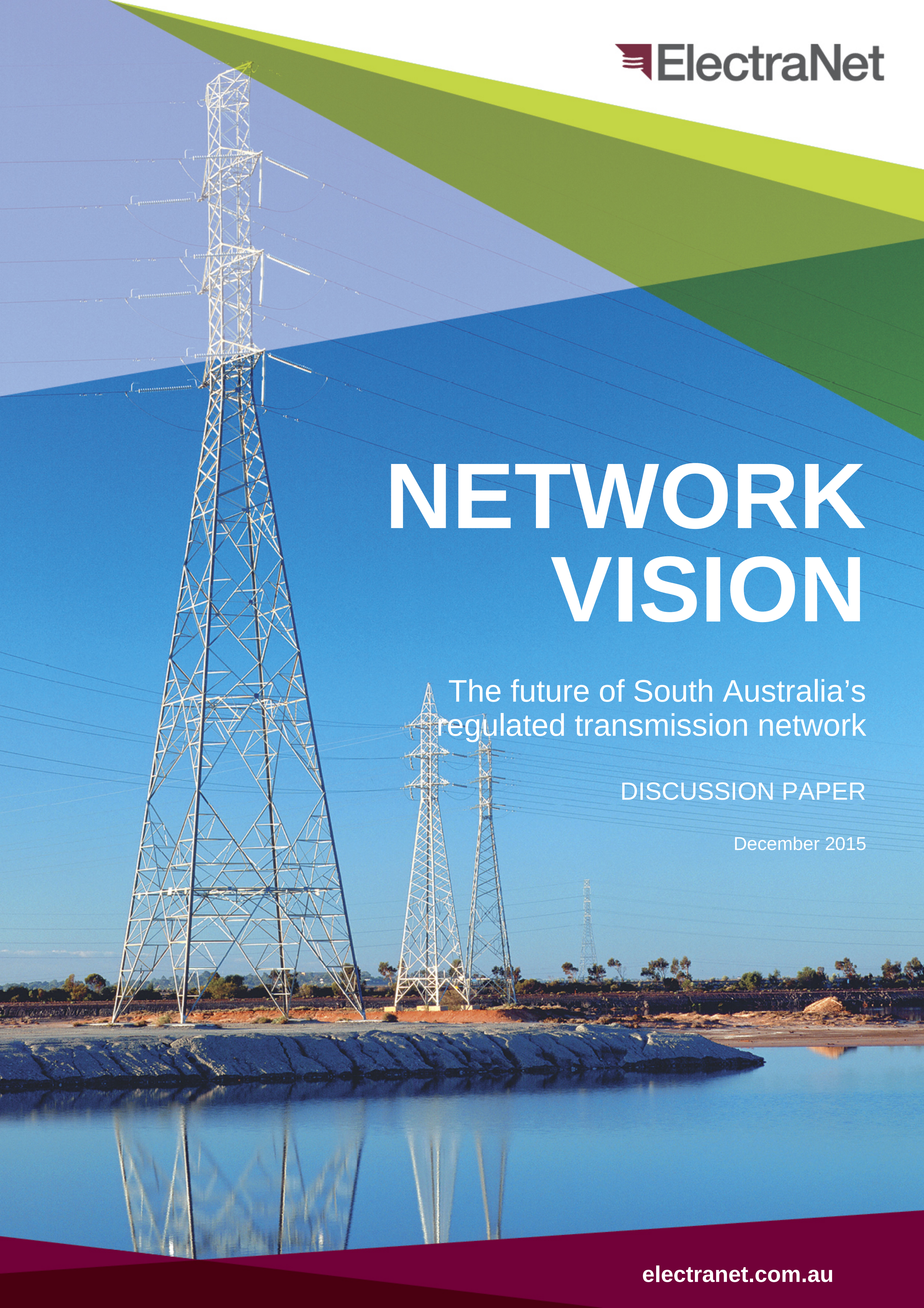

ElectraNet

NETWORK VISION

The future of South Australia's regulated transmission network

DISCUSSION PAPER

December 2015

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1. Introduction

1.1 About ElectraNet

ElectraNet is a specialist in electricity transmission, providing energy and infrastructure solutions across Australia. We power people's lives by delivering safe, affordable and reliable solutions to power homes, businesses and the economy.

Our business includes South Australia's regulated transmission network. We are the principal Transmission Network Service Provider (TNSP) in South Australia and operate in the National Electricity Market (NEM).

Our network safely transports electricity over long distances to metropolitan, regional and remote areas. It is made up of over 5,600 circuit kilometres of transmission lines and cables that operate at voltages of 275 kV, 132 kV and 66 kV, as well as 89 high-voltage substations with modern centralised monitoring, control and switching facilities.

Our direct customers include power generators, the State's electricity distributor SA Power Networks, and large industry. The services we provide also impact on the cost and reliability of electricity for consumers that are connected to SA Power Networks' distribution network.

The role of ElectraNet in the electricity supply chain is illustrated below.

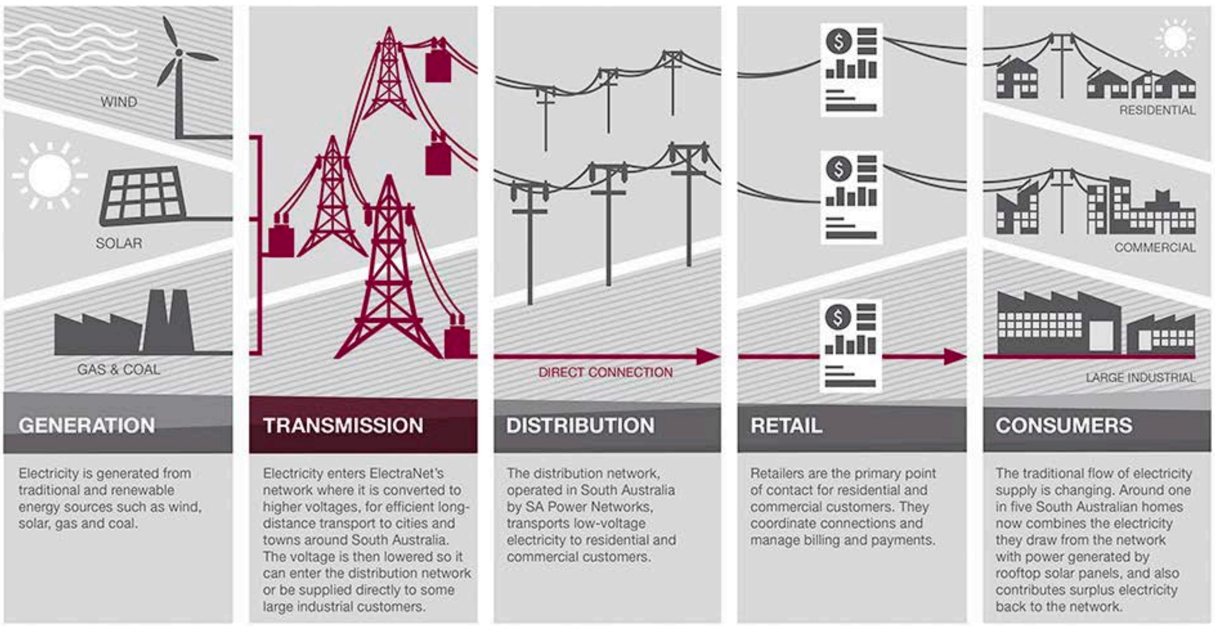

Figure 1 - How electricity gets to you

A reliable and competitive supply of electricity helps to alleviate cost of living and cost of doing business pressures and contributes to economic growth and employment opportunities.

In recent times, there have been important shifts in the drivers of centralised electricity consumption. Slower growth across global, national and state economies, continued uptake of solar photovoltaic (PV) systems and the refinement of emerging technologies such as battery storage are all contributing to a reduction in the energy consumed from the transmission network.

We are planning for the future – preparing the network for the changing way that electricity will be generated and consumed.

1.2 Purpose of this document

This document presents an analysis of the change drivers impacting on the transmission network, what the future might look like over the next 10-20 years, and what the implications are for planning and operation of the transmission network.

This includes implications for capital and operating expenditure requirements in the next regulatory control period that applies to ElectraNet from 1 July 2018 to 30 June 2023.

The document is provided as a Discussion Paper to prompt discussion and develop a shared understanding that helps align the planning of the network with the needs of our customers and consumers.

After we have considered all feedback, we will publish ElectraNet's Network Vision. The accompanying documentation will provide a summary of the key themes emerging from submissions on this Discussion Paper and participant's input from the December 2015 Transmission Network Stakeholder Forum. It will also explain how we have taken customer and consumer feedback into account in formulating the Network Vision that will also inform our Regulatory Proposal.

We are also party to the Energy Networks Association and CSIRO Electricity Network Transformation Roadmap project, which will launch an Interim Program Report on 3 December 2015. We encourage you to engage in providing feedback on this report and to consider its broader context in providing comments on this discussion paper.

1.3 Feedback

ElectraNet would like your feedback on our Network Vision discussion paper and the issues and questions presented within it. You can provide feedback through any of the following methods:

Online	Visit www.electranet.com.au and complete the online form which allows you to provide responses aligned to the questions posed in the discussion paper.
Email	Send your comments to consultation@electranet.com.au.
Post	Write to: Simon Appleby Senior Manager Regulation and Land Management PO Box 7096 Hutt Street Post Office ADELAIDE SA 5000

In order for ElectraNet to have sufficient time to consider your feedback we ask that you provide your comments by the close of business **Friday 15 January 2016**.

Please note that unless your submission requests otherwise, we will publish all of the submissions we receive on our website, to promote better awareness and transparency for all stakeholders.

1.4 Structure of this document

The remainder of this document is structured as follows:

- **Chapter 2: What do consumers value? –** Sets out our understanding of what's important to electricity consumers and their expectations of us and the transmission network**.**
- **Chapter 3: The Role of the South Australian Transmission Network** – Provides an overview of the services provided by the transmission network and the key characteristics of connected generators, loads and interconnections with interstate networks.
- **Chapter 4: Change drivers** – Describes the key drivers of the operational and business environment for the transmission network over the next 10-20 years.
- **Chapter 5: Planning for the future** – Provides an overview of a scenario planning approach we have used to develop our thinking on what the future might look like, and summarises the four future scenarios developed.
- **Chapter 6: Future Scenario Implications** – Describes how consumers are thought to respond to change drivers, and the implications for the transmission network.
- **Chapter 7: Network Vision** – Describes how the network of the future will provide for the needs of our customers and other key stakeholders.
- **Chapter 8: Directions and Priorities** – Describes the steps we plan to take over the next 10 years to achieve our Network Vision, in particular during the next regulatory control period from 1 July 2018 to 30 June 2023.

2. What do consumers value?

Changes in how consumers use, produce and value electricity services are transforming electricity systems worldwide. Nowhere is this clearer than in South Australia, where we have world leading numbers of consumers adopting rooftop solar PV systems.

However, not all consumers are the same and this diversity will increase in the future as consumers have more choices available to them about how they use and produce electricity.

What is the role of the transmission network in providing services our customers and consumers value now and in the future?

From conversations with our customers and consumer representatives we understand that customers and consumers expect the following from us and the transmission network:

- A safe, secure and reliable supply of electricity to power homes, businesses and the economy
- Transmission services delivered at lowest long-run cost
- Service solutions developed by evaluating all reasonable alternatives, including non-network solutions such as demand management
- Secure integration of renewable energy generation and emerging technologies
- Environmental and sustainability practices consistent with accepted standards
- Effective engagement to understand their needs and expectations and to respond to these in our business planning

We are guided by these expectations in the way we plan, develop and operate the transmission network.

This is summarised in three key themes:

Affordability	Keeping prices low and sustainable by focusing on lowest long-run cost outcomes.
Reliability	Safe, secure and dependable operation of the network to support reliable supply of electricity.
Choice	Innovating and transforming the network to meet the demands of new technology and the changing needs of the consumer.

DISCUSSION QUESTIONS
To what extent do you agree with our summary of customer and consumer expectations? Which do you think are most important? Are there other expectations that should be considered?

3. The Role of the South Australian Transmission Network

3.1 Transmission Services

South Australia's regulated transmission network is an essential part of how consumers get their electricity.

Large electricity generators have traditionally been located some distance from where most people live and work. The transmission network is an essential part of the process of transporting electricity to where it is needed, including between states.

The transmission network delivers large quantities of electricity at high voltages from where it is generated, to SA Power Networks' distribution network. The distribution network then supplies electricity directly at a lower voltage to households and businesses. The transmission network also directly supplies electricity to large industrial customers such as mines and pumping stations.

