia, including floods, fires, and natural disasters. AGL has assessed the associated risk of operational disruption resulting in plant damage or unavailability and revenue losses. While in the short term AGL considers the likelihood of this risk impacting upon its business to be low, AGL has devised a range of detective, preventative and corrective measures to manage this risk, including alarm and monitoring systems, water suppression systems, summer readiness audits, crisis management processes and separate plans to address asset management, dam safety management, bushfire mitigation, flood management and emergency response.

Rising temperatures stemming from the effects of anthropogenic climate change have the potential to impact directly upon electricity demand patterns, given that electricity demand is heavily dependent on both economic growth and temperature. In the Australian market, it has been observed that, as temperatures rise, the demand for electricity also rises, particularly in summer seasons (due to higher air-conditioning usage). Given that demand can change quite rapidly due to higher temperatures, wholesale electricity prices at peak demand times have the potential to increase by several thousand percent. Current climate science indicates that temperatures (both average and peak) are likely to increase throughout the National Electricity Market (predominantly on Australia's east coast). This is likely to drive higher, peakier electricity demand and lower residential gas demand in winter.

Peakier electricity load presents both risks and opportunities for AGL. As the owner of generation assets that operate during peak demand, peakier demand provides opportunity to bid electricity into the market at times of highest value. Conversely, as a retailer of electricity, AGL could be exposed to high costs if hedge contracts for supply do not match customer demand. Peak demand growth is significantly higher than underlying demand growth, so unit costs are increasing to recover capital expenditure on infrastructure that has a poor utilisation rate.

Peakier electricity load may also present opportunities for businesses operating in demand response, to manage impacts on the electricity system and its effects upon anthropogenic climate change. AGL is engaged in several demand response programs and anticipates that these services will become an important feature of Australia's evolving energy markets. Such markets are likely to become even more important with increased deployment of variable non-hydro renewable resources as a strategy to mitigate climate change.

Precipitation changes also have the potential to impact upon the efficacy of hydro generation assets in Australia. AGL owns and operates several hydro assets across Victoria and New South Wales. When these assets were acquired, a key element of the due diligence work undertaken involved long-term hydrology considerations. AGL engaged experts in this field and considered the risks associated with reduced rainfall and changes in rainfall patterns. AGL's hydro assets are predominantly peaking generation, typically only operating for a short period each week. Peakier demand created by changes in climatic conditions may increase the value of peak generation assets. In this context, AGL in June 2017 announced an investment of \$295 million in a 210 MW gas-fired peaking power station in South Australia. Changes in rainfall in water catchments can result in water supply for hydro assets may be constrained. AGL has also completed detailed modelling<sup>7</sup> designed to inform the public about the problems associated with higher temperatures and peak demand.



## AGL's demand response initiatives

AGL is engaged in several demand response programs in collaboration with the Australian Renewable Energy Agency (ARENA) and the Australian Energy Market Operator (AEMO). Our demand response program in New South Wales contracted by ARENA and AEMO will deliver 20 MW in total over three years. In its first year, the program will deliver 17 MW of commercial and industrial demand response and 1 MW of demand response from AGL's residential customers. The residential component will increase to 2 MW in the second year and 3 MW in the final year. AGL has contracted separately with AEMO to provide demand response for the period 1 November 2017 to 31 March 2018. The scale of this program is initially contracted at 10 MW and is anticipated to increase to a higher scale.

<sup>7</sup> This research can be found at: <http://www.sciencedirect.com/science/article/pii/S1040619013000870>

