Network Transition Strategy

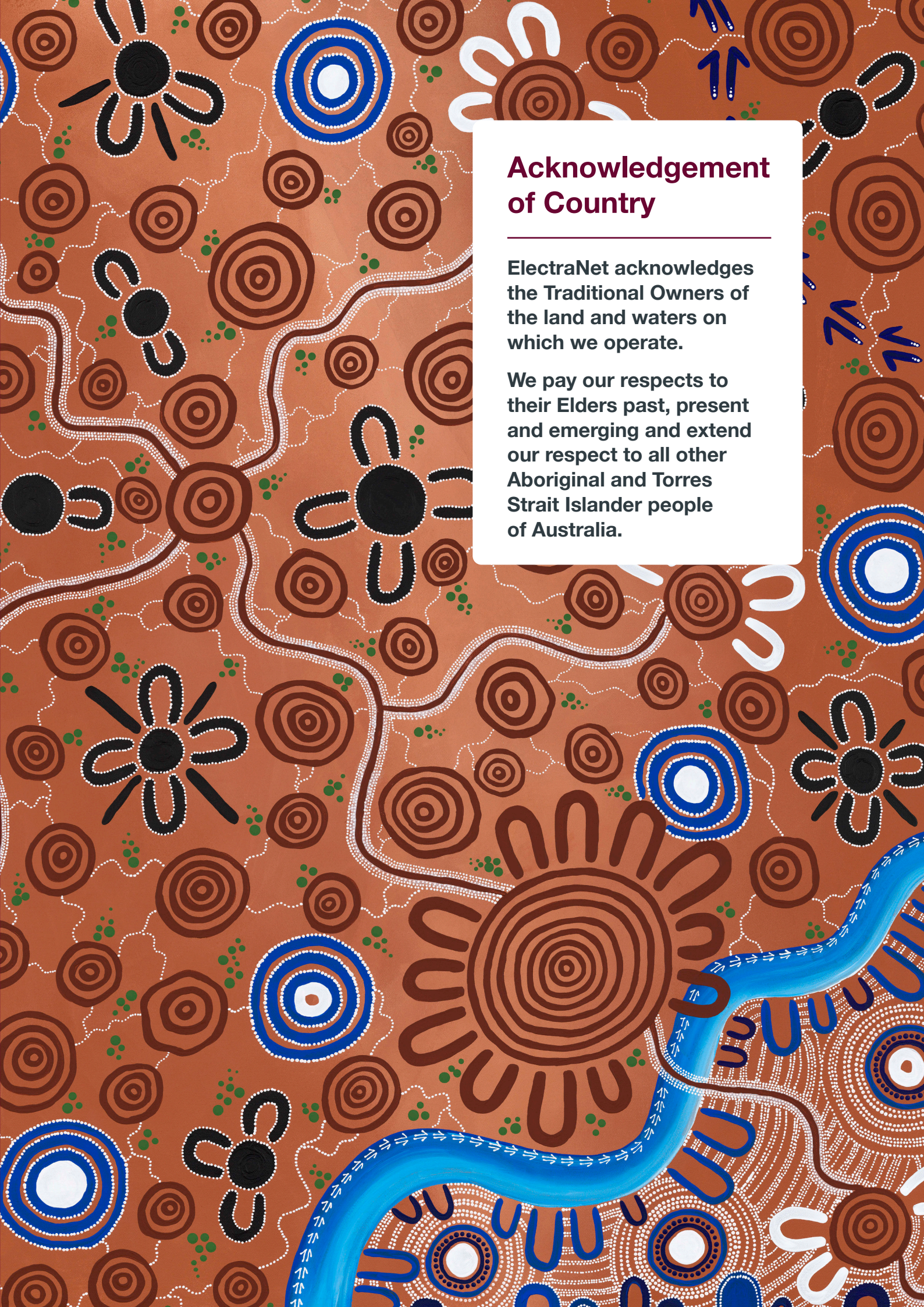
March 2024

ElectraNet

Artwork

Artist Gabriel Stengle is a proud Kaurna, Ngarrindjeri, Narungga and Wirangu Woman of South Australia.

The artwork represents the story of country where ElectraNet operates and moving forward in the understanding of culture and reconciliation.



Acknowledgement of Country

ElectraNet acknowledges the Traditional Owners of the land and waters on which we operate.

We pay our respects to their Elders past, present and emerging and extend our respect to all other Aboriginal and Torres Strait Islander people of Australia.

About ElectraNet

ElectraNet delivers reliable and sustainable electricity transmission services to power homes, businesses, and communities.

As South Australia's principal electricity Transmission Network Service Provider (TNSP), we are a critical part of the electricity supply chain and enabling the transition to a clean energy future.

We own and manage South Australia's transmission network which transports energy from local and distant generation sources to where it is needed to serve electricity customers. It also provides system services such as system strength and inertia to support the growth in renewable energy. Increasingly the network is supporting the two-way flow of power from distributed sources such as rooftop solar PV to local and distant customers.

We also provide services to customers and generators wanting to connect to the electricity transmission network.