The transmission network is often referred to as the 'backbone' of the grid. It enables a competitive market by transporting electricity across interconnected regions to reach consumers no matter where they are located. This allows the cheapest generation to be used to meet consumers' needs at all times, which over time, minimises the overall cost of electricity.

ElectraNet has in recent years connected large amounts of renewable wind generation to the transmission network. This helps to reduce South Australia's greenhouse gas emissions.

The network continues to evolve to meet the changing needs of consumers and to reflect new technologies and supply options at both large and small scale, such as rooftop solar PV installations combined with battery storage.

The network also continues to provide benefits to consumers who choose to adopt new energy technologies in their homes or businesses, for a cheaper overall solution than a stand-alone power system. These are shown in Figure 2.

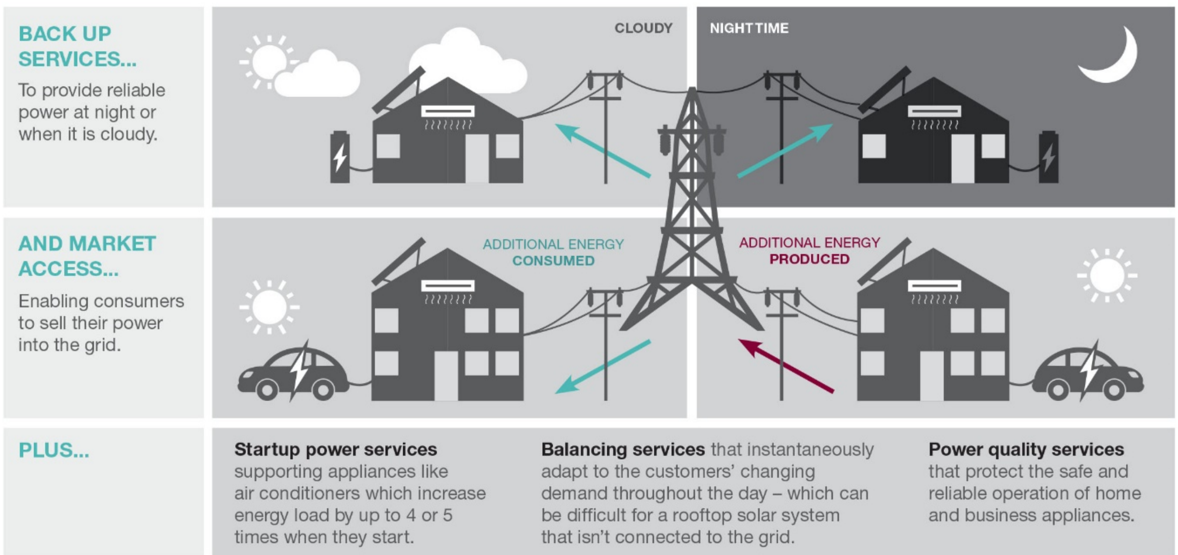

Figure 2 – The Value of the Grid

ElectraNet continues to plan for the future and prepare the network for the changing ways that electricity will be generated and consumed.

3.2 Network Overview

The South Australian transmission network covers an area of over 200,000 square kilometres of diverse and rugged terrain, connecting the major electricity demand centres around the State, with the various sources of electricity generation.

The majority of South Australia's 3,600 MW of large thermal generation plants are located in the North and Central (Adelaide) regions of South Australia. Most of the 1,500 MW of wind generators are situated in the mid-north region and coastal areas. Smaller power stations used to generate power at peak demand times are located throughout the State.

Historically, South Australian thermal generation was supplemented by imports from Victoria via the Heywood and Murraylink interconnectors, especially during maximum demand periods. More recently, the interconnector is also being used to export excess wind generation during off-peak periods. The Heywood interconnector connects the South East of South Australia to Heywood in Victoria, while the Murraylink interconnector connects the Riverland to Western Victoria.

The South Australian transmission network has a high capacity 275 kV backbone network. The backbone network links the generators and interconnectors to major demand centres (including the Adelaide metropolitan area), and to lower capacity 132 kV regional transmission systems providing supply to regional load centres.

The network maps shown in Figures 3 and 4 illustrate the location and reach of the South Australian regional and metropolitan transmission networks.

Figure 3 – The South Australian metropolitan transmission network
Source: ElectraNet

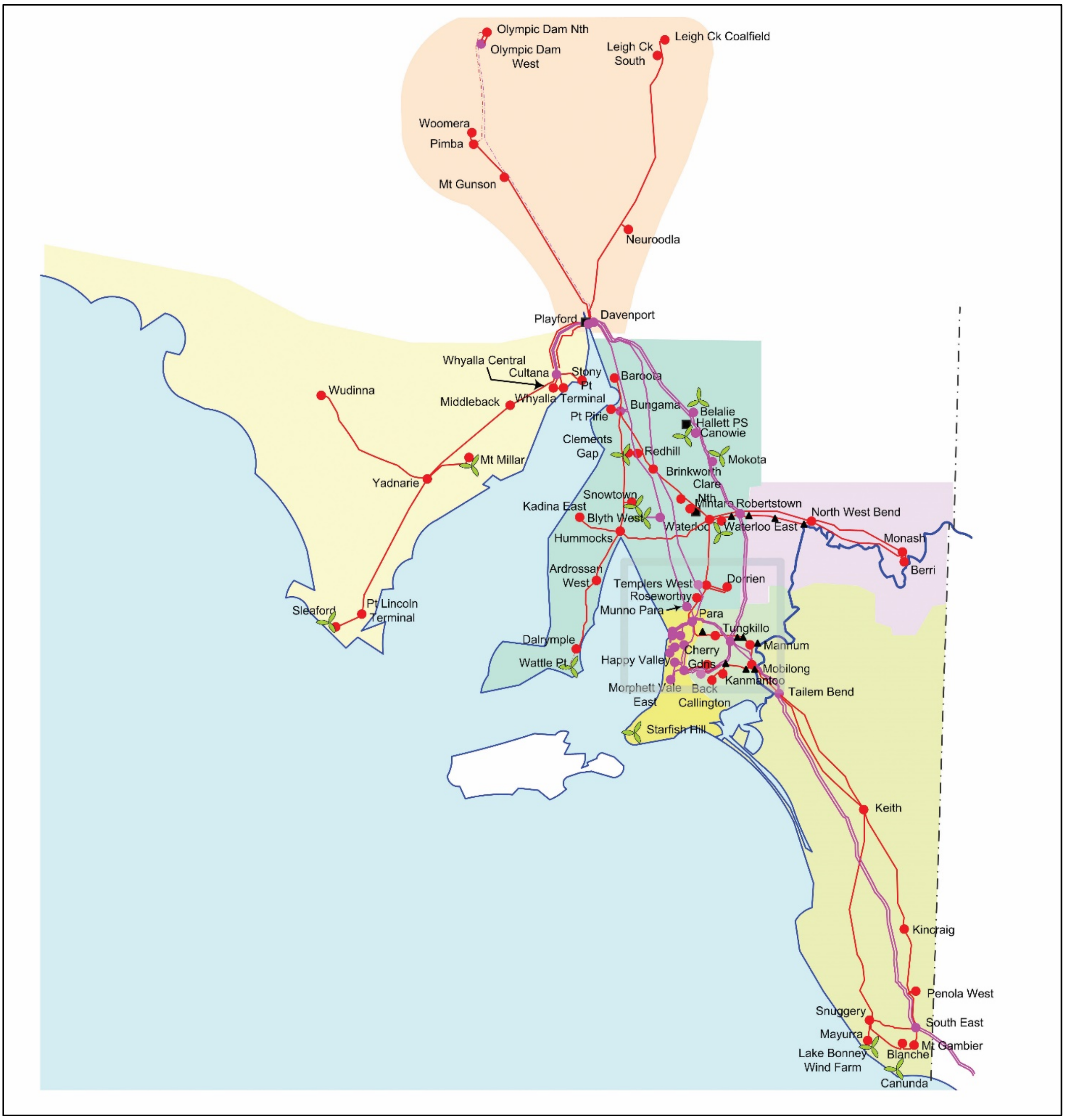

Figure 4 – The South Australian regional transmission network
Source: ElectraNet

The 275 kV transmission network traverses the State from north to south, with four 275 kV transmission lines connecting the North and Central (Adelaide) regions, and two 275 kV transmission lines connect the Central and South East regions.

There are underlying 132 kV meshed transmission lines which sometimes limit the ability of this 275 kV network to transmit power. A simplified view of the main transmission system showing the 275 kV corridors and the two interconnections with Victoria is shown below.

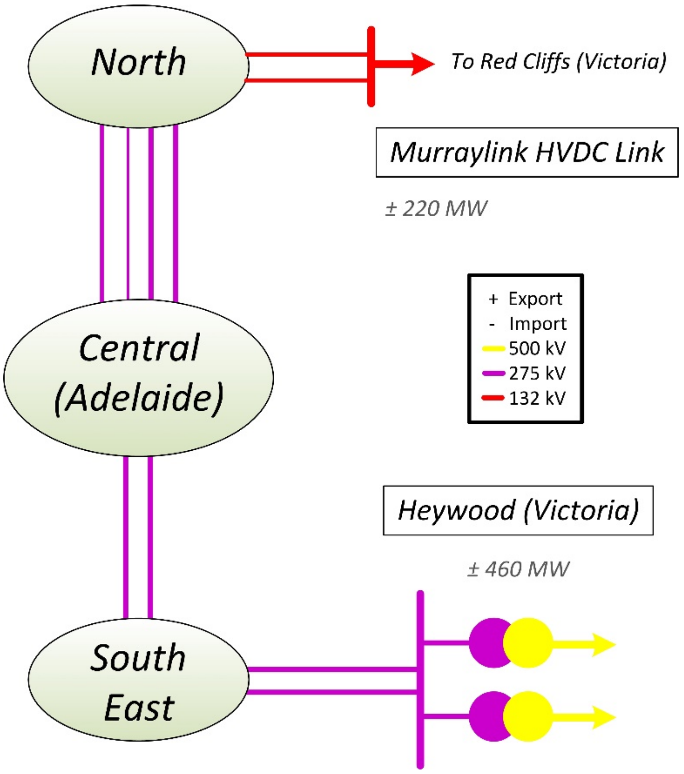

Figure 5 – 275 kV Backbone Network

Source: ElectraNet[1]

The Heywood interconnector is a 275 kV High Voltage Alternating Current (HVAC) interconnector that connects the South East in South Australia to Heywood in Victoria, and has a maximum capacity of ±460 MW. The Murraylink High Voltage Direct Current (HVDC) interconnector connects Monash in the Riverland to Red Cliffs in Victoria, and has a maximum capacity of 220 MW.

While the theoretical combined maximum thermal capability of the two interconnectors is 680 MW, this is not a firm capability and there are limits imposed by the Australian Energy Market Operator (AEMO) in real time operation, which are determined for different operating and environmental conditions.

An upgrade of the Heywood interconnector is scheduled to be completed by July 2016. This will increase the maximum capacity of the Heywood Interconnector to ±650 MW. As a result of the upgrade, South Australia will be able to import and export up to 870 MW via the combination of the Heywood and Murraylink interconnectors.

[1] Transmission Annual Planning Report, ElectraNet, Published May 2015

4. Change drivers

The pace of change in the energy industry is increasing.

New trends in global commodity prices, government policy, technology, consumer expectations, and industry regulation are emerging alongside established longer-term trends in ElectraNet's asset age profile, signalling the onset of significant changes in our operating environment.

This will influence our future network and operating model to varying degrees. The relative timing and intensity of these developments will determine the timing, pace and scope of future changes impacting on the transmission network over the next 10-20 years.

4.1 Economic growth

Local, domestic and global economic growth, as well as the relativities between the three, have a considerable impact on our operating and business environment driving demand for electricity.

Economic Growth as a Driver of Mining and Industrial Development

Global economic growth, exchange rates and corresponding changes in commodity prices will determine the scope for new large loads on the network in the form of mining developments which are significant in terms of expanding the customer base and overall demand.

Prospective mining projects could result in an increase in future baseload demand through the transmission network, with potential projects totalling over 1,000 MW.

The proposed Olympic Dam expansion project and Central Eyre Iron Project comprise the majority of this potential demand with the Hillside Mine and Carrapateena prospect contributing to the remainder.

However, the viability of these projects is highly uncertain with no guarantees that any will proceed.

The viability of the Central Eyre Iron project is dependent on long term iron ore prices and exchange rate conditions. While iron ore prices have been declining over the last three years (see Figure 6), a turnaround in prices could prompt swift action by mining companies.