### 4.3. Transitional risks and opportunities

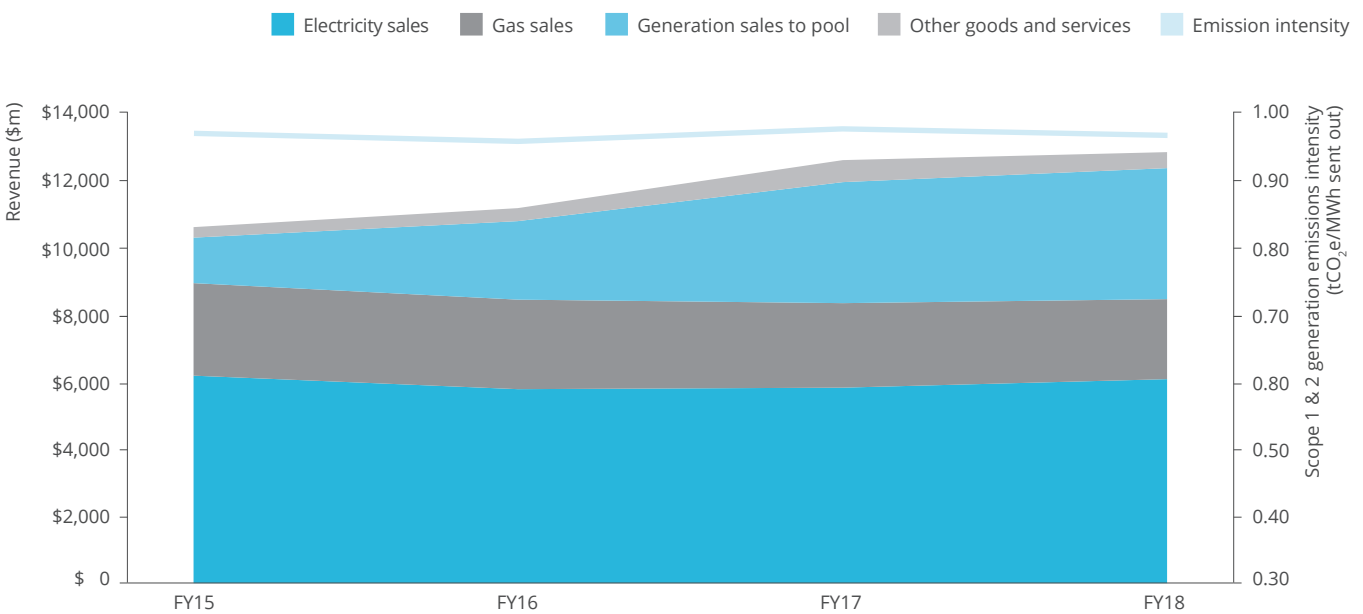
#### 4.3.1. Asset optimisation

Australia’s energy markets are undergoing a significant period of transition, characterised principally in the shift away from thermal power generation towards a greater penetration of utility-scale renewable energy sources and distributed energy resources driven by customers.

The progressive reduction in thermal generation capacity within the National Electricity Market has been accompanied by an increased focus on system security, reliability, and energy management systems. As the generation mix changes to incorporate a growing amount of renewable energy, demand for energy services such as Frequency Control Ancillary Services (FCAS), reactive power, and inertia will increase as the traditional suppliers of these services (i.e. thermal power stations) exit the market.

As AGL transitions away from our existing coal-dominated electricity generation portfolio, we intend to replace it with a mix of technologies with a significantly lower carbon intensity whilst remaining both cost-effective and reliable. AGL’s carbon intensity of generation is not inherently linked to its revenue as can be seen from the graph at Figure 4.

Figure 4: Carbon Intensity of AGL’s operated generation and revenue for the period FY15 to FY18



AGL’s (scope 1 and 2) emissions intensity of total revenue was 3.4 ktCO<sub>2</sub>e/\$ total revenue in FY18. This constitutes a reduction of over 12% from FY16, while total emissions remained at 44 million tonnes within the same period. The drop in the emissions intensity of revenue while total emissions remained consistent is indicative of a disconnect between revenue growth and emissions growth. As AGL continues to operate more renewable generation AGL anticipates a further decoupling of emissions and revenue.

AGL's NSW Generation Plan illustrates the way in which AGL is managing its physical assets and future investment plans to mitigate the risks associated with the energy market transformation.



## AGL's NSW Generation Plan

AGL released its NSW Generation Plan in December 2017. The Plan includes investments in new generation and repurposing Liddell. The Australian Energy Market Operator has stated that AGL's plan, once implemented, will address any capacity and energy shortfall that may occur following Liddell's closure. The NSW Generation Plan outlines a mix of high-efficiency gas-combustion peaking plant, renewables, battery, and demand response projects, coupled with an efficiency upgrade of Bayswater Power Station, and a synchronous condenser at the Liddell site. AGL plans to approve and deliver these projects in stages according to market conditions and requirements.

The current proposed timeframe is:

- Bayswater efficiency and capacity upgrade (100 MW) – approved
- Renewables (1,600 MW) – first 953 MW approved\*
- Demand response (up to 150 MW) – first 20 MW approved
- Liddell Synchronous Condenser – approved
- Newcastle Gas Peaker (250 MW) – approved
- Additional NSW Gas Peaker (500 MW) – feasibility in 2020
- Liddell Battery (250 MW) – feasibility in 2021

AGL is also considering the feasibility of building pumped hydro in the Hunter region.