Private owner and operator of South Australia's electricity transmission network

Extensive regional network covering over 200,000km² serving communities across the State

About 100 substation sites and 6,000 km of transmission lines

ElectraNet is a key enabler in the transition to renewable energy and decarbonisation of the economy

Connected 40+ large scale renewable energy projects to the network

Transmission costs are about 11% of household electricity bills

Foreword

Simon Emms
Chief Executive Officer

> **“The Network Transition Strategy provides a pathway and framework for working with our customers and stakeholders to manage the challenges and opportunities of the energy transition.”**

South Australia remains a leader in the global energy transformation.

South Australia is regularly achieving 100% instantaneous variable renewable energy, driven by the uptake of large-scale wind and solar resources and rooftop solar PV.

However, this transformation is far from complete.

There are two pressing challenges before us – meeting emerging demand growth driven by green re-industrialisation and electrification of the South Australian economy, while achieving the South Australian Government’s annual target of 100% net renewable energy by 2027.

The groundwork we have laid and the solutions we continue to develop with our customers and stakeholders will help us to meet these challenges.

ElectraNet has delivered over 1,000km of transmission lines over the last five years in partnership with the community and we have invested in four large synchronous condensers. These major investments have positioned us well to navigate the transition to date.

Throughout this journey we continue to be guided by our core objectives of safety, affordability, reliability and sustainability.

I invite you to join with us as we continue to energise South Australia’s clean energy future together.

Simon Emms
Chief Executive Officer

Executive Summary

Our Vision is to energise South Australia's clean energy future.

South Australia has one of the most advanced electricity networks in the world, regularly achieving 100% instantaneous variable renewable energy, driven by its world-leading uptake of grid scale renewable energy resources and rooftop solar PV.

However, the transformation of the energy system and wider economy is far from complete. South Australia is entering a new phase, capitalising on its abundance of wind and solar and other natural resources to deliver a green energy future.

In recognition of this potential, the South Australian Government has adopted a target of achieving 100% net renewable energy on an annual basis by 2027.

The green re-industrialisation and electrification of the South Australian economy will lead to a significant increase in electricity demand. This opens up new challenges and new opportunities and will require timely and efficient delivery of transmission infrastructure as the State embarks on the next phase of the energy transition.

Major projects such as Project EnergyConnect (the new high voltage electricity interconnector between South Australia and New South Wales), Eyre Peninsula Link, and investment in four large synchronous condensers, have helped prepare South Australia to manage the challenges to date associated with operating regularly at 100% instantaneous renewable energy.

This Network Transition Strategy provides a pathway and framework for managing the further transition of South Australia's transmission network and addressing new challenges to reliability, affordability, power system security and resilience.

We look forward to working together with customers and stakeholders to address these challenges and energise South Australia's clean energy future.

The Network Transition Strategy supports and is guided by our asset management objectives and is underpinned by three key themes:

Our Objectives	Safety | Affordability | Reliability | Sustainability

Energy reliability	Power system security and resilience	Operability
Plan and deliver timely and efficient transmission infrastructure to connect customer loads with renewable energy and storage and maintain reliability of supply.	Deliver system services and protection and emergency control schemes to maintain power system security and resilience during the energy transition.	Uplift network planning and operations capabilities, systems and tools to manage the increasing complexity and risk of the power system.

Contents

Purpose

South Australia is a leader in the global transition to a clean energy future.

As the owner and operator of South Australia's electricity transmission network we play a vital role in this transformation, as reflected in our vision and purpose.

Our Vision

Energising South Australia's clean energy future

Our Purpose

We are leaders in the clean energy transition, delivering reliable and sustainable electricity transmission services and valued customer connections.

South Australia has world leading levels of variable renewable wind and solar energy resources and has regularly experienced 100% or more instantaneous variable renewable energy generation since October 2021.

A power system with this level of instantaneous variable renewable energy generation faces greater complexity and risk from a network planning and operational perspective than one based on conventional coal and gas generation.

The growing connection of intermittent renewable generation at both transmission and distribution levels is creating greater variability in electricity generation and demand and is challenging the power system's technical limits, presenting new challenges to reliability, affordability and system security.

South Australia's economic growth and prosperity rely upon the transmission network continuing to operate safely and securely to deliver reliable and sustainable services to meet increased demand for electricity through the energy transition.

The South Australian Government has now adopted an annual target of achieving 100% net renewable energy by 2027.

South Australia's rapid transition to renewable energy coupled with the global commitment to net-zero is attracting strong interest from industries such as green steel, mining, desalination, hydrogen and other energy-intensive operations such as data centres.

This interest is driving a strong uplift in the electricity demand outlook.

South Australia is well-positioned to capitalise on this global green transition, with some of the highest quality and magnitude of wind and solar resources of any regional economy in the world.

Significant growth in renewable energy supplies and coordinated development of the transmission network will be required to meet this demand and maintain reliability, security and affordability of electricity supply for all customers.