The BHP Billiton Olympic Dam mining expansion would increase copper mining capacity as well as establish an expanded uranium mine. It has the potential to increase demand on the network by several hundred MW.

The expansion plans, originally approved by the State and Commonwealth Governments in 2011, were "indefinitely" delayed in 2012. In late 2014, BHP Billiton announced that an expansion of copper mining facilities would commence by 2024. While we expect the timing of the expansion to remain uncertain for some time, we are nevertheless forecasting it to be in place by 2030.

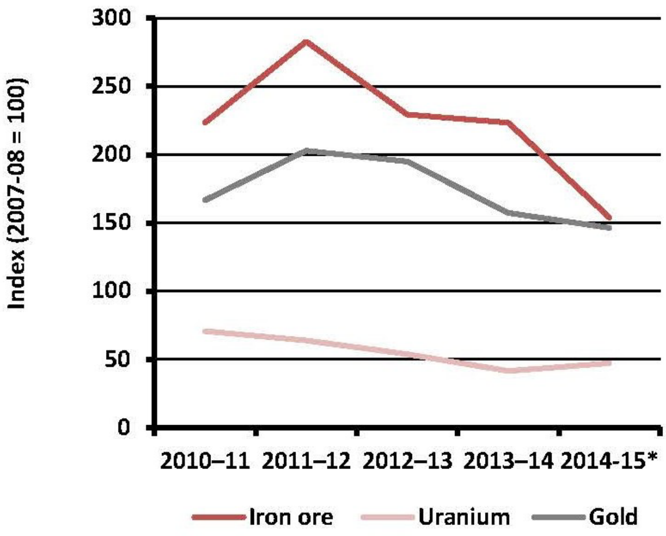

Figure 6 - Commodity Prices (2007 to 2015)
Source: Department of Industry[2]

Economic Growth as a Driver of Mass Market Consumption

Economic growth also has an impact on small to medium sized electricity consumers. Local economic growth impacts the viability of local business and employment conditions, which in turn influence the cost of doing business and cost of living pressures, and have an impact on electricity demand.

Under conditions of high economic growth, more business is attracted to South Australia, generating employment opportunities and net migration to the state.

Conversely, under conditions of low economic growth, population and business growth slow down and consumers are likely to actively seek out ways to reduce energy bills through behaviour changes, more energy efficient appliances and equipment and decentralised energy technology where cost effective.

4.2 Population growth patterns

Population growth is a function of births, deaths and net migration. Growth in population will increase electricity demand, but the impacts on the network will depend upon the location of this demand. Population growth in areas where the network has reached its capacity has the potential to result in the need for new investment whilst growth in unconstrained parts of the network can improve utilisation.

Currently, over 80 per cent of the South Australian population and corresponding demand is contained within the 275 kV Adelaide metropolitan transmission region, with recent trends showing a decline in rural populations and a continuation of the trend towards urban migration.

[2] Resources and energy quarterly, Department of Industry, Published Jun 2015

4.3 Energy prices

Energy prices, including resource prices (coal, oil and gas) drive the wholesale price of electricity as well as the potential for substitution of gas appliances and equipment with electric equivalents and uptake of electric vehicles.

By substituting electrical for gas appliances and charging an electric car instead of paying for petrol, fuel substitution has the potential to transition a large component of residential energy consumption from other fuel sources to the electricity sector.

However, at current gas prices, gas substitution is not likely to be a viable proposition for householders. While there are large potential fuel bill savings available to householders from transitioning to electric vehicles, the upfront cost of electric vehicles remains out of reach for the average householder. Significant increases in gas prices and price reductions in electric vehicles have the potential to change this equation.

Each major fuel substitution category represents a source of potential future demand should price relativities change due, for example, to excess solar PV generation and scarce Liquefied Natural Gas (LNG).

Gas Prices

Domestic gas prices have risen in recent times due to the construction of LNG production facilities in Queensland, linking domestic gas prices to international LNG markets. The extent of this linkage and further gas price rises in the future will depend on Australian LNG's relative competitiveness.

ElectraNet understands that this market is highly uncertain and that it is plausible that Australia's LNG production capacity could be expanded, more strongly linking domestic gas markets to international pricing and thereby causing further gas price increases and wide scale substitution.

Currently the South Australian economy consumes in excess of 52 Petajoules (PJ) of gas per annum (excluding generation plants)[3]. A shift in gas prices could see substitution of gas uses with electricity, particularly in the industrial/manufacturing sector where there is higher price sensitivity.

Gas fired electricity generators currently consume 63 PJ per annum[4], supplying around 30 per cent of South Australia's electricity needs. However, the year-on-year contribution of gas fired generation to the energy mix is highly sensitive to gas prices. While the withdrawal of coal plants in South Australia in the short term may increase gas generation, sharp increases in gas prices could over time, result in renewable technologies displacing gas generators in the market.

Oil Prices

Oil markets are equally uncertain. While current oil prices remain at historical lows, it is foreseeable that future prices could once again rise, creating a stronger market for transport fuel substitutes and further incentivising the electric vehicle market.

3 Bureau of Resources and Energy Economics 2014 Australian energy statistical data Table F http://bree.gov.au/publications/australianenergy-statistics/2014-australian-energy-statistics-data

Electricity Prices

The Australian Electricity Market Operator (AEMO) is forecasting SA wholesale real market price decreases of 0.5 per cent per annum to 2020 and increases of 1.0 per cent per annum to 2030, due mostly to a supply-demand rebalancing as renewable investment driven by the Renewable Energy Target (RET) scheme flattens out and demand recovers[4].

SA Power Networks' current regulatory determination is projected to result in an overall decrease in retail prices of around 5 per cent over the five years to 2020[5]. Significant investment in the distribution network may be required from 2020 to 2030 to replace ageing assets and to accommodate new network uses such as local energy trading and electric vehicles.

As off-grid alternatives decline in cost and improve in performance, the centralised network will increasingly face competition. To prevent wide scale grid defection, there will be increased pressure to drive operational and investment efficiencies at both the distribution and transmission level to ensure electricity prices remain competitive.

4.4 Technological development

There are a range of emerging technologies that have the potential to give rise to material impacts on electricity demand from the centralised system. These include decentralised energy technologies such as solar PV, battery storage systems, electric vehicles and centralised renewable generation technologies, such as solar thermal. The level of penetration of these systems depends on consumer preferences, the level of government support and technology cost declines driven by the global market.

In the last five years, government support and technology cost declines have seen significant domestic roof-top solar PV penetration in South Australia. As a result, the net demand from the centralised system over a five year period has reduced by 829 GWh[6] or around 6.6 per cent.

Solar uptake has also had an impact on demand at summer peak times, shifting peak demand to later in the evening. Figure 7 shows how the increase in rooftop PV installation between 2010 and 2015 has modified the demand profile over the averaged top five peak demand days, but peak demand has not fallen.

[4] Electricity market forecasts: 2015, Frontier Economics, Published April 2015

[5] Final decision SA Power Networks distribution determination - AER, Published October 2015

[6] National Electricity Forecasting Report, AEMO, Published June 2015

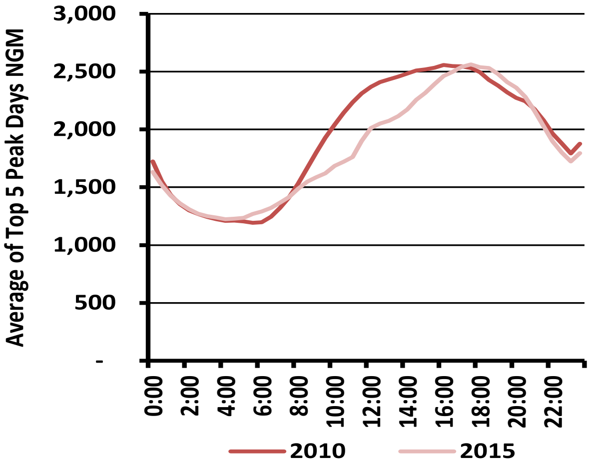

Figure 7 - Contribution of Residential Solar PV to Summer Peak Demand (2010, 2015)
Source: ElectraNet

Over time it is expected that technology costs for distributed energy and electric vehicles, as well as centralised renewable energy, will be driven down as a result of global investment, but tempered by the influence of exchange rates.

Buoyed by the decline in technology prices, we expect new energy services markets to emerge, delivering small consumers a mix of centralised energy supply and decentralised energy generation and control technologies. Micro-grid services may also emerge to transition grid connected consumers to a micro-grid environment where this is cost effective or where greater control or reliability are key drivers.

4.5 Consumer attitudes

Consumer expectations and attitudes to energy depend upon economic conditions. When the economy struggles, the community remains more concerned with cost of living pressures and is more likely to actively seek out opportunities to reduce bills.

In times of low economic growth, the community is likely to have reduced support for any expansion of environmental or other policies which result in a rise in electricity prices.

Notwithstanding, consumers are still likely to invest in distributed energy resources such as solar, storage and energy efficiency to save on electricity bills, especially where financing options are available that allow investment with low to no upfront costs

4.6 Environmental policy

In recent years, renewable energy generation has increased as a proportion of the total generation mix across all NEM regions. However, South Australia has by far the highest renewable energy penetration of any NEM region, driven by the quality of solar and wind resources available as well as supportive State policies.

In fact, South Australia has world leading penetration levels of renewable generation compared to demand (on a per capita basis).

South Australia currently has 1,474 MW of wind[7] and about 671 MW of rooftop solar PV generation[8] capacity installed. This compares to maximum, average and minimum electricity demand of about 3,400 MW, 1,500 MW and 800 MW respectively.

ElectraNet expects that environmental policy will continue to influence the deployment of renewable energy including the potential for:

- A carbon price with application to the electricity sector
- The expansion of the Commonwealth's RET target beyond 2020
- The winding-down of the small scale renewable energy certificate scheme and South Australian Feed-in Tariffs
- Continuation of State based renewable energy targets and schemes[9]

On 18 May 2015, the Commonwealth Government announced a bipartisan agreement for a national RET of 33,000 GWh of large scale renewable energy generation by 2020. The RET is expected to drive ongoing investment in large scale wind and South Australia will continue to attract a significant proportion of this investment.

Both the South Australian Government and Commonwealth Government have announced a winding back of support for small scale decentralised generation. However, ElectraNet expects that the winding back will only have a small impact on deployment of mass market decentralised solar PV.

[7] South Australian Wind Study Report, AEMO, p. 21. Published October 2014

[8] Detailed Summary of 2015 Electricity Forecasts, AEMO p 51. Published June 2015 National Electricity Forecasting Report published: June 2015

[9] For example, the ACT's renewable energy target has already resulted in the approval of 100MW of wind capacity in South Australia.

4.7 Network regulation

Revenue

ElectraNet's regulated revenue allowances are set by the Australian Energy Regulator (AER) to provide for ElectraNet's capital and operating expenditure, generally over a five year period. In recent years, regulatory determinations have resulted in lower than proposed expenditure allowances for most networks across Australia, mostly in response to a lack of growth driven investment requirements and customer calls to constrain price rises. This reduction in network revenue is shown below.

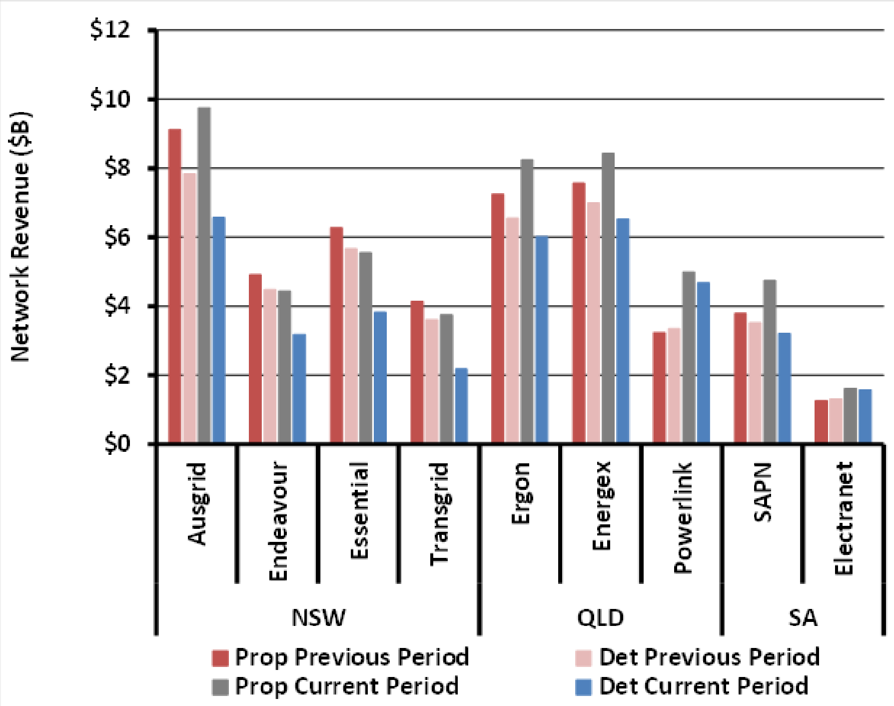

Figure 8 - Revenue Allowances (Proposals versus Determinations)
Source: AER[10]

The entry of solar and storage products into the market establishes the potential for consumers or entire communities to go off-grid. This essentially launches a competitive force into the otherwise monopoly market for network services that support centralised electricity supply.

