AGL Energy Limited

Committee Secretary

Select Committee into Fair Dinkum Power

Department of the Senate

PO Box 6100

Parliament House

Canberra ACT 2600

15 February 2019

Fair Dinkum Power Committee

AGL Energy (**AGL**) welcomes the opportunity to make a submission to the Select Committee into Fair Dinkum Power (**Select Committee**).

AGL is one of Australia's largest integrated energy companies and the largest ASX listed owner, operator and developer of renewable generation. Our diverse power generation portfolio includes base, peaking and intermediate generation plants, spread across traditional thermal generation as well as renewable sources. AGL is also a significant retailer of energy, providing energy solutions to around 3.5 million customers throughout eastern Australia.

In addition, AGL is continually innovating our suite of distributed energy services and solutions for customers of all sizes. These behind-the-meter energy solutions involve new and emerging technologies such as energy storage, electric vehicles, solar PV systems, digital meters, and home energy management services delivered through digital applications.

AGL is committed to meeting the needs of its energy customers. We are leaders in driving innovative solutions for our customers including the development of new products and services that utilise distributed energy technologies. At the same time, we recognise substantial changes to the dynamics of the NEM, in part due to the aggregated impact of small scale energy resources. Balancing customer needs at an individual level with the needs of the NEM in terms of reducing pricing, improving system security, and reducing emissions over time requires careful thought and long-term planning to ensure the transition to our energy future is efficient and orderly.

Disruption and change in the National Electricity Market

Australia's electricity needs are primarily met by the National Electricity Market (**NEM**). The NEM has historically provided electricity supply via a linear supply chain made up of three components: contestable generation, regulated transmission and distribution networks, and deregulated and competitive retail services.

In a market that saw steadily increasing electricity demand for a number of decades, ongoing investment in large-scale thermal generation such as coal-fired power stations was traditionally very effective at providing the majority of Australia's energy needs. However, these older thermal assets are reaching the end of their design life and will need soon replacing. At the same time, conditions across the NEM have changed. Overall system demand since the mid-2000s has decreased, and is not forecast to increase significantly over the near term (see chart below).

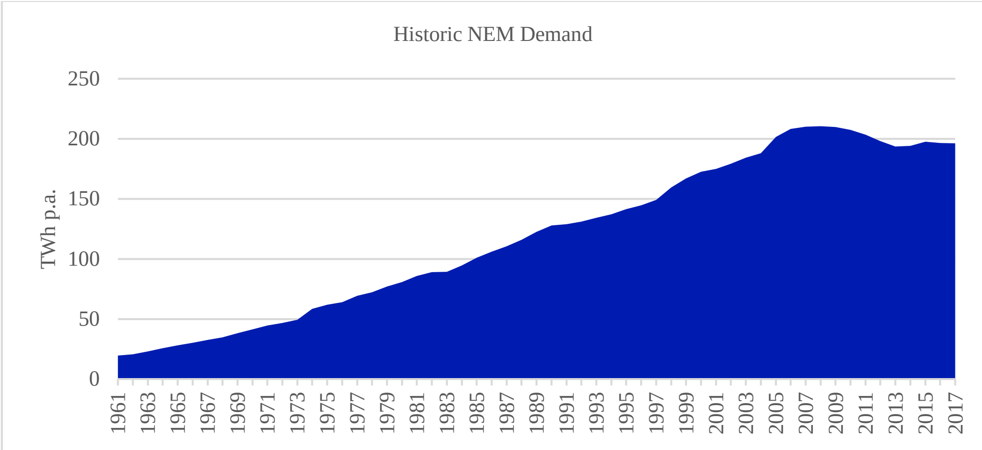

Chart: Annual NEM electricity consumption 1960-2016 (ABS Data)

Although overall NEM consumption has remained flat over the last decade, over the same time a vast amount of subsidized small-scale solar photovoltaic (**PV**) generation has entered the market, in large part due to subsidies such as the small-scale renewable energy scheme and generous feed-in-tariffs set by State legislation.