\* Includes projects to which AGL has committed, including the Coopers Gap Wind Farm (453 MW to be fully operational by mid-2019), the Silverton Wind Farm (200 MW to be fully operational by mid-2018) and 300 MW of offtake that will underwrite the development of two new solar power stations in NSW.

AGL anticipates that the role of traditional generation will increasingly be met by flexible distributed energy resources and a range of low-emissions generation. However, the proliferation of distributed energy resources within a broader generation mix will require a commensurate ability to co-ordinate those assets to maximise the benefit to the primary and ancillary wholesale markets. AGL's Virtual Power Plant (VPP) is an example of how distributed energy resources can deliver those services within a competitive market if it is orchestrated effectively.

The risks and opportunities associated with the energy market transformation also span end-of-life planning for AGL's thermal generation fleet as well as the appropriate rehabilitation of those assets. Due to the potential for inadequate or inaccurate end-of-life planning, there is the risk that maintenance programs may not align with end-of-life expectations, resulting in stranded assets or unscheduled outages, plant damage and revenue loss. Moreover, due to the potential for inadequate or ineffective forward planning in relation to rehabilitation there is the risk that planned activities may not be acceptable practice or that provisioning is not adequate, resulting in reputation damage (community and regulatory), expectations not met, non-compliances, and/ or adverse commercial outcomes.

AGL estimates the impact of inadequate or ineffective forward planning in relation to rehabilitation could result in increases in costs, as well as potential adverse effects on future earnings. AGL's Rehabilitation Report outlines the way in which AGL approaches end-of-life planning and rehabilitation with a clear long-term strategy, and effectively outlining mitigation strategies for this risk.

## AGL's Virtual Power Plant

AGL's VPP, co-funded with the ARENA, seeks to demonstrate the value that grid-connected batteries can create for a range of stakeholders when managed as part of a coordinated virtual power plant. Once complete, AGL's VPP is expected to include 1,000 smart, connected batteries installed behind-the-meter, with a combined nameplate output of 5 MW and an energy storage capacity of more than 9.8 MWh. The project seeks to enable the 'stacking' of multiple values and demonstrates at a commercial scale the value that distributed energy technologies (solar and batteries in particular) can provide to three groups:

- **Consumers** can use the batteries to self-consume more of their solar power by storing energy produced during the day that might otherwise be exported to the grid
- **Networks** can benefit from peak load shaving and voltage management services that potentially avoids further infrastructure expenditure, and
- **Retailers** can benefit from their reduced wholesale exposure during peak demand periods and using the battery to provide synthetic inertia and frequency balancing services.

Importantly, all grid users stand to benefit from such an arrangement through reduced spending on network infrastructure and improved grid stability.

## AGL's Rehabilitation Report

In August 2017, AGL released its Rehabilitation Report. Consistent with its Greenhouse Gas Policy, it articulates clear time limits for the closure of its fossil fuel plants, providing certainty to communities and the market as to AGL's decarbonisation pathway. AGL is committed to working with stakeholders to connect rehabilitation priorities with emerging technologies and industries, enabling the best pre-conditions for future growth, diversification, and regional prosperity. AGL considers that the transition is likely to have concentrated impacts on those communities where coal-fired power stations and related mining activities are based. Working in partnership with local communities, governments, and other parts of industry to plan for rehabilitation can act as a catalyst for the broader social, economic, and environmental transition of these regions. The resultant AGL Transition Project is an outcome-oriented process designed to determine the best and most innovative use of site, existing infrastructure, and technologies.

### 4.3.2. Capital projects development and execution

AGL has established a range of preventive and corrective measures to manage capital project development and execution in accordance with AGL's key objective to transition its asset base from coal-fired power to lower emissions technologies. These include AGL's project management framework and the establishment of the Powering Australian Renewables Fund.

As outlined in the AGL Greenhouse Gas Policy, AGL uses an internal carbon price as part of our assessment of strategic decisions. AGL also incorporates the same cost of carbon into planning and maintenance decisions through a capital budget allocation tool. AGL uses the tool for program assessment and prioritisation and incorporates an internally-modelled carbon price to ensure that abatement and carbon efficiency is appropriately valued in the internal decision-making process. This results in a periodic reporting process that enables effective assessment of opportunities based on a combination of factors including not only the financial payback but also the carbon abatement opportunity.