In the short term this will further increase regulatory (and internal business) pressure on costs and in the long term may reduce the extent of regulation required, at least at fringe of grid locations where competitive forces are most likely to be at play.

10 AER Determinations (various), Retrieved Jun 2015, www.aer.gov.au

Pricing

The majority of South Australians receive a quarterly electricity bill from their retailer that includes embedded distribution and transmission network and wholesale charges. The distribution and generation components typically make up the bulk of the bill (40% and 31% respectively), while the transmission component only constitutes 10% of the bill for a typical residential customer[11]. The government solar PV feed in tariff makes up the balance.

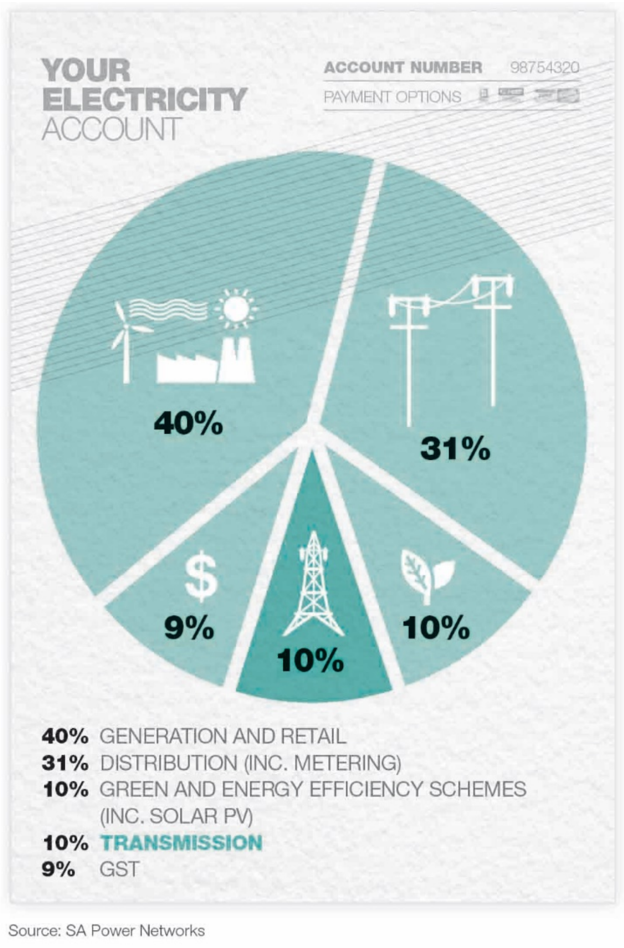

Figure 9 – Typical South Australian Residential Electricity Account

Source: SA Power Networks

In 2014, the Australian Electricity Market Commission (AEMC), determined a Rule Change that required distribution networks to offer more cost reflective network tariffs. As a result, distribution networks across the NEM have begun to offer alternative tariffs, which tend to be demand based rather than volume based. Over time this should see consumers move to more cost reflective tariffs.

This will result in opportunities for distribution customers to respond to peak signals through behaviour change and also drive investment in technologies to manage peak demand, such as home energy management systems and battery storage systems coupled with smart meter technology, and have a moderating impact on PV installation rates.

11 The South Australian Distribution Network: Directions and Priorities, 2015 to 2020, SA Power Networks, p 8

Cost reflective tariffs tend to incentivise smaller solar systems and more storage systems compared to conventional volume based tariffs. However, this effect might be mitigated by retailers offering solar PV and storage on a per kWh, leasing basis, which tends to driver larger systems.

SA Power Networks has put forward a maximum demand tariff for their residential customers, but this is yet to be made broadly available by retailers.

4.8 Network condition

Our transmission lines are heading towards the end of their nominal asset lives with the majority of our assets having been installed more than 30 years ago. The history of the development of our asset base is shown in below.

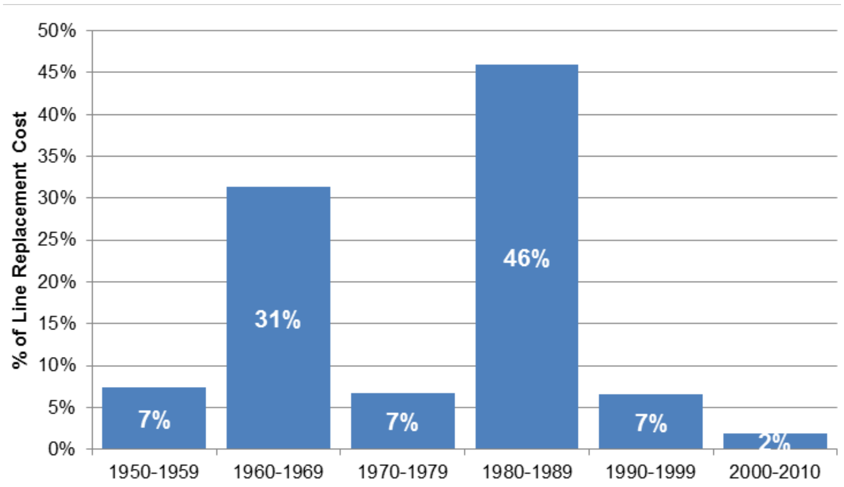

Figure 10 - Average Asset Age Profile at 2015 for transmission lines
Source: ElectraNet

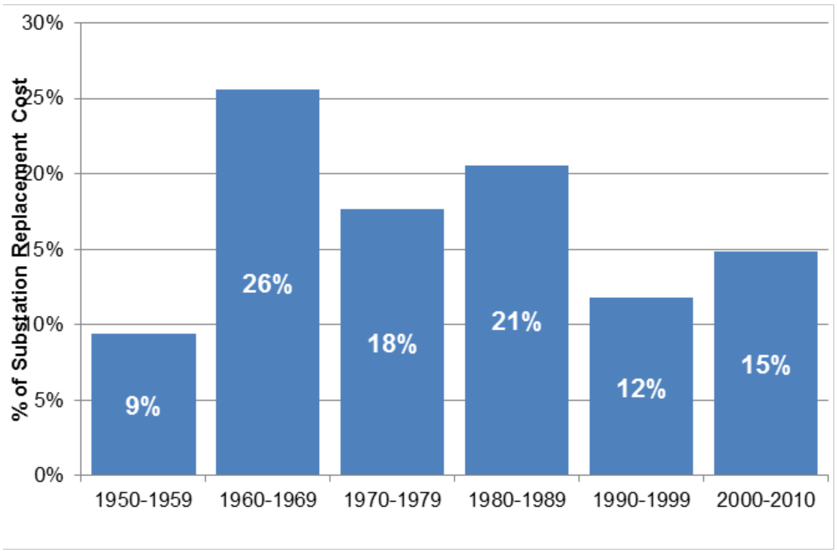

Figure 11 - Average Asset Age Profile at 2015 for substations
Source: ElectraNet

Currently, there are no plans for wholesale replacement of transmission line or substation assets in the foreseeable future, due mostly to the absence of any demand growth drivers.

Instead, we are adopting an approach of condition based replacement of component assets and a reliability centred maintenance program designed to extend the life of existing assets, in order to deliver network services at lowest long-run cost.

DISCUSSION QUESTIONS
To what extent do you agree with the major change drivers discussed above? Are there additional drivers that need to be recognised or contemplated?
Which change drivers (already noted above or those not yet captured) do you think will have the greatest impact on the future role of the transmission network and why?

5. Planning for the future

The electricity system is currently undergoing fundamental change from a system dominated by centralised conventional supply to a decentralised new technology system with less dependency on centralised infrastructure.

Historical trends of increasing demand and the corresponding need for increasing system capacity are breaking down. While the direction of the change is apparent, the timing and magnitude of change is less clear.

Scenarios provide a robust planning framework by enabling a range of feasible futures to be incorporated into the planning process. We have accordingly adopted a scenario planning approach to our Network Vision as a way to better address future uncertainty.

The scenario planning approach requires the development of a range of plausible futures. Network planning then focusses on a particular plausible future (or planning scenario) but is robust to the range of plausible futures.

Each scenario is developed with an internally consistent set of assumptions describing a possible future. Alternative strategies can then be tested against the set of scenarios to ensure each strategy is robust. Although multiple scenarios are developed, only one is selected as the basis for detailed planning.

5.1 Plausible Futures

Scenarios are storylines of potential futures defined by key drivers. Scenario planning requires the development of a range of future scenarios covering the full range of plausible outcomes in terms of the key drivers. This strategic planning framework is illustrated in Figure 12.

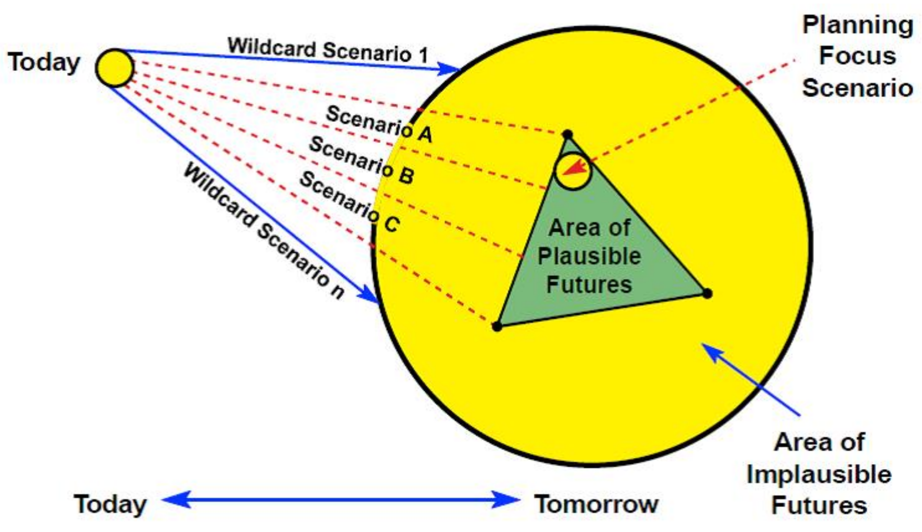

Figure 12 - Plausible Futures
Source: Cambridge Energy Research Associates

Scenarios are defined as plausible where each of the narratives is plausible and the set of drivers are consistent with one another.

5.2 ElectraNet scenarios of the future

We have identified the following four future scenarios as covering a range of plausible futures for the purpose of developing our draft network vision.

The four scenarios are framed across two axes representing the main driving forces at work:

- The level of distributed energy technology diffusion and the implied level of consumer adoption of emerging technology
- The level of economic growth and corresponding appetite for strong environmental policy

In this way, it is assumed that distributed energy technology diffusion and consumer adoption of technology are inextricably linked. Likewise that the level of economic growth will dictate the community's appetite for environmental policy.

The relative placement of the four scenarios within the scenario development framework is shown in Figure 13.

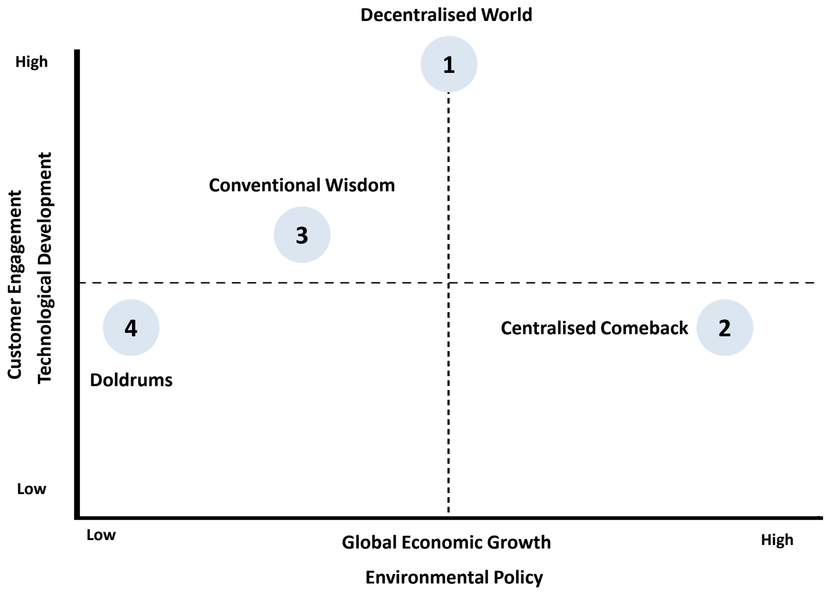

Figure 13 - Scenario Development Framework
Source: ElectraNet

Scenario 1 – Decentralised World describes a future where global and local economic growth continue at historical rates. However, the mutually reinforcing factors of high consumer adoption of energy technology and lower technology prices drive a high degree of decentralised energy penetration.