Since 2008, almost 10 GW of small-scale solar PV generation has been built and connected to the NEM, with the rate of capacity installed increasing in recent years as technology costs continue to decline and systems are becoming larger in size. To put this figure into context, the total electricity generating capacity of all generators in the NEM is currently around 55 GW. Even with the closure of most solar incentive schemes, the amount of solar PV capacity installed has recently accelerated, and the total amount installed is expected to continue to grow (see chart below).

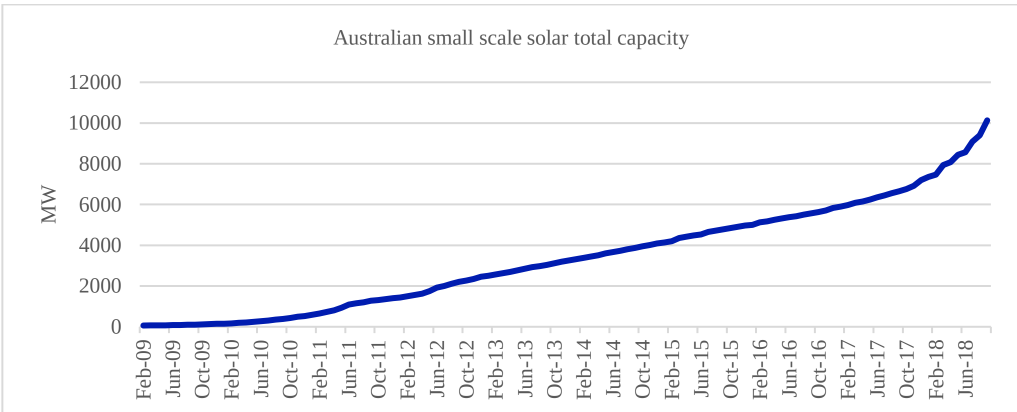

Chart: Growth in small-scale solar PV in Australia 2009-2018 (Australian PV Institute data[1])

As well as small-scale solar generation, significant amounts of large-scale wind and solar generation have also been connected to the NEM. The increase in distributed solar generation and large-scale renewable

[1] Australian PV Institute, Australian PV installations since April 2001: total capacity (kW), available at: http://pv-map.apvi.org.au/analyses

assets has not only reduced the overall amount of demand required to be met by traditional thermal generation, but has also changed the traditional ‘load shape’ of daily demand requirements, with a significant proportion of generation requirements during the day now being met by small-scale solar and large-scale renewable.

Within a few years, some states within the NEM are forecast to become net exporters of energy during the middle of the day when solar PV and other renewables will meet the generation needs of an entire region. In fact, by 2027–28, AEMO forecasts that for minimum demand days, continued uptake of rooftop solar is forecast to offset 100% of demand in South Australia during the middle of the day, and as a result SA will become a net exporter of generation simply through small-scale installations.[2]

Despite this significant uptake in generation, however, solar PV has done little to reduce peak system demand, which in most Australian regions occurs early in the evenings when solar PV generation is minimal (see chart below). With a hot summer climate, Australia’s peak electricity demand generally occurs on summer evenings, when there can be a risk of low wind due to extended high pressure conditions. Peak demand at these times can three times higher than peak demand on regular days.