The Network Transition Strategy is designed to deliver this outcome through a focus on the following key themes:

> **The Network Transition Strategy provides a pathway and framework for working with our customers and stakeholders to manage the challenges and opportunities of the energy transition.**

- **Energy Reliability** – timely and efficient development of transmission infrastructure is essential to connect new renewable generation and storage to supply existing customer demand and meet increasing demand from electrification and new industrial loads.
- **Power System Security and Resilience** – we must plan and deliver new investments and system services to maintain power system security and resilience during the energy transition.
- **Operability** – we need to build new capabilities, including advanced tools, for network planning and operations to manage the increasing complexity and risk of operating a network with 100% variable renewable energy.

We look forward to engaging with our customers and broader stakeholders as we continue to develop and implement solutions to enable the energy transition.

Challenges and Opportunities of the Energy Transition

South Australia is a global leader in the adoption of Variable Renewable Energy (VRE) wind and solar resources.

Until 2003, all our electricity came from fossil fuels (largely coal and gas). Since then, we have seen a world leading uptake of large-scale wind and solar, rooftop solar and large and small-scale battery storage.

South Australia has more than 3,000 MW of large-scale wind and solar generation capacity. This compares to average grid demand of about 1,400 MW and peak demand of about 3,300 MW.

South Australia also has over 2,200 MW of installed rooftop solar PV capacity which together represents the largest generator in South Australia.

In October 2021 South Australia achieved 100% variable renewable energy output on an instantaneous basis, which is understood to be a first for a power system of our size.

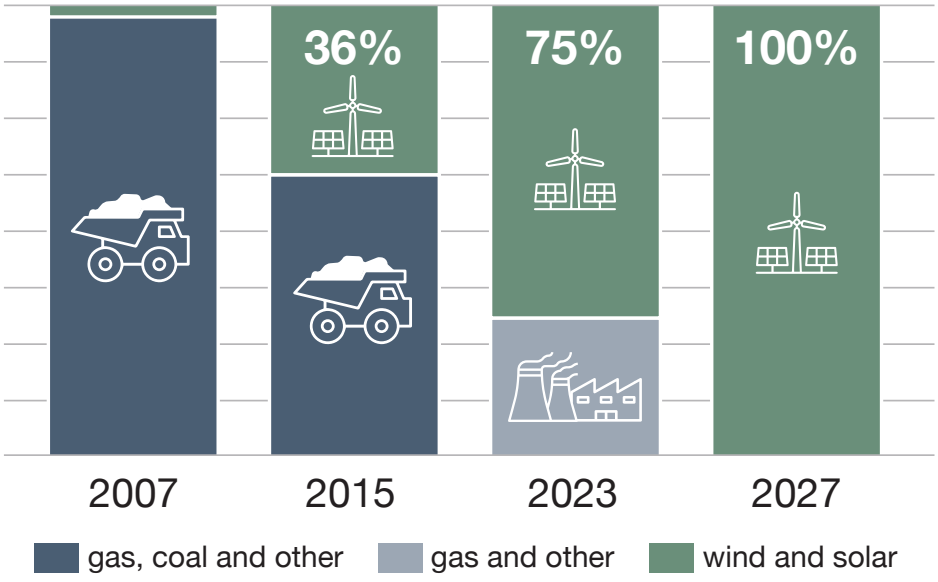
South Australia now averages around 75% net renewable generation output on an annual basis. This is projected to reach 100% within the next three years.

The last coal plant in South Australia closed in 2016 and the share in output of gas generation continues to fall.

South Australia has no material hydroelectricity, pumped storage hydro or nuclear power, and remains weakly interconnected with the rest of the National Electricity Market (NEM).

These factors and the high penetration of VRE are creating a range of challenges for the efficient development and operation of the power system to maintain secure, reliable and affordable supply.