Scenario 2 – Centralised Comeback describes a future where global economic growth accelerates resulting in corresponding local economic growth buoyed by the return of a mining boom in South Australia. The level of uptake in decentralised energy technology is relatively low due to relatively slower than expected technological progress and a return of consumer confidence in the centralised system, which provides for more cost effective outcomes and achieves the community's high expectation for environmental outcomes.

Scenario 3 – Conventional Wisdom describes the current conventional wisdom, where there is a near-term slowdown in global and local economic growth, and only weak environmental policy is supported. There continues to be a relatively high level of consumer adoption of decentralised energy technology and energy efficiency in part due to a lack of confidence in the centralised system to deliver lower prices.

Scenario 4 – The Doldrums describes a sluggish economy where growth stagnates over the long-term. Jobs and cost of living dominate community concerns and environmental policies are all but axed. Consumers have little interest in taking risk investing in distributed energy resources, preferring instead to reduce energy bills via low cost behaviour change and energy efficiency.

A summary of the scenario drivers is presented below.

Settings	Scenario 1 Decentralised World	Scenario 2 Centralised Comeback	Scenario 3 Conventional Wisdom	Scenario 4 Doldrums
Global Economic Growth	Above long term average	High	Below long term average	Low to stable
Renewable Energy Policy	Moderate RET, High small scale incentives	Strong RET, Moderate small scale incentives	Moderate RET, Moderate small scale incentives	Wind back of RET and all small scale incentives
Carbon Pricing	Moderate carbon price	Strong carbon price	Moderate Carbon price	None
SA RET Share	Population pro-rata	Current share	Population pro-rata	Population pro-rata
Cost Reflective Tariffs	Introduced at moderate pace (within 10 years)	Introduced quickly (within 5 years)	Introduced slowly (within 15 years)	Introduced slowly (within 15 years)
Distributed Energy Resource Prices	Decline faster than historical solar PV rate	Decline slower than historical solar PV rate	Decline at historical solar PV rate	Decline slower than historical solar PV rate
Wholesale Gas Prices	$10/MMBtu by 2020	$12/MMBtu by 2020	$8/MMBtu by 2020	$8/MMBtu by 2020
Electric Vehicle Adoption	65% of sales by 2035	35% of sales by 2035	25% of sales by 2035	15% of sales by 2035

Figure 14 – Scenario Drivers
Source: ElectraNet

While the scenarios represent equally likely future states, one is typically selected as the basis for planning, and signposts may be developed to identify a shift towards any of the alternative scenarios.

We propose to adopt the Conventional Wisdom scenario for planning, and are testing our plans against each of the alternative scenarios to ensure they are robust in the early years should any of them eventuate. Were this to occur, we would update our plans accordingly during our annual planning cycle.

The Network Vision in this document therefore describes a future that will allow transmission network services to be efficiently delivered under the Conventional Wisdom scenario but is robust to the range of scenarios considered.

DISCUSSION QUESTIONS
How do you view the scenarios which were developed? How well do you think they cover a reasonable range of plausible futures based on the scenario drivers?
To what extent do you agree with the adoption of the Conventional Wisdom scenario as the central planning scenario? If not, what scenario should be selected?

6. Future Scenario Implications

Based on the scenarios described in the previous section, a view of future transmission network requirements was developed with reference to the types of customers connected to it:

- **Distribution Customers** – Small to medium customers served via SA Power Networks' distribution network (also referred to as consumers).
- **Major Load Customers** – Large customers including mines, military and other major loads directly connected to the transmission network.
- **Generation Connections** – Large thermal and renewable generators directly connected to the transmission network.
- **Backbone Network** – ElectraNet's 275 kV network connecting loads to generators and other states.
- **Interconnections** – Assets connecting South Australia to the remainder of the NEM to access least cost energy supplies.

6.1 Distribution Customers

Consumption

Steady uptake of distributed energy resources, combined with flat State growth over the period leads to long-term stagnation in centralised demand growth across greater Adelaide in the Conventional Wisdom scenario.

Figure 15 compares projected consumption in each scenario (including both distribution customers and major load customers).

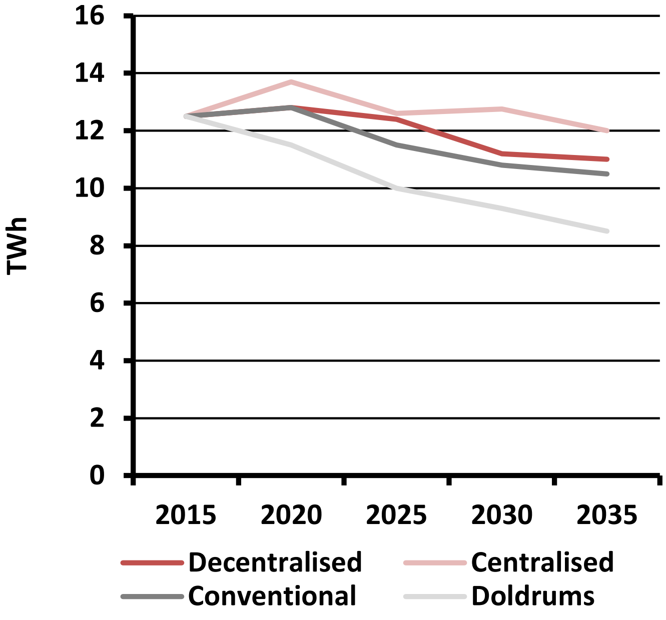

Figure 15 – Projected Annual Consumption
Source: Energeia

Under the Conventional Wisdom scenario, underlying energy growth from economic and population growth are sufficient to outstrip declines in centralised consumption from distributed generation in the early years. However from between 2020 and 2025 distributed solar and storage technology prices decrease enough to offset these growth factors and consumption declines.

Under all scenarios centralised consumption by 2035 reduces by between 4 per cent and 32 per cent depending on distributed technology price declines and economic growth factors.

Maximum Demand

In the Conventional Wisdom scenario, maximum demand declines initially but then recovers to reach 2.9 GW by 2035. Figure 16 compares projected maximum demand in each scenario.

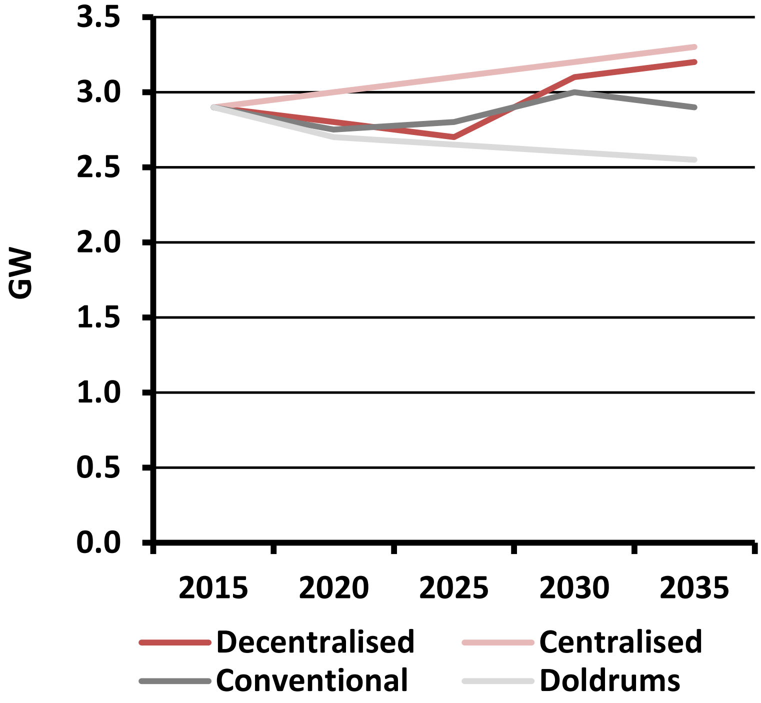

Figure 16 - Projected Maximum Demand
Source: Energeia

In all scenarios, there is significant adoption of solar PV. However, maximum demand has already been pushed to later in the day, and as a result, from 2015, falls outside the peak hours of solar PV generation. Moving forward, the level of additional installed solar capacity has a limited impact on network maximum demand.

Solar Uptake

Under the Conventional Wisdom scenario, distribution residential and business customers are expected to install 1.34 GW of solar by 2035 as shown in Figure 17. Solar PV is expected to be particularly attractive to business customers as their relatively flat day time load profiles allow for high utilisation of solar PV to reduce grid consumption.

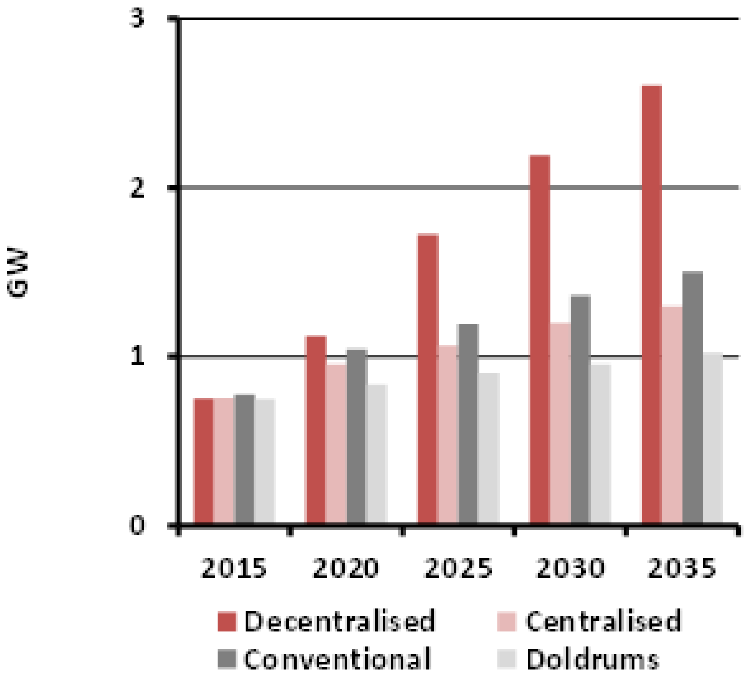

Figure 17 - Cumulative Mass Market Solar Capacity
Source: Energeia

In a Decentralised World, we expect up to 1 GW more solar PV to be installed than under our planning scenario. This would result in significant levels of unusable solar at the distribution network level as customer demand would not be sufficient to absorb customers' own solar PV generation and the exports of others.

This contrasts with the Doldrums scenario where lack of incentives for solar PV and slow technology price declines, limit growth in adoption to just over 1 GW of capacity by 2035.

Storage Uptake

Under our Conventional Wisdom planning scenario, we anticipate that distribution customers will install around 280 MWh of decentralised storage by 2035 as shown in Figure 18.

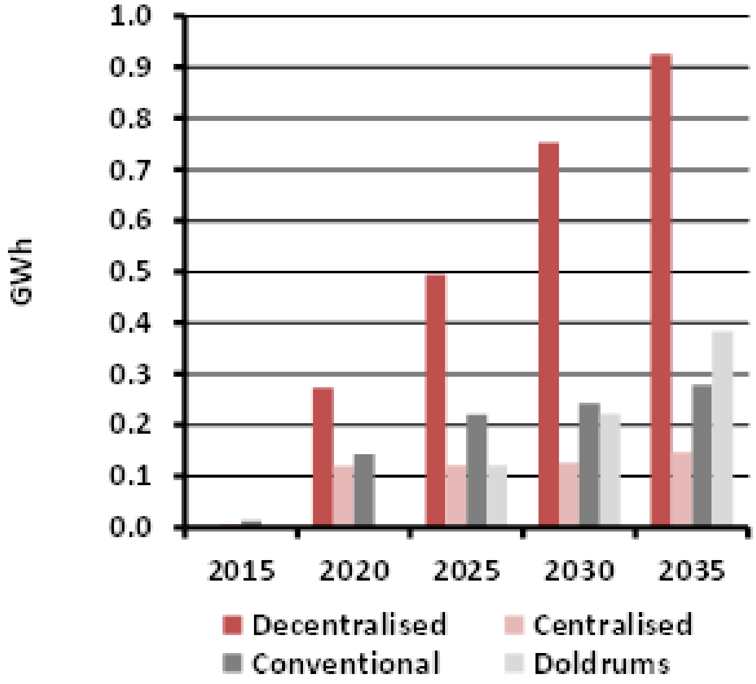

Figure 18 - Cumulative Distribution Storage Capacity
Source: Energeia

Adoption of storage across all scenarios is primarily driven by tariffs that incentivise storage to reduce a distribution customer's exposure to peak prices during maximum demand or notified periods rather than giving rise to grid defection.