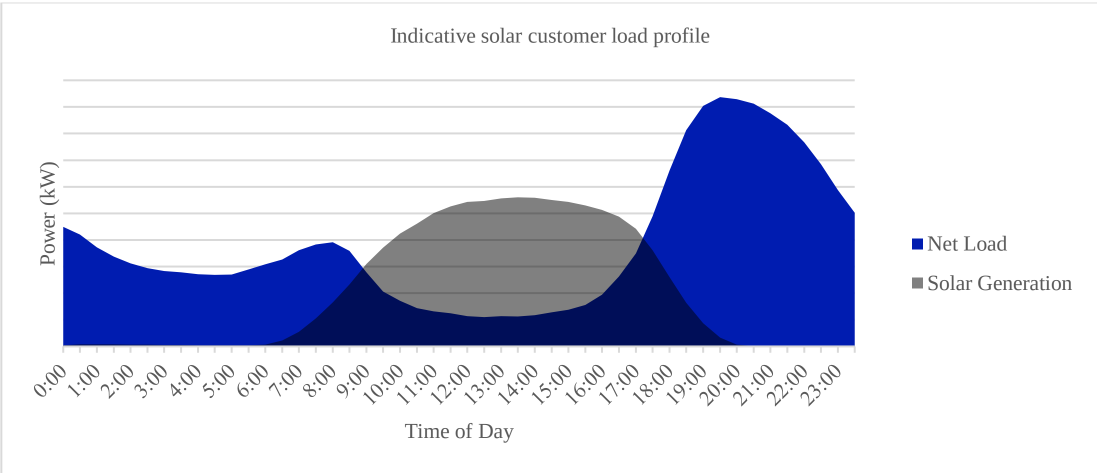

Chart: Indicative customer load profile after solar PV self-consumption in South Australia (AGL data)

These changing load shapes both on a daily and annualised basis are impacting the traditional economics of large-scale generation in the NEM, as well as increasing operational pressures on thermal assets that are constrained in their ability to respond quickly to sudden demand changes over the course of a day in the NEM. Coal plants are subject to extreme thermal stresses over time and maintenance costs and operational risks become excessively great as the end-of-life period approaches. Coal plant units are subject to ‘ramping’ limitations (i.e. the ability to quickly change output) and minimum generation levels that they cannot operate outside of, limiting their ability to respond flexibly or operate in periods of low demand.

The result of these factors, coupled with reductions in operational demand and increases in solar generation, mean that coal plant is becoming increasingly uneconomic to run and maintain. Indeed, since 2012, over 5000 MW of coal generation has been decommissioned (see chart below).

[2] AEMO, 2017 South Australia Demand Forecasts, July 2017

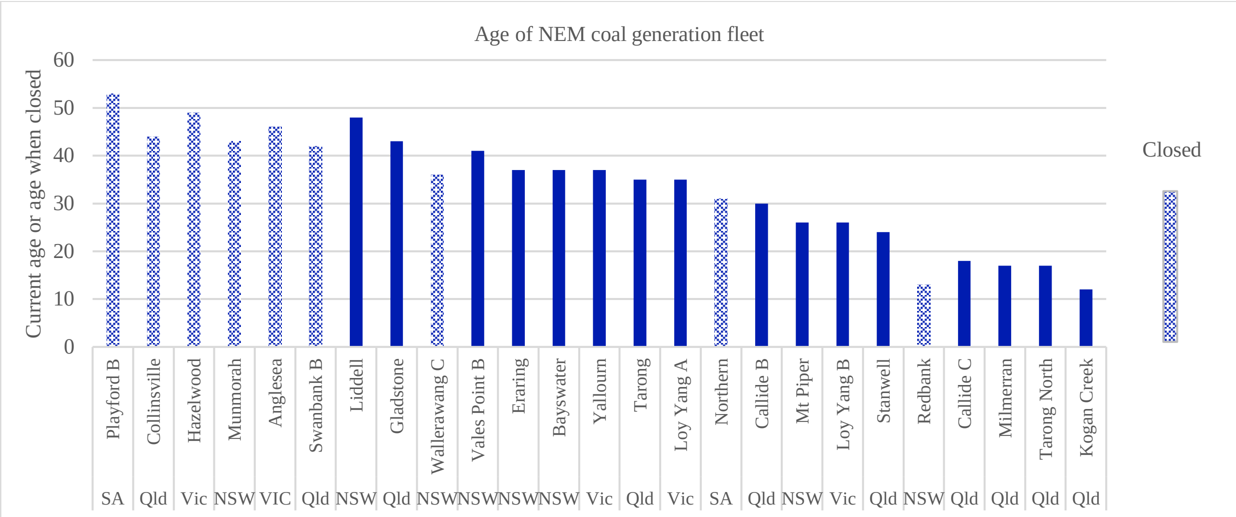

Table: Age of active coal generation in the NEM (in 2019) and age of decommissioned coal generation (AEC industry data)

The changing load profile and exit of existing thermal plant as a result of the uptake of renewables will not only have implications for generators in the NEM, but also for the system operator AEMO and distribution networks who must accommodate shifting load patterns, as well as changes to grid parameters such as frequency, voltage, and localised capacity limits.