The transition to 100% variable renewable energy in South Australia



Supply and Demand Variability

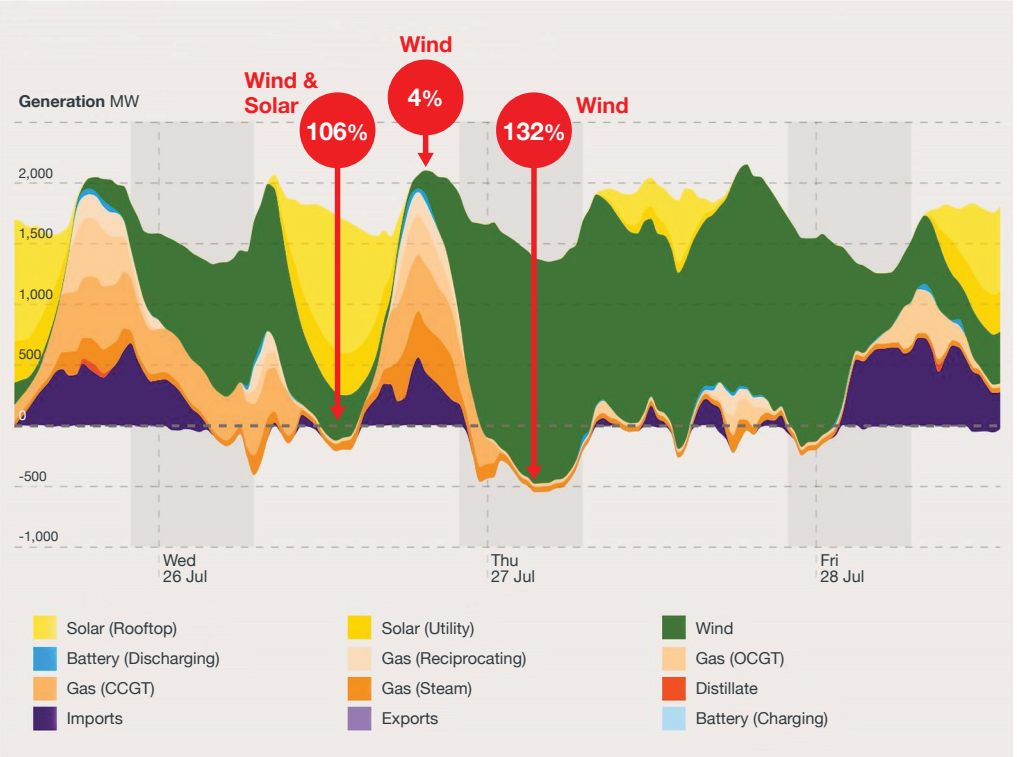
The variability of wind and solar energy resources leads to an increasing rate of change of power flows on the network. This needs to be managed to maintain secure and reliable supply.

The chart below shows an example of the level of variability that can be experienced over a 48-hour period:

1. On 26 July 2023 in the middle of the day wind and solar were providing 106% of South Australia's electricity supply.
2. Six hours later this had dropped to 4%, with minimal wind output.
3. After another nine hours this was back to 132% with high levels of wind output.

There is an increasing need for firming capacity and energy storage on the network to help manage this variability, including increasing ramp rates. High variability also creates challenges for short-term forecasting and real-time operation of the network, such as frequency management and voltage control.

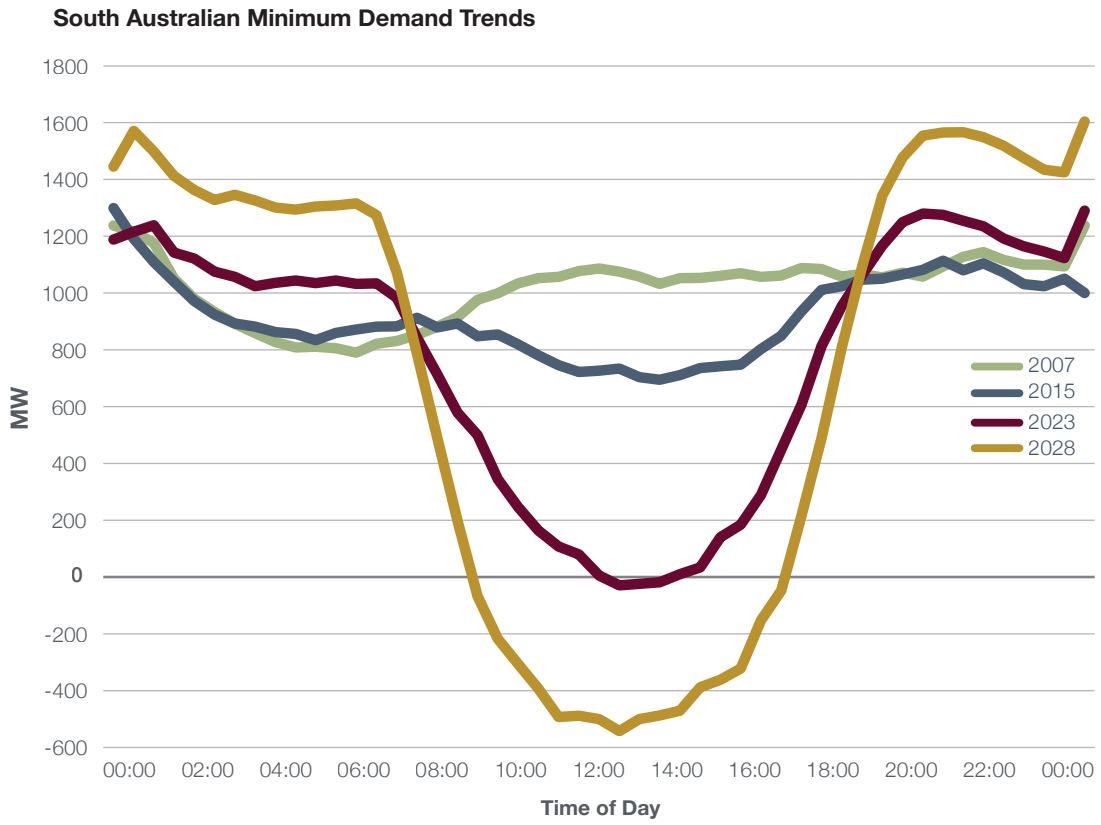
Variability in South Australia wind and solar generation, 26–27 July 2023



Sources: AEMO, APVI, BoM, OpenNEM, Jess Hunt

Minimum Demand

Minimum demand levels on the transmission network have fallen steadily in recent years. Forecasts show minimum demand will continue to fall sharply over the coming years, given the ongoing uptake of distributed solar PV.