To define the internal carbon price, AGL assessed a range of information, including but not limited to, prices imposed at the time of acquisition via the Australian Government's carbon pricing mechanism, projections of carbon prices based on a range of national and international political outcomes, forward trajectories from government and market institutions and internal modelling. Currently AGL is using a price of \$12.50/tCO<sub>2</sub>e.

### 4.3.3. Changing customer preferences and expectations

We understand that energy bills can comprise a major proportion of some households' living expenses. In June 2018, AGL announced that prices for FY19 for customers in New South Wales, Queensland and South Australia will be going down – albeit very modestly – but that this is a change welcomed by our customers following the price increases seen in recent years. AGL is focused on responding to customer needs by investing in new low-emissions capacity with a view that more supply places downward pressure on prices, reduces emissions and improves system reliability and resilience.

Customers are increasingly adopting distributed energy solutions. These include embedded solar PV installations and energy efficiency with the potential to combine battery storage. Effective utilisation of this technology has the potential to impact the long-term demand for centralised electricity generation as well as impact the ability of price structures to reflect and therefore recover costs involved.

Australia leads the world with small-scale solar PV installations. Across the country, approximately 17% of households have a solar PV system installed. Installations are expected to continue to grow and, as costs decline, are anticipated to increasingly be accompanied by the installation of a battery energy storage system. Digital meters, smart appliances, smart inverters, and intelligent control systems are also entering the market. The emergence and increasing accessibility of these technologies are enabling a range of new energy service offerings by both traditional energy market participants and new entrants.

Rapid advancements in technology are also driving customers' uptake of distributed energy resources. Due to the rate of change regarding technology uptake there is some risk of owning stranded assets resulting in a lower return on investment. As the energy sector transitions towards new technologies, there is also the risk that those new technologies may not perform as expected.

One of AGL's key objectives is to become an orchestrator of both large and small assets. This is in recognition of the current transformation of the energy industry from the traditional centralised generation model to a more distributed and integrated energy supply chain. In our view, orchestration would enable customers to realise the full value of their distributed energy resources. By modifying the overall volume and shape of demand, distributed energy resources can be deployed and operated to avoid or delay more expensive augmentations to the network. Further, smart inverters and local sensing devices can enable the provision of voltage and frequency services back to the distribution network, which is an associated benefit of distributed energy resources.

AGL has developed a range of new energy products and services designed to focus on customers' changing preferences and expectations. While this may compete with certain parts of AGL's established retail business, it will also position AGL to capitalise on and maximise the opportunities from this growing area of energy services. AGL has made various investments in market-leading energy storage and management technology, such as the VPP discussed earlier.



Image supplied courtesy of PARF

## Powering Australian Renewables Fund (PARF)

In February 2016, AGL announced the creation of PARF, an innovative financing vehicle for renewable energy. PARF was established to develop and own approximately 1,000 MW of large-scale renewable generation, which would require approximately \$2 to \$3 billion of total investment, and represent around 20% of the estimated 5,000 MW of new renewable generation capacity required by 2020 to meet the Australian Government's Renewable Energy Target. In July 2016, PARF was formally launched. AGL agreed to commit \$200 million in equity funding and Queensland Investment Corporation (via its clients the Future Fund and the QIC Global Infrastructure Fund) agreed to provide \$800 million of equity funding.

PARF has achieved three major milestones since inception:

- In November 2016, AGL reached financial close on selling its existing 102 MW Nyngan and 53 MW Broken Hill solar plants into the fund.
- In January 2017, AGL and PARF reached a final investment decision on the construction of the 200 MW Silverton wind farm project in western New South Wales. This wind farm is targeted to be fully operational by late 2018.
- In August 2017, AGL and PARF reached a final investment decision on construction of the 453 MW Coopers Gap Wind Farm project located approximately 250 km west of Brisbane.