Already, the market operator is issuing directions to generators on a much more regular basis to ensure that system strength parameters are preserved during all periods of dispatch. New generators are being requested to contribute to initiatives that improve system strength, and rule changes have been proposed to bolster the ability of generators to meet performance standards and operational requirements that ensure the electricity system operates securely.

Given the age of existing assets in the NEM, many of which were commissioned over 30 years ago, we can expect that older and under-utilised coal assets will continue to close over the next few decades while more renewables continue to enter the market. The way that these closures are managed is critical to the how well the NEM will operate over the coming decades.

Orderly replacement and investment in new generation

As older thermal plant becomes increasingly uneconomic to run and maintain, the primary question for the NEM is how existing plant will be replaced in an orderly and efficient fashion. A further critical question is what type of generation will replace the services currently provided by the NEM generation fleet, not only in terms of providing enough capacity to meet peak demand but also sufficient ancillary services to keep the system secure.

The NEM is, to a large degree, technology neutral in terms of the energy that is dispatched. Purely from a capacity and demand perspective, any fuel source can be used to meet supply. Nevertheless, thermal generation sources also provide critical ancillary services, such as ramping, voltage, inertia, and frequency control, which are required for the overall stability and reliability of the market. It is important to consider these matters in understanding the optimal future mix of generation that is required by the NEM.

In recent years, it has become clear that low-emissions generation (in particular wind and solar) has the lowest levelised cost to build on a per-MWh basis, even taking into account the capacity factor[3] and firming costs[4] of these projects.

Importantly, it has also been recognised that the electricity generation sector has an important role to play in meeting Australia's emissions reduction targets and its long-term international commitments under the Paris Agreement: a 26-28% reduction in emissions by 2030 relative to 2005 levels.[5]

While electricity generation currently accounts for approximately one third of Australia's greenhouse gas emissions inventory, technological substitutes to fossil fuels are available and are increasingly cost effective. Decarbonisation of the electricity generation also has the potential to facilitate emissions reductions in other sectors, most notably transport and manufacturing, with electrification powered by renewable energy replacing traditional fuel sources.

However, renewable generation without storage is not dispatchable, and does not provide the same ancillary services as traditional thermal generation. The interactions between an increasing penetration of renewables, new interconnection, gas and coal availability, and closure of thermal plant could feasibly lead to adverse unserved energy outcomes and system strength issues under certain conditions, if sufficient consideration is not given to the type of generation required in the future to meet the overall needs of the broader power system.

As the outlook for the NEM changes over the next few years—for example, if proposed interconnectors are built or if federal legislation is amended to impose a more direct emissions reduction target on energy market participants—further market reform should be considered to ensure a generation mix that can provide all the attributes that the system needs for secure and reliable operation.

This could include reforms to develop efficient markets and mechanisms to incentivise capacity, reserves, inertia, and necessary ancillary services such as voltage and frequency control, as well as retaining a market for energy. Numerous examples exist of electricity markets around the world that have made reforms to the design of their grid to address similar concerns.

Key to the current design of electricity markets are factors peculiar to the physical nature of electricity in that supply and demand must be matched instantaneously and on an ongoing basis. As electricity storage becomes more widespread, a number of broader market design issues may be able to be resolved by changing this constraint in the market. However, currently large-scale storage options are not available at an economic level. As storage becomes more economically viable, there may be opportunities to make significant reforms to the NEM that take account of the increasingly ability to use electricity storage to meet supply and demand imbalances.

In the interim, customers are also being afforded increasing opportunities to participate in this energy market transformation, both at an individual level and also by aggregating a number of small-scale assets to participate in wholesale markets. Small-scale solar generation and residential storage will have the ability to play an increasingly important role in how the NEM of the future should be designed and operated to meet the objectives of affordability, reliability, and sustainability.

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[3] Some renewables technologies, especially wind and solar, have a much lower capacity factor than their 'nameplate' capacity. Although generators will have a registered capacity, in practice renewables generation will run at a much lower capacity (i.e. 40%) when dispatching energy to the market. Similarly, aged generators undergoing maintenance activities may run at a much lower capacity than their registered capacity may suggest. In this context, it is important to compare the levelised cost of energy (LCOE) by MWh.