The reducing minimum demand level and the regular transition to low or negative demand flows creates challenges for managing voltage levels on the network.

Technical Challenges

As traditional synchronous generators have been replaced by variable renewable energy sources, the system services provided by these generators are being displaced.

This has created shortfalls in services such as system strength and inertia in South Australia. These gaps need to be addressed to maintain the stability of the power system. System strength and inertia shortfalls are increasingly becoming an issue elsewhere in the NEM.

With rooftop solar now the largest single generator in South Australia it has been necessary to develop ways to curtail rooftop solar output, when necessary, as a last resort, to maintain system security.

There is also the opportunity to use excess solar power in the middle of the day for electric vehicle charging, hydrogen production and other uses incentivised by solar sponge tariffs, or to store the energy for use at other times.

What is system strength?

System strength helps the power system withstand disturbances while maintaining stable voltage levels.

Without adequate system strength:

- Generators may trip after disturbances
- Voltages may fluctuate
- Protection systems may not operate properly

This may result in supply interruptions to customers and can also lead to constraints being applied to generation output levels.

What is inertia?

Inertia helps the power system withstand disturbances while maintaining stable system frequency.

Without adequate levels of inertia:

- Generators may trip after disturbances
- Limits may be required to manage the power system, such as reduced power flows between regions

This may result in supply interruptions to customers and can also lead to regional 'islanding' events.

Technical challenges arising from the energy transition:

System security

Shortfalls in frequency control, system strength and inertia services, historically provided by synchronous generators

Voltage control

Increasing VRE, reducing minimum demand and changes in customer load characteristics (more capacitive) are increasing voltage control challenges

Protection adequacy

Changing requirements require more frequent review, including for minimum fault level conditions

Increasing system complexity and risk

Wider range of system operating conditions with more frequent stress points, including under minimum, zero and negative grid demand conditions

Extreme events

Greater reliance on complex special protection schemes to manage risk and maximise power transfer capability

Harnessing customer energy resources

Integrating CER to deliver lowest cost outcomes while addressing system security risks

Demand Growth

South Australia is attracting growing interest from new electricity loads due to its green energy credentials. This has led to a rapid and significant uplift in the electricity demand outlook.

Key drivers of this demand growth include:

- The potential connection of large new customer loads such as new and expanded mining operations, new industrial loads, desalination facilities and other energy-intensive projects such as data centres.
- The development of large iron ore mining operations and the production of "green steel" in keeping with South Australian Government's Magnetite Strategy.[1]
- The development of hydrogen facilities near Whyalla and other large hydrogen hubs in accordance with the South Australia Government's hydrogen strategy.[2]

We are actively engaged with a range of existing and potential customers seeking to expand or connect to the transmission network with potential load interest exceeding 2,000 MW. In addition, we are also aware of a range of known loads that have not yet started connection discussions.

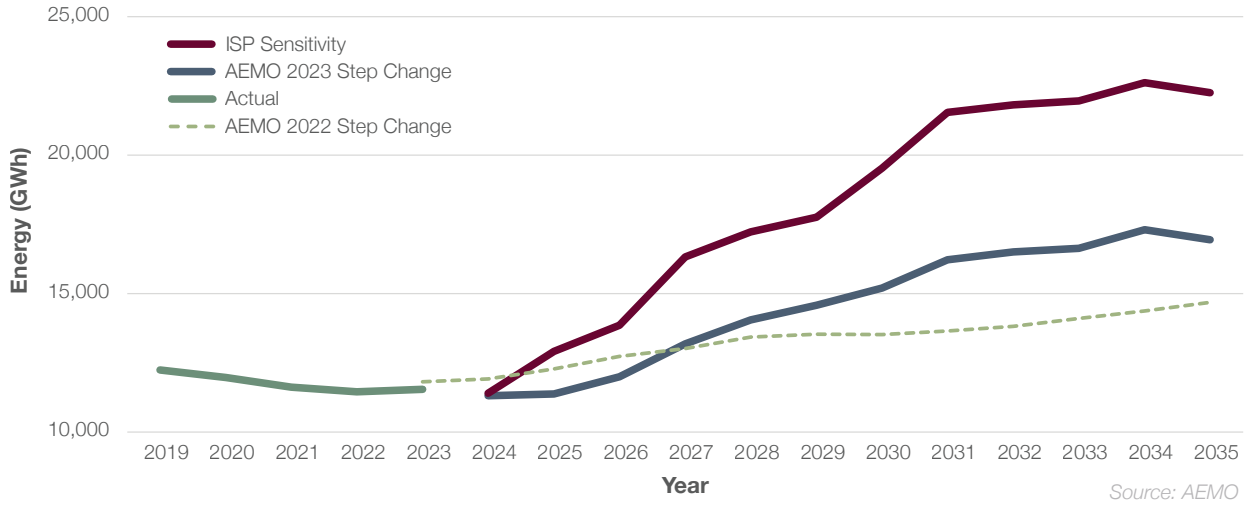
On present indications, it is reasonably likely that around 1,000 MW of additional load will connect to the transmission network by 2030. This represents a significant increase compared to current average demand of about 1,400 MW.