AGL has also engaged in a range of other innovative initiatives, including:

- **Energy Insights:** Culminating in January 2018, AGL's 'Energy Insights' trial was successful in highlighting the potential for customers to eliminate waste and save money by turning appliances off rather than leaving them on stand-by mode. Using innovative technology which allowed AGL to analyse meter data and produce details of energy use by appliance categories, AGL was able to provide customers with tailored Energy Insights reports to help better manage energy usage.
- **Solar energy trading technology:** To improve our customers' energy experience, we have been investigating ways that customers can derive more value from distributed energy resources, including solar panels and battery storage. In May 2017, we led a project to investigate how 'blockchain' technology could be used to enable households with solar panels, batteries and 'smart' air conditioning to trade or share the excess electricity they generate.
- **Solar Smart Plan:** We were the first major Australian electricity retailer to launch a solar power purchase agreement (PPA) offer in February 2015: the Solar Smart Plan. Under this plan, customers buy their power from a solar system installed on their roof and owned and maintained by AGL for a fixed term. The Solar Smart Plan has been key to our solar customer growth, especially in the commercial and industrial customer segment.
- **Business energy services:** AGL offers a range of energy efficiency services designed to help businesses of all sizes reduce energy costs. Our specialists work with business customers to understand their requirements and budget, and design and deliver custom, engineered solutions with professionally project-managed installation. Product and service options include solar PV system installations lowering daytime energy costs, energy efficient LED lighting upgrades to reduce energy consumption, and the use of power factor correction technology to reduce peak power demand.

AGL is also aware of the potential for electricity generation to facilitate emissions reductions in the transportation sector through electrification powered by renewable energy and sees potential for AGL's business in the development of Australia's electric vehicle industry.

AGL considers that with managed charging, the increased penetration of EVs could play an important role in increasing electricity demand and improving the reliability of the grid. AGL is well set to benefit from opportunities presented by EVs.

Further details on AGL's approach to becoming a more inclusive and customer-centric business, including insights from AGL's research<sup>8</sup>, are set out in AGL's 2018 Sustainability Report, available on AGL's website. Previous research by AGL economists has been strongly focused on the social aspects of a just transition.

#### 4.3.4. Energy policy and regulation

Australia's continued public policy uncertainty relating to climate change creates ongoing risks to AGL's ability to perform against its strategic imperatives and deliver on its key objectives. Accordingly, AGL continues to work within current Commonwealth and State policies and advocate for long-term, nationally-consistent public policy settings on climate change.

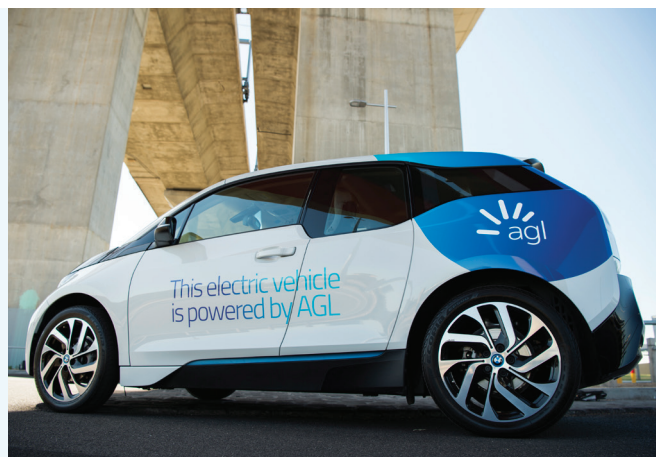
The potential implementation of disparate State and Commonwealth climate change and energy policies also presents risks to AGL's business, given AGL's integrated operations across the National Electricity Market. Accordingly, AGL considers the trajectory of any State-based emissions targets impacting upon the energy sector need to be appropriately coordinated with the National Electricity Market.

The Commonwealth's Large-scale Renewable Energy Target requires the generation of additional electricity from large-scale renewable sources by 2020 through to 2030. Electricity retailers are required to contribute to the target through the purchase of Large Scale Generation Certificates (LGCs, known previously as RECs). As a major retailer participating in this market, AGL is exposed to general price and volatility risk through this mandated scheme.

Over the past decade AGL has invested significantly in renewable electricity generation, in line with AGL's strategy to be largely self-sufficient in meeting obligations under the Renewable Energy Target. AGL invested \$200 million in equity to seed the Powering Australian Renewables Fund, which is developing 1,000 MW of renewable generation. This in addition to the further generation development outlined in the NSW Generation Plan should allow AGL to meet its obligations under the RET.