[4] Firming costs refer to the additional cost to ensure that generation is dispatchable, either by itself or through contracts with other firm generators.

[5] This figure represents Australia's current Nationally Determined Contribution (NDC) to reduce national emissions and adapt to climate change under the framework of the 2015 Paris Agreement.

Customers are playing an increasingly active role in the NEM

Customers are playing a critical role in the energy market transformation, driving a shift away from the traditional linear electricity supply chain to a more decentralized and bi-directional market. New technologies are offering opportunities for customers to actively manage their energy use, and the digitalisation of services in other sectors is driving an expectation of more choice and increased competition in the energy sector.

The role of active customers in driving change in the energy industry is significant. Whereas the electricity retail market traditionally provided a standardised good, with price the only significant differential between products, increasingly businesses are responding to a more diverse range of customers with different needs. These developments are fundamentally changing the way in which consumers interact with electricity markets.

While these changes have resulted in intense price competition among Australian electricity retailers, some customers are also beginning to give greater weight to emerging energy services over unit prices alone when considering the best options for their supply of electricity. These services include the ability to access distributed energy resources (**DER**) such as solar and battery storage or electric vehicles, participating in peer-to-peer electricity sharing, contributing through demand response products, or having the opportunity to be rewarded for provision of network and wholesale support services back to the system.

Small scale solar is the first of these technologies that has become widespread; however, customers are increasingly requesting access to a broader range of energy services, which necessitate a greater spectrum of product offerings and price offers from competitive businesses. It is therefore critical that policy makers recognise appropriate long-term and fit-for-purpose policy settings that will drive the uptake of these products and services while also contributing beneficially to the broader issues faced by changing dynamics in the NEM.

Battery storage and electric vehicles

The intermittency of solar PV and its inability to effectively address evening peak demand as described above has led to discussions regarding the value of intermittent distributed generation.[6] Indeed, electricity in an energy-only market such as the NEM is more valuable at peak times. Battery storage is therefore increasingly a compelling value proposition for customers as well as aggregators of energy to choose when to draw energy from the grid and when to consume energy that they have generated themselves.

Connected smart appliances, home management systems, smart inverters, and battery software may be able to mitigate the impacts on load profiles by optimising localised usage or shifting periods of usage. However, underlying incentives to efficiently utilise this technology must be in place for those services to be offered to customers.

This may require changes to tariffs to ensure they are more cost-reflective. As the cost of providing energy services becomes more intrinsically linked with demand characteristics rather than the volume of energy provided, cost-reflective pricing will provide more efficient behavioural responses than flat or volumetric pricing. Tariffs that incentivise the type of technology customers desire provide a more sustainable long-term outcome for the market than one-off subsidies, which can distort the market.

However, the transition to cost-reflective tariffs needs to be orderly. While the costs of providing energy services should be shared equitably, products and tariffs must be structured in a way that does not

[6] See for example, the Essential Services Commission of Victoria's report: Essential Services Commission of Victoria, *The Energy Value of Distributed Generation, Distributed Generation Inquiry Stage 1 Final Report*, August 2016.

discriminate against cohorts of customers that cannot access the benefits of distributed energy. Products such as AGL's virtual solar trial[7] should also be encouraged to allow all customers to participate in the energy transformation where they may otherwise be excluded.

While tariff reform is one approach to helping resolve this issue, storage is also a natural solution to smoothing out supply and demand imbalances. While battery storage uptake has begun slowly, with only around 20,000 storage systems installed nationally by 2018, storage uptake is forecast to accelerate sharply after 2020 in both the residential and the commercial sectors as capital costs decline and more cost-reflective pricing structures incentivise load-shifting.

As well as residential and business storage systems, substantial increases in the electrification of the passenger vehicle fleet is likely to occur. The widespread uptake of electric vehicles (**EV**), when coupled with the decarbonisation of the electricity grid, presents a substantial opportunity to deliver emissions reductions consistent with Australia's long-term commitments under the Paris Agreement.