Timely and efficient transmission development is required to ensure we build the right infrastructure at the right time to unlock the renewable generation required to supply this load and deliver least cost outcomes for customers.

The Australian Energy Market operator (AEMO) publishes demand forecasts in its Integrated System Plan (ISP). The chart below shows the expected increase in demand (in energy terms) as 'ISP Sensitivity' compared with the level currently included in AEMO's forecasts shown as 'AEMO 2023 Step Change'.

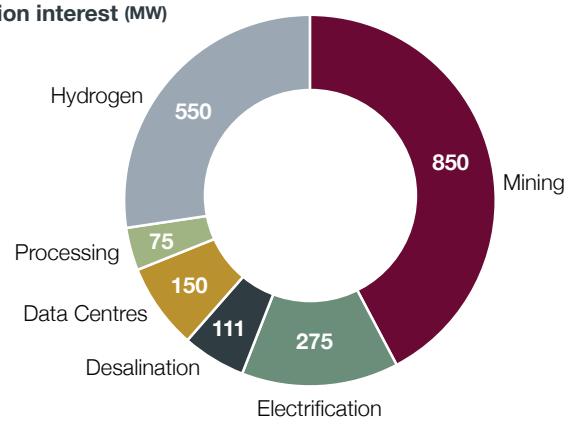
[1] SA Government, Magnetite Strategy.
[2] SA Government, Hydrogen Jobs Plan.