### AGL's Electric Car Plan

The Electric Car Plan allows customers to charge their electric vehicle (EV), whenever they like and as often as they like for \$1 per day. AGL's Electric Car Plan is 100% carbon offset through our Future Forests Program, effectively delivering zero emission charging to our EV customers. Our Future Forests Program enables customers to offset the carbon emissions associated with their electricity usage through Australian forestry carbon credits. This program is underpinned by robust accounting to ensure its integrity.



<sup>8</sup> See <https://www.sciencedirect.com/science/article/pii/S0313592612500305> for further information.



AGL is also a liable entity under a range of state-based energy efficiency schemes, which expose the company to a low level of general price and volatility risk. The Victorian Energy Efficiency Target Scheme (VEET) (2008 potentially to 2029) requires retailers to purchase energy efficiency savings through energy efficiency certificates to meet their individual targets, based upon market share of the overall target. The South Australian Residential Energy Efficiency Scheme (REES) requires retailers to procure energy efficiency activities (through certificates) applied at the household level. In addition, it requires 35% of the prescribed abatement to be sourced from low-income households. Retailers are also required to deliver a set number of energy audits for low-income households. As a liable entity under each scheme, AGL is exposed to general price and volatility risk through the mandated scheme. AGL considers this risk to be low.

Longer-term, AGL's operation of its generation fleet and wholesale energy markets business remain exposed to uncertainty around energy markets supply, disparate State and Commonwealth regulatory frameworks and the risk that future policy decisions and regulatory structures may impose greater operational rigidity on the business, impacting on AGL's ability to effectively manage its portfolio.

Long-term, nationally consistent policy is the most desirable policy outcome for the energy sector, given the long-term investment horizons and large upfront costs involved. Nationally coordinated targets would also ameliorate some of the economic risks associated with setting emissions reductions targets at the State level.

AGL is focused on diversifying its asset portfolio by fuel, geography and technology and continues to develop a pipeline of diverse projects to enable to AGL to adapt to an evolving regulatory environment.

### **AGL's EV charging management trial**

AGL will be trialling remote EV management during peak events for several AGL EVs in New South Wales through our Managed for You program. Our Managed for You program is part of a nationwide initiative administered by ARENA and AEMO to deliver a three-year demand response pilot project. The New South Wales Government has provided additional funding to the initiative for projects that are based in New South Wales, such as AGL's EV trial. Demand response contributes to the stability of the electricity system by reducing discretionary energy use at times when demand spikes, such as during summer heatwaves. AGL anticipates further opportunities to develop demand response in Victoria, including through projects that test EV charging management.

## 5. Key metrics and targets

AGL reports its greenhouse emissions in our Sustainability Report annually using three different approaches. These three approaches can be found in the report data centre and provide a complete accounting of the impacts of AGL's emissions. The footprints are as follows:

- The operational greenhouse gas footprint, covering the emissions from activities and assets that AGL operates
- The equity greenhouse gas footprint, which sets out AGL's share (by percentage of investment level) of the emissions from fully or partly owned assets, regardless of who operates the asset. The equity footprint indicates to AGL shareholders the greenhouse gas impacts associated with their investment, and
- The energy supply greenhouse gas footprint, which estimates the supply chain emissions associated with the energy that AGL sells to our customers, covering emissions resulting from the production, transportation, distribution and consumption of electricity and gas.

AGL's total scope 1 and 2 emissions across the business totalled 44 MtCO<sub>2</sub>e in FY18, which is consistent with previous years. Total historical scope 1 and 2 emissions from AGL's operational facilities as reported under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) can be seen in Table 3.<sup>9</sup> The total FY18 emissions will be reported with AGL's NGER submission, and will be available in AGL's FY18 Sustainability Report from November 2018. The Sustainability Report can be accessed at [agl.com.au/sustainability](http://agl.com.au/sustainability).

**Table 3: Historical AGL scope 1 & 2 emissions**

	FY17 (MtCO <sub>2</sub> e)	FY16 (MtCO <sub>2</sub> e)	FY15 (MtCO <sub>2</sub> e)
<b>Scope 2 emissions</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>
Black coal combustion	23.0	23.5	18.7
Brown coal combustion	18.7	18.1	18.5
Natural gas combustion	1.7	1.6	1.0
Other scope 1 emissions	0.1	0.1	0.1
<b>Scope 1 emissions</b>	<b>43.4</b>	<b>43.3</b>	<b>38.3</b>
<b>Total scope 1 &amp; 2 emissions</b>	<b>43.9</b>	<b>43.8</b>	<b>38.8</b>