Both the Decentralised World and Conventional Wisdom scenarios see a slow to moderate transition to cost-reflective tariffs. However, the effect of this is overshadowed by technology price declines in each scenario. This is particularly noticeable in the Decentralised World scenario where the strong Australian dollar, coupled with aggressive declines in storage prices drives significantly more uptake than under other scenarios, with installed capacity surpassing 0.9 GWh by 2035.

Electrification of Transport

Under our planning scenario, it is expected that by 2035 there will be approximately 185,000 electric vehicles on South Australian roads or approximately 35 per cent of the total vehicle market in SA. The cumulative electric vehicle sales for SA by scenario are shown in Figure 19.

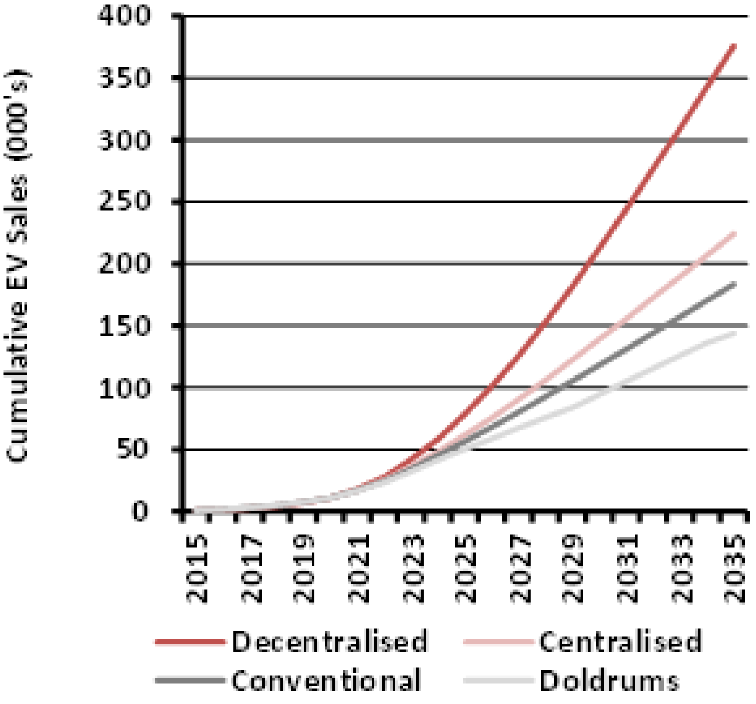

Figure 19 - Electric Vehicle Adoption
Source: Energeia

We expect markedly more electric vehicles under a Decentralised World scenario in which vehicle emissions standards have been strengthened, tax breaks have been introduced and vehicle costs have fallen. The surplus of solar generation in this scenario reduces the cost of charging vehicles during the day, which also drives uptake and cumulative sales reach 375,000 by 2035.

Under the Doldrums scenario, electric vehicle development stalls as international support policies are weakened. A weak Australian dollar compounds the higher vehicle price environment, making the cost of importing vehicles greater. Despite this, vehicle sales still reach around 150,000 by 2035.

Metropolitan Bulk Supply Points

Despite the increasing reliance on decentralised generation, ElectraNet’s 50-60 year old connection assets are largely expected to be maintained and component assets replaced as economic over the period, due to the strong value proposition of the centralised grid. However, growth driven investment is expected to be limited.

Regional and Remote Bulk Supply Points

The end of the mining boom, and wider macro-economic challenges in the near-term are expected to lead to a near-term contraction in regional and remote demand.

The need to replace 50-60 year old regional transmission and distribution assets based on their condition and falling technology costs are expected to have led to some regional centres being taken totally off the grid by 2035.

Those regional and remote bulk supply points that remain are expected to have significantly less peaky load profiles in 2035 thanks to storage, allowing some older assets to be replaced with lower cost assets.

6.2 Major load customers

New major load customers and connections are strongly dependent on both local economic growth and global economic forces influencing long-term commodity prices

While the number and size of new major load customers is uncertain, we expect a limited number of new connections, including the Olympic Dam expansion, which is assumed to be in place by 2030 under our planning scenario.

We also must ensure the network is robust to a range of outcomes for the major load connections. The Doldrums scenario provides a worst case outcome for the South Australian economy where new mining projects are highly unlikely and the Olympic Dam expansion is further delayed. The Centralised Comeback scenario considers high economic growth and positive investment conditions which bring forward a number of new mining projects and significant new load on the network.

Across all scenarios, existing major loads are seen as viable given their investment costs are sunk, and are therefore expected to continue operating over the forecast period. Exceptions to this may emerge, for example the Leigh Creek community where the early closure of the coal mine presents a potential asset stranding risk for our lines connecting both the town and major mining load.

6.3 Generation connections

Under all scenarios, we expect an increase in wind generation enabled by the RET target to 2020 as South Australia continues to attract a proportion of national wind investment.

Under our Conventional Wisdom scenario, there is very little investment in centralised renewables after 2020 as the RET gives way to a carbon price and lower cost carbon abatement activities take precedence to 2035.

By 2035, the combined capacity of rooftop solar PV and wind generation is more than sufficient to meet the entire States' demand from 10am to 3pm on most days. The wind generation will typically occur over the entire day with thermal generation relegated to overnight when there is no solar PV generation. On most days there will be excess wind generation coinciding with peak solar generation times.

Figures 20, 21, 22 and 23 show the energy supply mix for an average day in 2035 under each scenario.

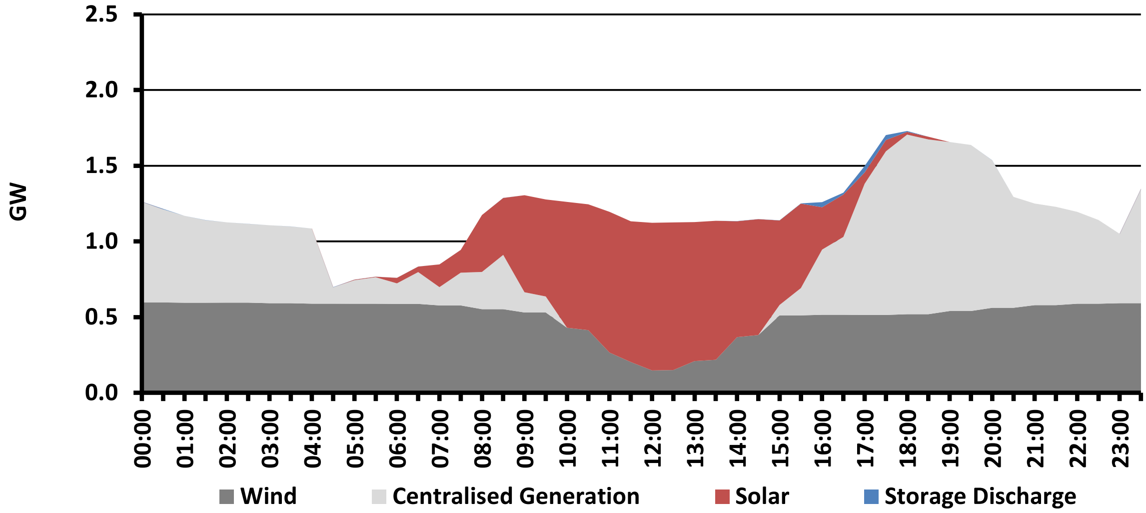

Figure 20 - Impact of Solar PV on Centralised Generation (Conventional Wisdom)
Source: Energeia

Under our planning scenario, as illustrated in Figure 20 we expect high levels of solar PV installation to erode demand for centralised generation during daylight hours. Given the slow move to cost-reflective tariffs, installed storage capacity will not be sufficient to shift solar PV generation into the peak period. As a result, centralised thermal generation will be required to ramp down during these hours and ramp up to meet the evening peak of around 1.2 GW.

There is virtually no need for baseload thermal generation and we expect gas to provide supply overnight and in times of low solar or wind generation.

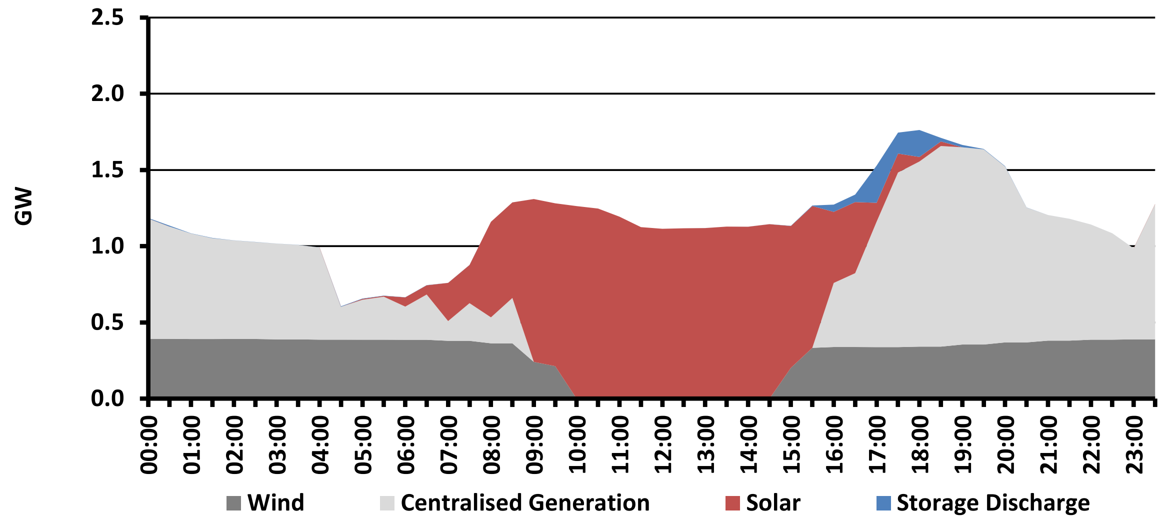

Figure 21 - Impact of Solar PV on Centralised Generation (Decentralised World)
Source: Energeia

In a Decentralised World, as illustrated in Figure 21, sharply declining technology prices and volume based tariffs continue to encourage large solar PV uptake. Some storage is observed, but only towards the end of the period as consumer's transition to demand based tariffs. This solar penetration will result in bi-directional flows at the distribution network level as local solar PV generation outstrips consumer demand and storage and a significant proportion of solar PV will be 'spilled' where distribution networks are not able to address voltage issues and/or provide for two way flow.
Rooftop solar PV capacity would satisfy consumer demand during the middle of the day and push out wind generation.

This dramatic intraday variation would put thermal power stations and the network operator under significant strain earlier in the period compared to the other scenarios.