Today, less than 1% of new car sales in Australia are EVs; however, under AEMO's forecasts, EV sales within the NEM are forecast to reach almost half a million vehicles per annum by the mid-2030s, increasing to 90% of new vehicle sales by 2050. The transition towards automated and zero emission technology vehicles could have substantial implications for Australia's electricity grid with flow-on effects for infrastructure. Smart EVs in effect will be able to operate as a portable smart battery, interacting with the electricity grid to provide optimized services at the right location and time.

Automation and the ability to integrate EVs into the grid will enable further opportunities for system-wide optimisation. This could be enabled through technology platforms that enable EVs and EV supply equipment to connect to various nodes allowing energy service providers to proactively manage charging activity to assist with a variety of grid services.

However, the transition will require careful consideration of generation and tariff design to support charging. System optimisation and charging management must progress to address the risks of wholesale market distortion in order to realize the full benefits of an efficient EV uptake. Network infrastructure to support EVs must be developed in an efficient manner, and network and retail tariffs in particular may need to be redesigned to optimize EV charging and reduce impacts on system load shape.

Demand response, orchestration, and emerging retail services

Increased technological expansion has also led to increased opportunities to develop new products and services for customers utilising existing technologies. For example, controlled solar and storage installations provide an increased range of options for customers to change the way they use electricity.

Improved technology capabilities and potential for aggregated and dynamic response offer significant innovation potential, from enabling peer-to-peer energy trading and the participation in large-scale Virtual Power Plants (**VPP**), to the development of highly dynamic and efficient embedded networks or micro-grid systems. These product and service models represent emerging trends in sharing services that are not unique to energy. AGL has been trialling a VPP in South Australia that has provided an indication of the opportunities and challenges associated with integrating this technology into the grid.[8]

New tools such as blockchain technology may help to facilitate peer-to-peer electricity trading or sharing within local energy communities. Smart demand response is emerging as an increasingly useful option to avoid peaks in demand that cannot easily be offset by capacity increases. Technology is now also available that allows small customers to participate in demand response at their homes, and some energy market

[7] The trial allows customers who are renters or in an apartment access the benefits of a solar installation despite not being able to physically locate one within their residence
[8] For more information see: https://arena.gov.au/projects/agl-virtual-power-plant/

participants are providing products and services that enable customers to switch off their energy in exchange for payment during peak periods. For example, AGL's peak rewards program provides a financial incentive for customers to respond to periods of high demand by lowering their usage.

The growth of these different customer services has led to the emergence of new retail models to service those requirements in the energy industry as well. For example, alongside the 36 traditional licensed retailers operating in Victoria and the 59 operating across the remainder of the NEM, the number of alternative energy sellers, exempt from the requirements to hold an authorised retail license, has increased dramatically. Regulatory frameworks must be fit for purpose to ensure that customers are being protected but also that innovative and beneficial practices are not being limited.

Digitisation of services

Changes to the way that customers interact with energy are not merely limited to generation and storage. In 2006, to replace basic accumulation meters, the Victorian Government mandated a rollout of 2.6 million digital interval meters capable of measuring energy use at 30-minute intervals and remotely sending that meter information back to energy businesses.

Since December 2017, in other NEM jurisdictions, new metering regulation requires that all new and replacement meters must be smart meters, and retailers have also been given the responsibility to manage customers' old meters and arrange installation of new smart meters through the newly created role of a metering coordinator. Importantly, a key principle of this reform is that customers, rather than energy companies, are the key decision makers in whether a digital technology solution is adopted within their home or business.

This increased digitisation of energy data through meters and other smart devices is a trend that is likely to continue. The connected device ecosystem is likely to grow rapidly over the next 5 years, with increased monitoring of homes at the device and appliance level. Customers will have increased visibility over the efficiency of their homes and will have greater ability to automate and optimise their energy usage. There will be continued growth in the world of home energy monitoring using a range of devices including sub-meters, smart switches, and power sensors. The number of internet connected devices in Australian households is forecast to more than double by 2021 to 31 devices per home, resulting in over 300 million devices in Australia homes by 2021.