South Australian electricity demand outlook

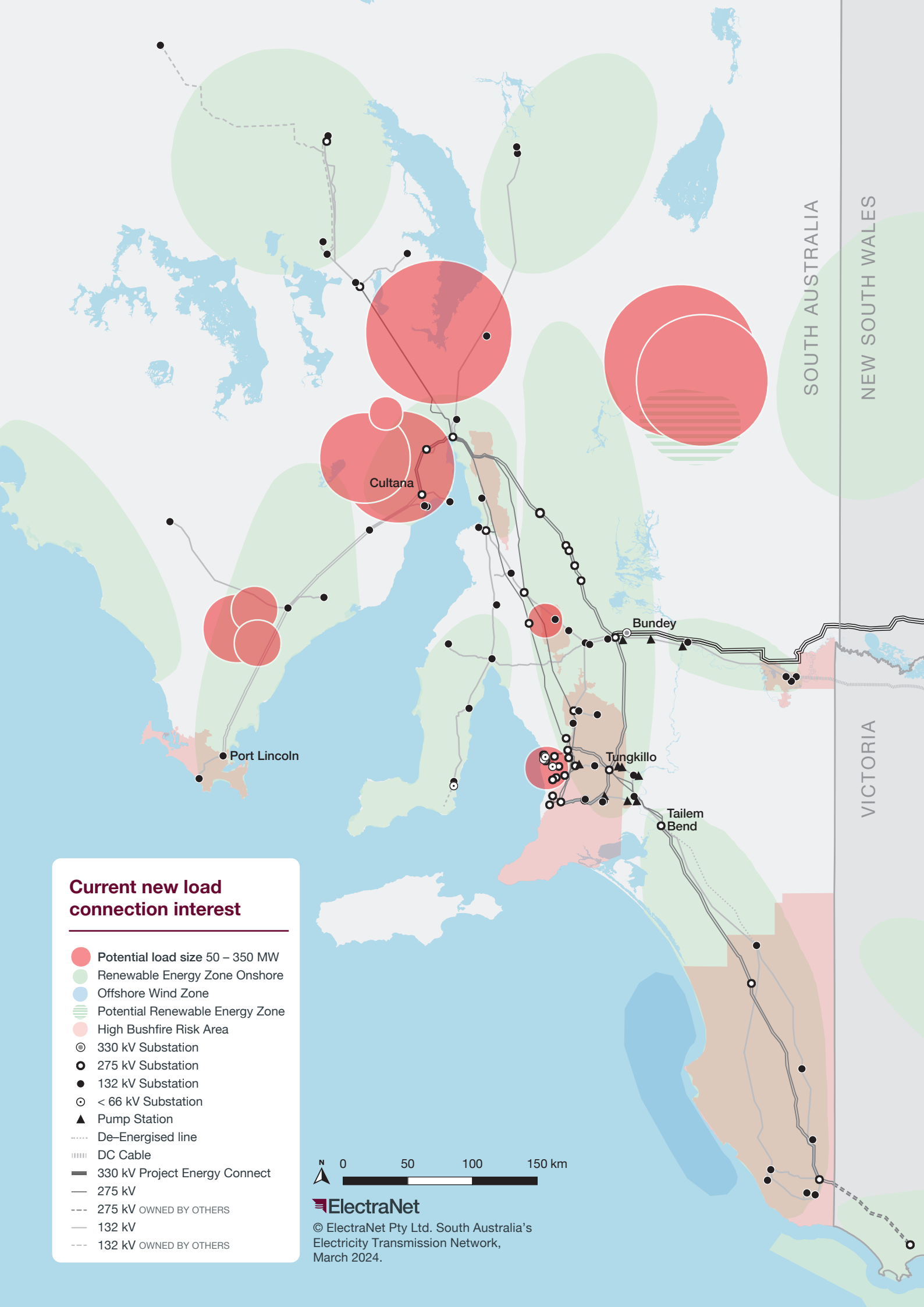


Source: AEMO

Breakdown of new load connection interest (MW)



Our analysis shows that the transmission investment required to serve this increased demand results in average unit cost per customer falling due to costs being shared over a wider customer base.



Underlying Network Challenges

In addition to the impacts of the energy transformation, South Australia faces unique challenges in managing the efficient delivery of its power supply. Seventy seven per cent of South Australia's population and the associated customer load is centred in the Greater Adelaide area, while the network extends across a vast area to serve one of the least densely populated areas of the country.

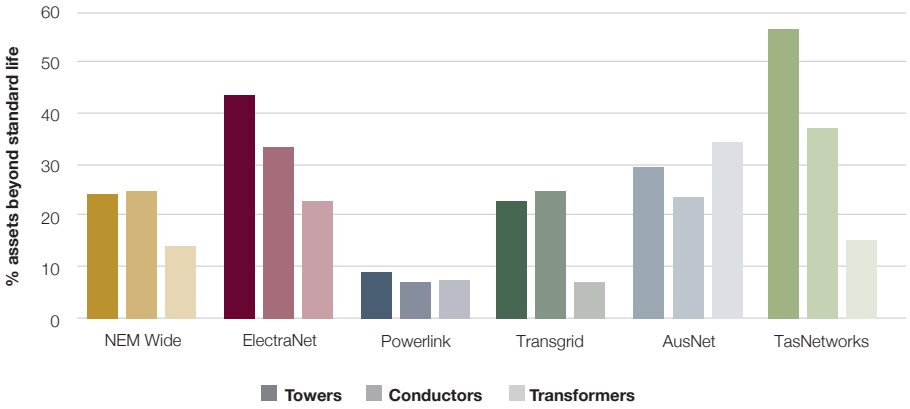
The unique challenges of South Australia's transmission network can be expressed across three key metrics:

1. Age Profile
2. Georgraphical Spread
3. Peakiness of Demand

These factors mean that the efficient costs of South Australia's transmission network are relatively higher compared to other States.

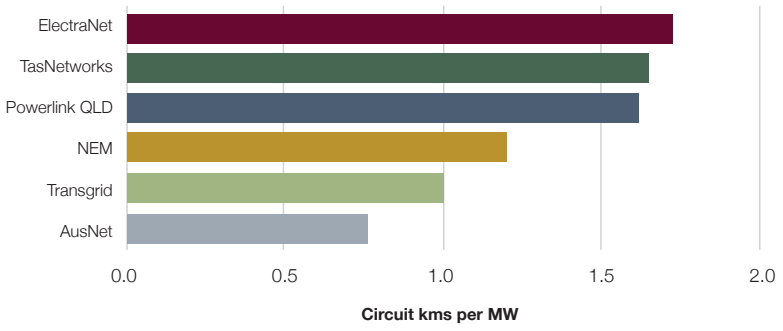
1 Age Profile

South Australia has one of the oldest transmission networks in the NEM. Over 40% of transmission towers, 30% of conductors and 20% of transformers are beyond their standard asset life and require increasing maintenance.



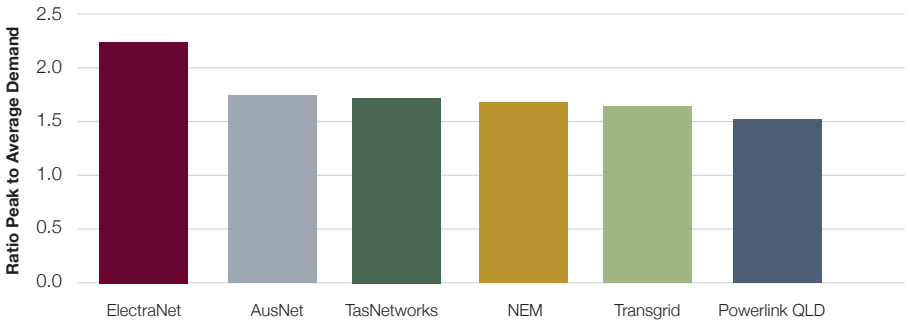
2 Geographical Spread

South Australia has the longest network per unit of peak demand in the NEM. It requires more assets to supply a thinly spread population.