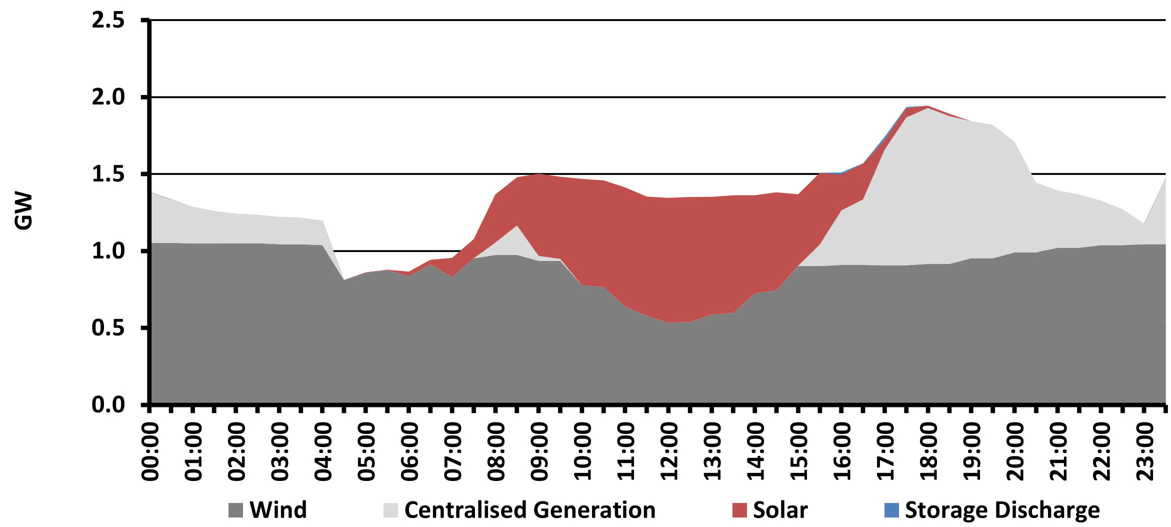

Figure 22 - Impact of Solar PV on Centralised Generation (Centralised Comeback)
Source: Energeia

Under the Centralised Comeback scenario, as illustrated in Figure 22, solar PV capacity in 2035 is the lowest among all scenarios, and the disparity between day-time and evening centralised generation supply is not as profound.

High electric vehicle uptake will go some way to flattening the load curve across the day as charging takes place overnight, increasing overall demand for centralised generation. Under this scenario, there remains a role for thermal generators in the provision of baseload electricity, although much is displaced by wind energy.

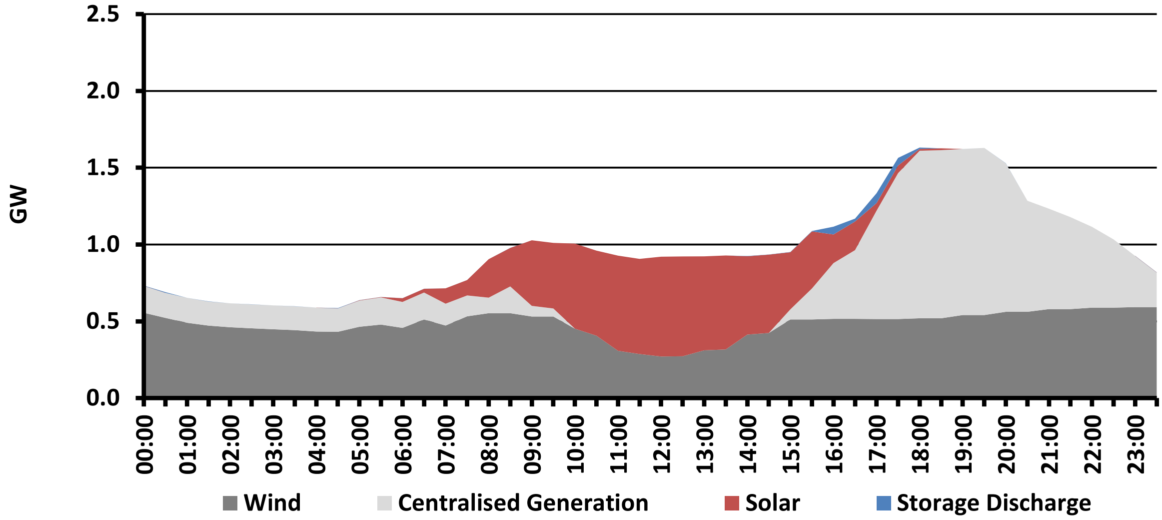

Figure 23 – Impact of Solar PV on Centralised Generation (Doldrums)
Source: Energeia

Under the Doldrums scenario, as illustrated in Figure 23 consumption would decrease to such an extent that overnight demand would almost be entirely satisfied by existing wind generation on most days. As a result, thermal generation would be required almost exclusively for the evening peak resulting in more volatile prices.

Expected Mothballing of Thermal Generators

We expect that the fall in demand during the day will lower prices below the short run marginal costs of baseload thermal generators and potentially force further significant thermal generation closures over the coming 20 years.

The major thermal generators currently in the NEM are shown in Figure 24 by age or current closure status.

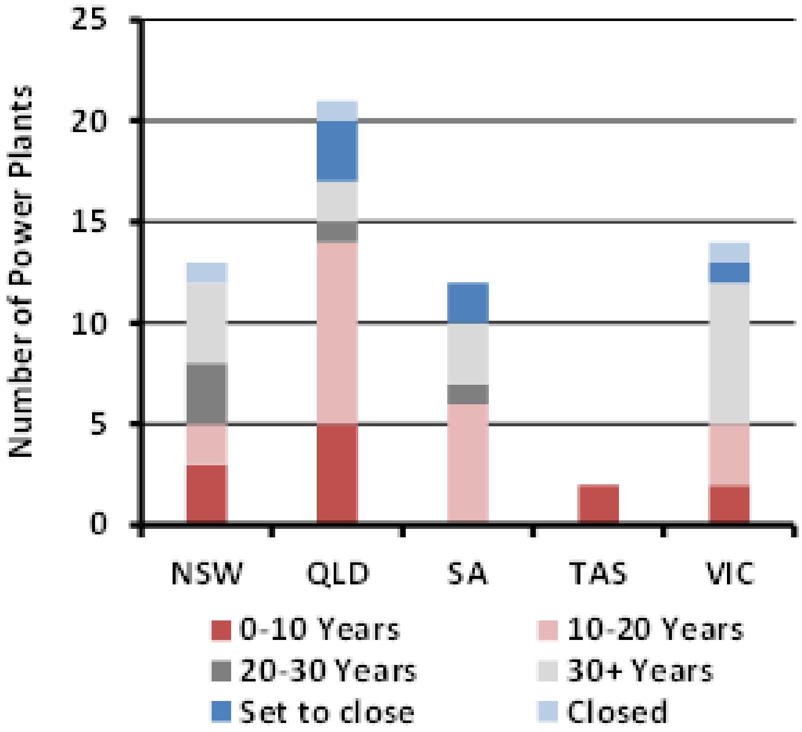

Figure 24 – Expected Mothballing of Thermal Generators
Source: AEMO ESOO, Various generator websites

Across all scenarios, except perhaps the Centralised Comeback scenario, it is likely the majority of the SA thermal plants and particularly the older plants, could see early retirement.

Towards 100% Renewables

Towards 2035, it is expected that all NEM states will converge in terms of high centralised renewables and rooftop solar PV penetration.

This is expected to result in new wholesale price patterns, with the market characterised by prices oscillating between zero (when there are sufficient renewables available to meet demand including storage) and very high levels (when there is not).

This impact is already being observed in forward hedging prices in the South Australian market as shown in Figure 25.

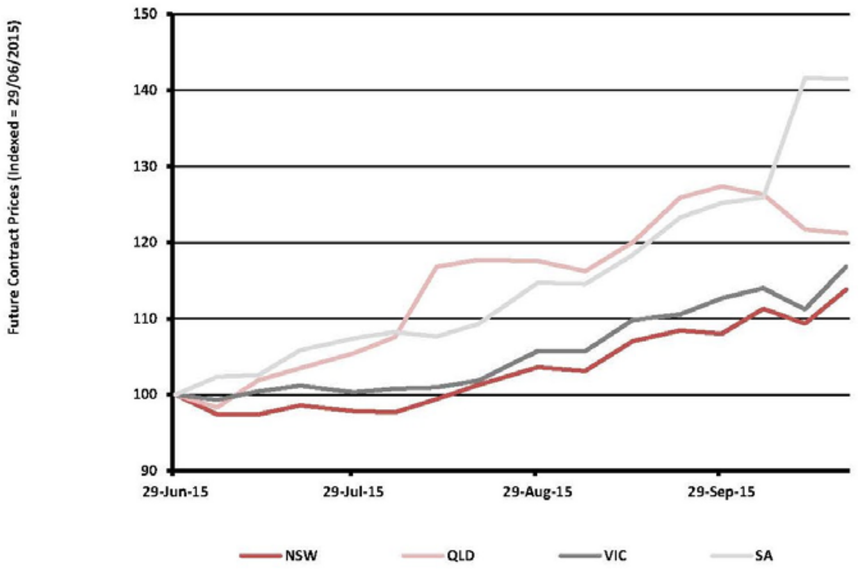

Figure 25 – Future Contract Prices
Source: esaa

As storage prices continue to fall, this volatility will trigger wide scale investment in storage systems at both the distributed and centralised level potentially displacing the need for any thermal generation at all and pushing SA within reach of a 100 per cent renewable generation target.

6.4 Backbone network

Expectations of long-term stagnation or even decline in bulk power demand will lead to a rationalisation of the 275 kV and 132 kV regional networks by 2035.

Utilisation of the backbone network is expected to be reduced due to the availability of storage at major load and renewables sites, as well as bulk supplied customers' sites.

6.5 Interconnectors

Ongoing reconfiguration of the Australian generation fleet is expected to change the way interconnectors operate by 2035.

The expected rise of wind capacity in South Australia, Victoria and New South Wales to 2020, the existing high cost of thermal plant in South Australia and large investment in distributed solar PV, will lead to new daily trading patterns between South Australia and its neighbouring states.

We expect that South Australia will continue to lead the way in terms of distributed solar PV penetration and wind generation. This will result in increasing reliance on interconnectors for interstate imports for both capacity and ancillary services during daylight hours or low wind penetration over the next 10 years as the thermal generation fleet is retired. During times of high wind generation South Australia will also export interstate at increasingly greater levels.

These factors will both give rise to the potential for a new high capacity interconnector.

In the second decade, levels of solar PV penetration in New South Wales and Victoria will begin to catch up with South Australia. From this point there will be greater reliance on South Australia's own infrastructure to provide for supply and network support services outside of solar hours and where there is low wind generation.

The interconnectors will continue to provide balancing and ancillary services when there are differentials in renewable resource availability and therefore wholesale market prices between states.

DISCUSSION QUESTIONS
What is your view of the scenario outcomes presented above?
What are the implications for the future role of the transmission network?

7. Network Vision

ElectraNet's vision for the South Australia's transmission network is that it will deliver affordable and reliable power supplies that support consumer choices into the future.

Whereas historically there has been a focus on building a stronger and expanding network, the future network will require optimisation and rationalisation of expenditure all within an environment of increased technological sophistication to accommodate more volatile loads and intermittent and diverse generation sources. This is true across all potential future scenarios considered.

For all future scenarios, uptake of solar PV and storage technologies will impact growth in centralised demand and network utilisation. This may be somewhat offset by gas substitution, additional electric vehicle load and new industrial loads, but the size and timing of these potential new loads is uncertain and varies widely between the future scenarios.

As utilisation decreases, we expect increasing consumer pressure to reduce expenditure in the centralised network and hence reduce or at least stabilise unit prices. This will be compounded by intensifying pressure from a competitive off-grid and microgrid services market.

The overall challenge for our future network will be to achieve high levels of operational and investment efficiency while at the same time managing more complex power quality, dynamic stability and network reliability issues. These issues are already present in our network today, but looking forward will be exacerbated as a result of wide scale retirement of thermal generation, requiring new forms of ancillary service provision.

7.1 Stakeholder engagement

ElectraNet will remain committed to genuine engagement with customers, consumers and other stakeholders to ensure the transmission services it provides deliver maximum value.

We expect to maintain a strong relationship with our large industrial customers enabling better understanding of the risks of large customers reducing demand, exiting the State, or disconnecting and transitioning to off-grid solutions.

ElectraNet will work together with our customers to find the best solutions for both parties.
Similarly, ElectraNet's relationship with SA Power Networks will remain strong allowing both organisations to work effectively together to coordinate the re-optimisation of the State's electricity infrastructure to best serve future needs.

Strong engagement with key policy makers and regulators will help ensure that pricing signals, including tariffs and other policy incentives for distributed energy resources and electric vehicle investment, are cost reflective, reducing the level of cross-subsidies and uneconomic bypass of the electricity network.

7.2 New connections

In the future, potential new transmission connections, particularly for regional and remote sites, may choose to install on-site solar PV and/or storage to lower their connection and energy costs, or even transition to a microgrid or off-grid environment.

Increased competition from distributed energy resources and microgrid technologies will require new approaches to pricing and connecting customers, and potentially new energy supply solutions to ensure the most efficient cost of supply.

While the connection process is not expected to change significantly, the potential scope of services that customers will require will expand to include storage, renewable generation and even microgrid solutions – where economic.

ElectraNet expects to be increasingly called upon to integrate consumer-side energy technologies into transmission network planning and operational processes, requiring additional integration technologies, capabilities and systems to those that are currently in place.

Managing protection and control issues associated with greater connection of renewable energy technologies and their impact on minimum loads, generator ramp rates and fault levels are a major challenge to be addressed.