**Table 4: Scope 1 emissions from electricity generation – material sites**

	FY18 (MtCO <sub>2</sub> e)	FY17 (MtCO <sub>2</sub> e)	FY16 (MtCO <sub>2</sub> e)	FY15 (MtCO <sub>2</sub> e)
AGL Torrens	1.6	1.6	1.5	1.0
Liddell Power Station	7.8	8.8	7.6	6.5
Bayswater Power Station	13.7	14.1	15.9	12.3
AGL Loy Yang	19.8	18.7	18.1	18.5

**Table 5: Scope 1 emissions intensity (sent out) from electricity generation – material sites**

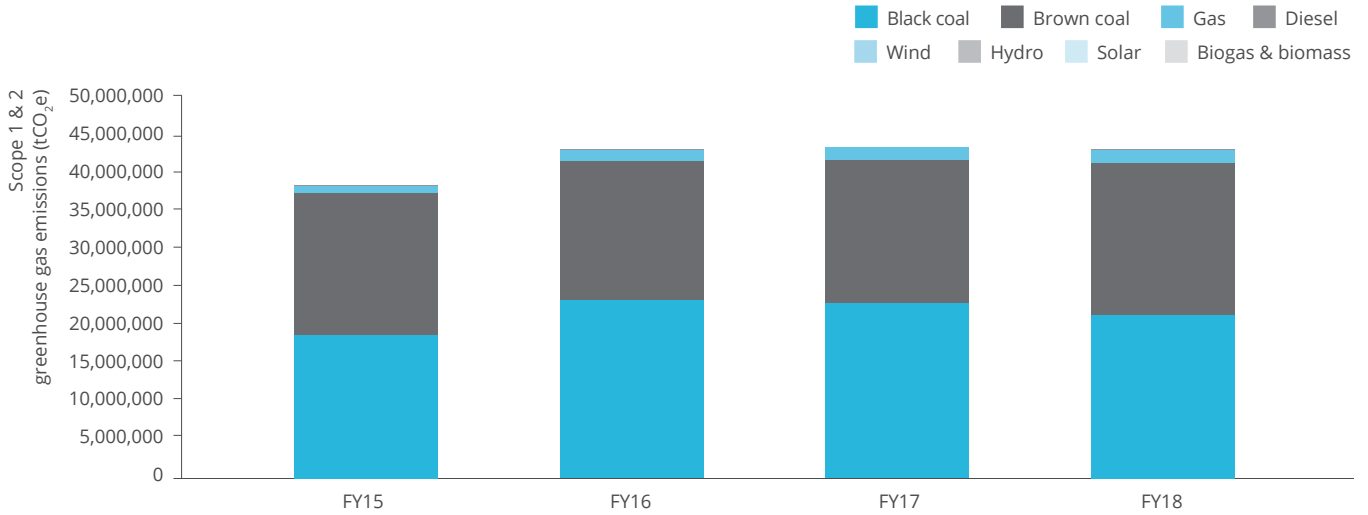
	FY18 (tCO <sub>2</sub> e/MWh)	FY17 (tCO <sub>2</sub> e/MWh)	FY16 (tCO <sub>2</sub> e/MWh)	FY15 (tCO <sub>2</sub> e/MWh)
AGL Torrens	0.60	0.61	0.62	0.63
Liddell Power Station	0.96	0.97	0.99	0.98
Bayswater Power Station	0.94	0.94	0.94	0.93
AGL Loy Yang	1.28	1.29	1.26	1.25

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

AGL's scope 1 emissions associated with electricity generation for the material sites, for the last four years can be seen in Table 4, with Table 5 showing the scope 1 emissions intensity of each asset. Figure 5 illustrates scope 1 and 2 emissions by the primary fuel source of the generation facility.

<sup>9</sup> Scope 1 emissions are direct emissions (e.g. burning coal). Scope 2 emissions are indirect emissions (e.g. electricity use).