The integration of energy services with smart homes will change how customers experience and interact with energy providers. Nevertheless, even without access to load data from individual appliances, service providers may still be able to provide innovative services utilising improved data analytics. For example, AGL has recently developed an Energy Insights platform where data including a customer's smart meter data, home profile information, and weather, is run through algorithms to approximate energy usage and costs by appliance category including lighting, cooling, heating, entertainment, pool pumps, and refrigerators (see figure below).[9]

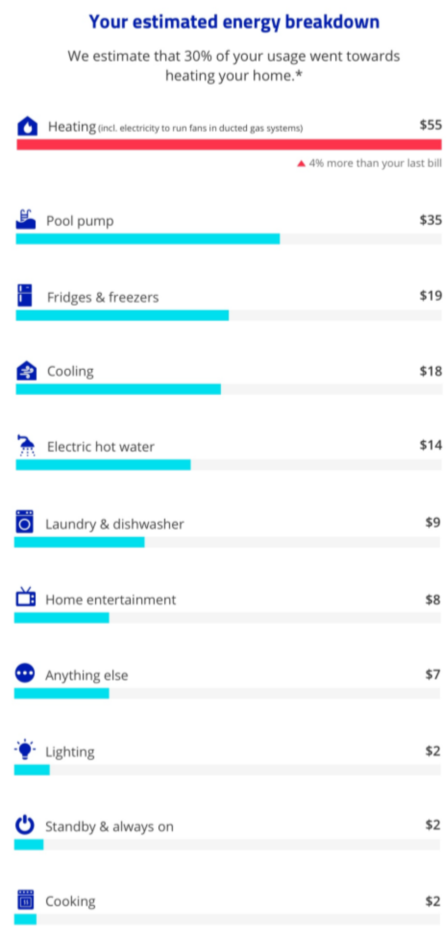

Figure: The AGL Energy Insights approximates energy usage and costs at an appliance level based on smart meter data

Regulatory and policy responses to disruption

Emerging technological disruption requires changes to the regulatory landscape and new developments of fit-for-purpose regulation. The future of the grid will be as a gateway to multiple competitive platforms that enable a range of markets for customers, and change may need to occur to enable this direction. Effectively managing uncertain system impacts of new technologies and maximising their efficient deployment requires a long-term vision and is likely to require commitment to several principles including:

- Ensuring that customer centricity and choice is embedded as a firm principle within the broader energy ecosystem;
- Promoting competitive platforms and innovation in technology and business models as the primary means for allying the needs and interest of customers with their energy service providers;
- Establishing appropriate consumer protections and technology standards that enable interoperability and encourage economies of scale; and
- Understanding key long-term constraints in the delivery of electricity including reliability settings and emissions reduction targets.

Keeping these principles as a guidepost improves the predictability of modifications to existing regulatory and market frameworks when it becomes evident they are required. Open competitive markets and technological neutrality provides businesses the impetus and latitude to pursue technology and service delivery innovations that meet system and customer needs at efficient cost. Customer preferences are continuously evolving, and these changing market dynamics require public policy reform to ensure fit-for-purpose consumer protection and robust participation in a competitive market.

Historically, there have been numerous examples of detailed regulatory obligations limiting the ability for retailers to engage in modern and innovative practices. For example, the use of SMS messages and e-mail as preferred modes of communication with customers has been hampered by restrictions on requirements to send notices by post and make telephone calls. Customer consent requirements, pricing arrangements, and marketing obligations remain more stringent in energy markets than in comparable service industries, and there has been a limited desire by regulators to accept emerging technology and innovative approaches as useful replacements for traditional ways of meeting regulatory obligations.

The regulatory framework should therefore facilitate digital engagement and service providers in their efforts to expeditiously bring to market new products and services and through channels that consumers value. It should promote competitive neutrality and allow existing and emerging business models to compete on their merits, enabling consumers to choose products and services that suit their circumstances.

Customer-focussed regulation, however, should be equally focussed on the aggregated impacts of these new technologies on the wholesale market. Positive outcomes for individual customers need to be balanced by reductions in prices and improvements in the sustainability of the NEM at a national level. This requires a long-term policy vision with clear settings into the future.

Should you have any questions in relation to this submission, please contact

Yours sincerely,

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