7.3 Network development

The unprecedented reconfiguration of the NEM's generation fleet over the next 10-20 years, the redrawing of the line between grid and off-grid supply and the proliferation of solar PV, energy storage and electric vehicles will have a profound impact on our network development processes, and the roles and systems that underpin them.

We expect that there will be limited if any growth in maximum demand on the network requiring investment in additional backbone network capacity.

Rather, as a result of high renewables penetration and limited thermal generation, especially during daylight hours, new power system infrastructure will be required to provide frequency control and network support services. We expect that support services will come from a combination of grid solutions, (e.g. grid scale storage), aggregated non-network services and interconnector capacity, depending upon the relative cost and availability of these services in other states.

Greater uncertainty in demand due to distributed generation and competitive positioning of wholesale generators will also challenge accurate planning of the long-term optimal transmission network for South Australia.

Our long-term planning processes will therefore need to develop additional capabilities to address the emerging forecasting and planning risks, including improving the ability to develop long-term demand and generation forecasts.

An improved long-term forecasting capability will be essential for maintaining our planning effectiveness in light of substantial changes in our external environment. It will also help ensure effective integration and harnessing of distributed energy resources into our long-term plans and day-to-day operations.

For example, accurate long-term forecasts will help ensure we make effective and timely investment decisions around our regional and more remote assets, some of which may not be required in the next ten to twenty years as micro-grids become more competitive and network assets are retired from service.

7.4 Network operations and maintenance

Increasingly complex cross-border power flows driven by increasing wind generation in South Australia, New South Wales and Victoria, utility scale and distributed storage, and saturation of distributed solar PV, will challenge day-to-day operations by 2035.

Maintaining dynamic stability under these conditions will require greater real time data from Phasor Measurement Units (PMUs) and access to advanced network support resources and technologies, e.g. storage and Flexible AC Transmission System (FACTS).

Improved real-time data from PMUs will improve the performance of our real-time control systems, including FACTS, helping to ensure we are able to continue to deliver a safe, reliable and secure transmission service.

Strategically placed grid scale storage assets, along with distributed storage resources contracted through third parties, will be used to help meet the expected rise in real and reactive power compensation requirements.

As our assets age, capital cost pressures and the uncertainty surrounding long-term load patterns will drive us to focus on lower cost life extension strategies wherever feasible, particularly around our relatively old, bulk supply point connections.

Life extension implies older assets on average, which typically require greater maintenance effort. Delivering higher levels of asset maintenance at the lowest possible cost will increasingly challenge our operations and maintenance functions.

We expect to turn to new technology and techniques such as predictive maintenance to keep costs as low as possible while maintaining current levels of network reliability and safety.

7.5 People and organisation

ElectraNet's workforce will remain highly skilled and engaged, through the systematic upskilling of personnel in areas required to provide the future service priorities of our customers and stakeholders.

Key skills and knowledge areas that will be required include new technologies and advanced transmission engineering capabilities to engineer a more flexible, dynamic transmission network.

Finally, we see big data and analytics as a key source of business efficiency that requires development.

ElectraNet will ensure our people remain strongly engaged in the journey ahead through clear and open communication, and a systematic approach to managing change across our people, processes and systems.

DISCUSSION QUESTIONS
How does the Network Vision, outlined above, align with your views of what the transmission network will need to look like in future? If there are gaps, what are these?
To what extent does the Network Vision, outlined above, tell you how the future transmission network will likely be planned?
Does the Network Vision, outlined above, appropriately identify all the key issues that should be taken into account in developing specific transmission network plans for the 1 July 2018 to 30 June 2023 5-year regulatory control period?

8. Directions and Priorities

Our plans will be designed to meet the emerging challenges discussed in this paper as we work towards our vision for the network of the future.

The directions and priorities emerging to deliver on this vision are set out below.

1. The transmission network will continue to play an important role into the future to support safe, reliable and affordable electricity supply

EMERGING DIRECTIONS	PROPOSED PRIORITIES
• Grid maximum demand remains steady • Grid supplied energy remains flat or declining • The existing grid needs to be maintained efficiently and safely • Maximum demand driven investment is expected to be minimal • Network utilisation will continue to fall, placing ongoing pressure on unit costs • The age and condition of the network will be an increasing challenge to manage	• Focus on efficiently prolonging asset life wherever possible and deferring major replacement • Continue to maintain the existing network as safely and efficiently as possible through reliability centred maintenance • Retire assets unlikely to be needed in the future where economic to do so • Consider options to recover past and future investment in the most timely manner to protect future consumers • Explore more efficient pricing arrangements to promote clarity, stability and fairness • Manage any major mining triggered developments as contingent projects within the regulatory framework

2. The ongoing uptake of distributed energy by consumers is changing the role of the grid

EMERGING DIRECTIONS	PROPOSED PRIORITIES
• Further significant installation of rooftop solar PV capacity is expected, with periods of zero grid level demand expected within a decade • The impact of energy storage at a consumer level is likely to have limited impact on the grid over the planning horizon • The uptake of electric vehicles by consumers is expected to be modest • Distributed energy growth rates are uncertain and will be driven by consumer preferences, technology costs and policy support	• Actively monitor trends and developments to ensure the grid is ready to integrate distributed energy technology • Plan for emerging technologies in order to maintain safe, reliable and secure supply under foreseeable operating conditions

EMERGING DIRECTIONS	PROPOSED PRIORITIES
• Forecasting technology uptake is therefore challenging and scenario planning is important to consider a range of possible futures	

3. The generation mix is changing, creating new challenges for the operation of the grid

EMERGING DIRECTIONS	PROPOSED PRIORITIES
• The withdrawal of conventional generators is placing greater reliance on wind generators and interconnectors • The operation of the network is becoming more complex and challenging • The potential consequences of State-wide outages after rare interconnector separation events is increasing	• Pursue efficient options to address more complex network operation with less conventional generation • Investigate further interconnector upgrade opportunities where in the consumer interest (with any major investments to be pursued as contingent projects)

4. New technologies are changing the way network services are delivered

EMERGING DIRECTIONS	PROPOSED PRIORITIES
• Storage technology is likely to become economic in the medium term at a grid scale, offering a new potential option to efficiently deliver network and ancillary services • In a flat demand environment, non-network solutions and new technologies such as storage can offer more economic alternatives to traditional network options • Ongoing advances in information technology and network control systems provides access to a wealth of ‘big data’ to inform network decision making	• Continue to investigate application of grid scale storage where economic and seek to gain experience in the deployment and operation of this emerging technology • Actively pursue demand side solutions and other innovations in the deployment of non-network solutions and new technology • Develop analytical capability to manage ‘big data’ to improve decision making in asset management and network operation

DISCUSSION QUESTIONS
What do you see as the future direction of South Australia’s transmission network?
To what extent do you agree with the key themes, directions and priorities set out above? Which do you see as being the most important priorities? Are there others which should be contemplated?

9. Glossary of Terms

Term	Description
AER	Australian Energy Regulator. Responsible for the economic regulation of network service providers in the National Electricity Market (NEM), in accordance with the National Electricity Rules (NER).
AEMO	Australian Energy Market Operator. An independent organisation which operates the NEM. They are the market and system operator, responsible for power system security and national transmission planning. In Victoria, AEMO is also responsible for transmission planning and directing augmentations of the electricity transmission network.
Ancillary Services	These are services used by AEMO that are essential for managing power system security, facilitating orderly trading, and ensuring electricity supplies are of an acceptable quality. This includes services used to control frequency, voltage, network loading and system restart processes, which would not otherwise be voluntarily provided by market participants on the basis of energy prices alone.
Baseload	A power generator or load that operates most of the time. This is in contrast to a peaking power generator or load that operates intermittently.
Capacity	The amount of power able to be used by a customer over a short period of time.
Capital Expenditure	When a business spends money either to buy fixed assets or add to the value of existing assets. Expenditure to acquire or upgrade physical assets such as buildings and machinery
Contingent Projects	Significant network augmentation projects that may arise during the regulatory period but are not yet committed and are not provided for in a capital expenditure forecast. Contingent projects are linked to unique investment drivers, which are defined by unique 'trigger events' that are set by the AER when it determines to accept a proposed contingent project in a revenue proposal.
Constraint	An inability of a transmission system or distribution system to supply a required amount of electricity to a required standard.
Cost-reflective tariffs	Charge customers based on their maximum demand on the network rather than solely their energy consumption. An end user of electricity, for example large users, such as mines, or small users, such as households
Consumers	An end user of electricity, for example large users, such as mines, or small users, such as households.
Customers	ElectraNet's customers are those directly connected to our network. They include the Distribution Network Service Provider (SA Power Networks), directly connected generators and large industrial customers.
DER	Distributed Energy Resources. Smaller-scale power generation or storage devices. Typical DER systems include solar photovoltaic, combined heat and power, wind or micro turbines.
Demand	Energy consumption at a point in time.

Term	Description
Distribution Network	The assets and service which link energy consumers to the transmission network.
EV	Electric vehicles
Energy	The amount of power used by a customer over a billing period.
FACTS	Flexible AC Transmission System
Feed-in tariff	The payment rate customers receive from energy fed back into the distribution network from small photovoltaic generators under the State Government's Feed-in Scheme.
GW	Gigawatt
GWh	Gigawatt hour. The unit of energy which represents the consumption of electrical energy at the rate of one gigawatt over a period of one hour. One GWh equals 1000 Megawatt hours or one million Kilowatt hours.
Generator	A person who engages in the activity of owning, controlling, or operating a generating system that supplies electricity to, or who other supplies electricity to, a transmission or distribution system.
Greenhouse gas	A gas which, when in the atmosphere, has a global warming effect. Carbon dioxide, methane and water vapour are the most significant greenhouse gases.
HVDC	High Voltage Direct Current
Interconnector	A network flow path between NEM pricing regions.
Intermittent generation	A description of a generating unit whose output is not readily predictable, including, without limitation, solar generators, wave turbine generators, wind turbine generators and hydro-generators without any material storage capability.
kV	Kilovolt. A kilovolt is a unit of electrical potential equal to a thousand volts.
kW	Kilowatt. A kilowatt is the standard unit equal to one thousand watts.
kWh	Kilowatt hour. The standard unit of electrical energy that represents the consumption of one kilowatt over the period of one hour.
LNG	Liquefied Natural Gas is a clear, colourless, non-toxic liquid that forms when natural gas is cooled to -162ºC (-260ºF). This shrinks the volume of the gas 600 times, making it easier to store and ship.
MMBtu	One Million British Thermal Units
MW	Megawatt. A Megawatt is equal to one thousand kilowatts or one million watts
MWh	Megawatt hour. Megawatt hour being the unit of energy which represents the consumption of electrical energy at the rate of one Megawatt over a period of one hour. One MWh equals 1,000 Kilowatt hours or one million Watt hours.
Maximum demand	A period in which power is expected to be provided for a sustained period at a significantly higher than average supply level.

Term	Description
NEM	National Electricity Market. The wholesale market for electricity supply in the Australian Capital Territory and the states of Queensland, New South Wales, Victoria, Tasmania and South Australia.
Network	The systems and assets which allows electricity to be transported to and from consumers.
Non-Network Solution	Alternatives to network augmentation which address a potential shortage in electricity supply in a region, e.g. demand response or local generation.
Operating expenditure	Expenditure ElectraNet incurs to operate on an ongoing, day to day basis in order to plan, maintain and operate the transmission network.
PMUs	Phasor Measurement Units
PJ	Petajoules. A petajoule is equal to one million gigajoules. A joule is the primary measure of energy in the metric system. Equivalent to a Watt-Second.
PV	Photovoltaic. Photovoltaic is the direct conversion of light into electricity at the atomic level; e.g. solar panels.
RET	Renewable Energy Target scheme aims to meet a renewable energy target of 23.5 per cent by 2020. It requires electricity retailers to source a proportion of their electricity from renewable sources developed after 1997. The scheme is currently structured in two parts; Small-scale Renewable Energy Scheme and Large-scale Renewable Energy Target.
Reliability	The extent to which customers have a continuous electricity supply.
Substation	A set of electrical equipment used to step high voltage electricity down to a lower voltage, or from a lower voltage to a higher one. Lower voltages are used to deliver power safely to small businesses and residential consumers.
Transmission Network	Transports large quantities of electricity at high voltages from where it is generated to distribution networks and directly to large industrial customers such as mines and pumping stations.
Transmission Line	A high-voltage power line running at 275 kV or 132 kV (in South Australia). The high voltage allows delivery of bulk power over long distances with minimal power loss.