Figure 5: AGL scope 1 & 2 electricity generation emissions by fuel type of generator

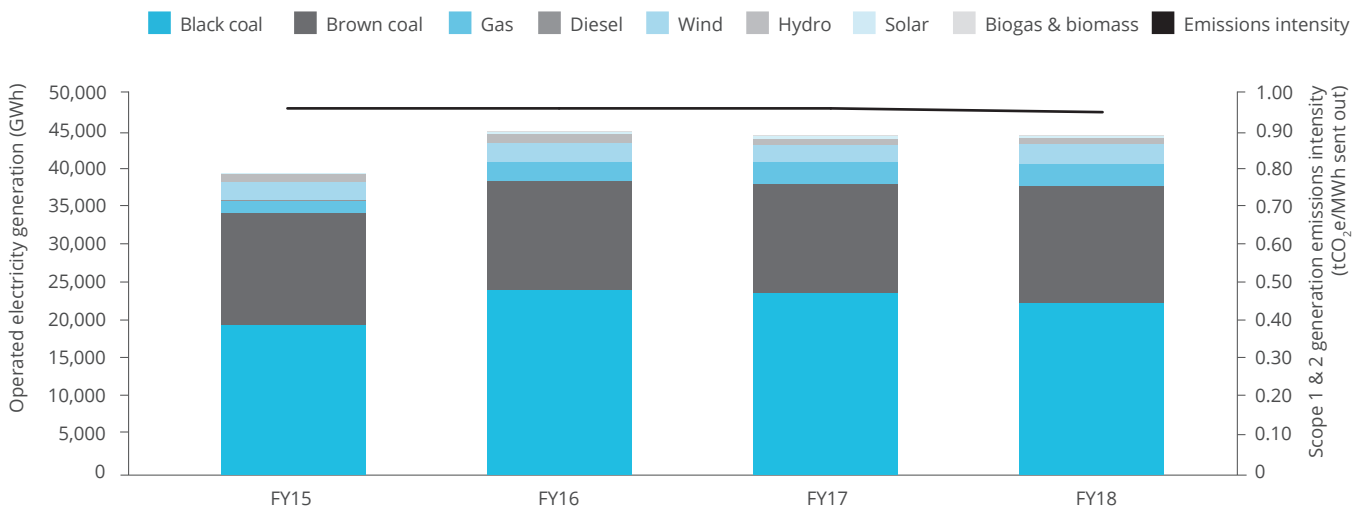


AGL will continue to publish these footprints, in addition to reporting under the mandatory *National Greenhouse and Energy Reporting Act 2007*.

Based on AGL's commitments of closure in the AGL Greenhouse Gas Policy, AGL has targeted a 10% reduction in the emissions intensity of its operated generation by FY24 from a baseline year of FY15. AGL aims to meet this target through the expansion of our renewable generation fleet as well as the staged closure of our coal-fired generation.

AGL's operated generation emissions intensity has remained materially consistent since FY15 as can be seen in Figure 6. This graph shows emissions intensity of AGL's total operated generation portfolio as well as electricity generation by fuel type.

Figure 6: AGL operated generation and emissions intensity



## 6. Conclusion

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AGL acknowledges and accepts the scientific consensus on climate change and notes that to stay within concentrations consistent with 2 degrees of warming or less, a gradual decarbonisation of the electricity generation sector is likely required by 2050. Decarbonisation approaches should be based upon a just transition for customers, employees, shareholders and communities. Ensuring system reliability and improving affordability are key priorities that must be met within any decarbonisation strategy.

Physical risks could manifest in climatic disruption, including the potential for increased frequency and severity of extreme weather events resulting in operational disruption, rising temperatures impacting upon electricity demand patterns and resulting in peakier electricity demand, and precipitation changes impacting upon the efficacy of hydro generation assets.

Transitional risks include the optimisation of AGL's assets as the National Electricity Market shifts away from thermal power generation towards a greater penetration of renewable energy sources at the industry scale and distributed energy resources with customers.

Capital project development and execution, including the financing or otherwise enabling and supporting the development of new low-emissions generation will also be critical to AGL's ability to transition its asset base.

Australia's continued public policy uncertainty on climate change also creates ongoing risks to AGL's ability to perform against its strategic imperatives and deliver on its key objectives. Despite this uncertainty, AGL continues to be responsive to current policy settings, while engaging with Commonwealth and State policy makers to advocate for long-term, nationally-consistent public policy settings on climate change, renewable energy and energy efficiency. AGL considers long-term, nationally-consistent policy to be the most desirable policy outcome for the energy sector, given the long-term investment horizons and large upfront costs involved.

AGL's strategic imperative to prosper in a carbon constrained future, supported by its transition plans and robust approach to carbon risk management, demonstrates our resilience in the face of these risks. These risks are managed through AGL's standard risk management process overseen by both management and the Board.