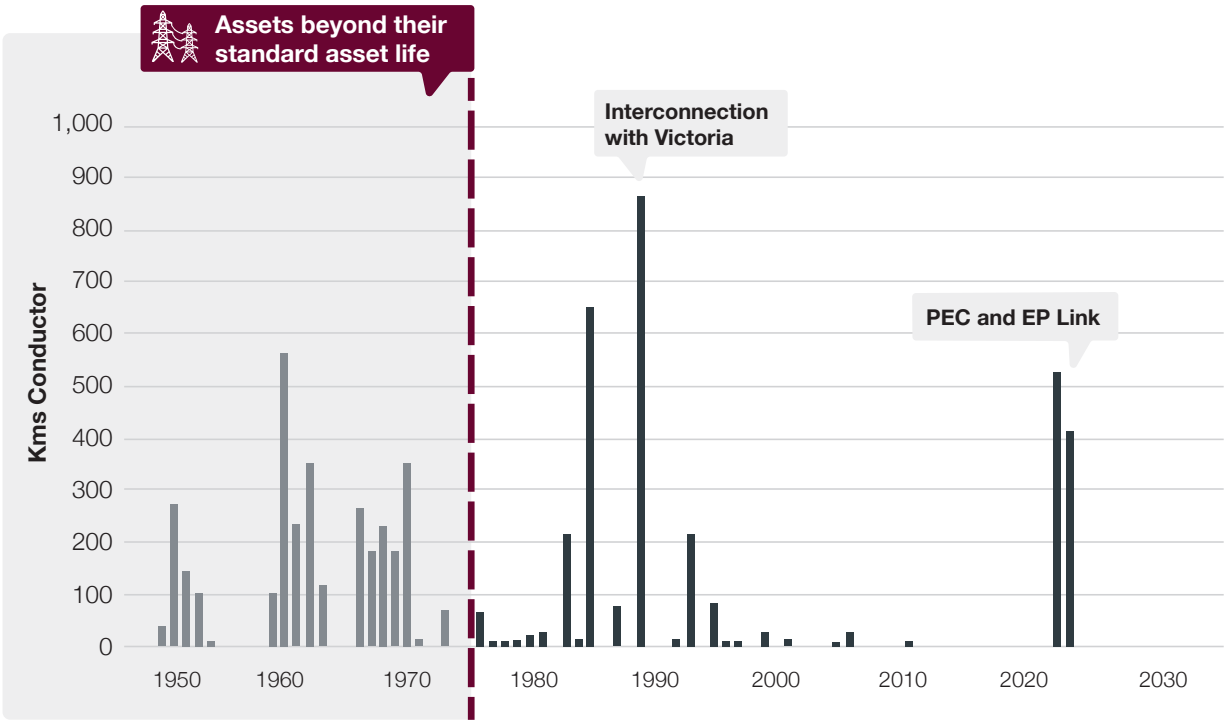
3 Peakiness of Demand

South Australia has the highest ratio of peak demand to average demand in the NEM. This leads to higher costs per unit of energy transmitted. With average demand declining, this ratio is expected to increase.



Source: Australian Energy Regulator Regulatory Information Notice data 2020

Age Profile of South Australia's Electricity Transmission Lines



The standard life of a transmission line in South Australia is 55 years. By 2030 nearly two thirds of South Australia's existing transmission lines will have exceeded their standard life.

Extreme Events

Recent environmental events have highlighted the potential impact of extreme events on customer supply.

This includes the weather event that caused extensive network damage and led to total loss of supply (i.e. ‘system black’) in South Australia on 28 September 2016 and the more recent weather event in Victoria on 13 February 2024 that damaged multiple transmission lines and led to the loss of significant customer load.

Transmission lines throughout the world are not designed to withstand the most extreme events as the cost involved would be prohibitive.

Rather, measures such as emergency control schemes and emergency response arrangements are put in place to minimise the impact of the most extreme and unlikely events.

We must ensure that the network is resilient to the impact of electrical, physical or cyber disruption events by balancing the cost and risk involved and responding to how these risks change over time to ensure that the network can continue to enable the transition to a clean energy future.

Our Objectives

We apply sound asset management principles and practices to manage the transmission network and the services it provides.

Our Asset Management Objectives guide asset management activities and decision-making. These objectives were originally developed and have been recently updated in consultation with our Consumer Advisory Panel.

Safety

Ensure the safety of staff, contractors, and the public.

Affordability

Reduce the overall cost of electricity to customers by removing network constraints, operating the network, and delivering our capital and maintenance works as efficiently as possible.

Reliability

Maintain the reliability of transmission services and the security and resilience of the network while balancing risk and service outcomes.

Sustainability

Operate our network in a way that enables people and nature to thrive.

These objectives are aligned to and support achieving our vision and purpose and provide the framework within which we manage the network.

Upholding sound asset management practices to effectively balance affordability and reliability is essential, especially during a time of rapid change, to maximise value and maintain the performance of the transmission network.

Our key asset management improvement priorities include:

- Strengthening asset management of the transmission network with priority focus on critical network elements to ensure ongoing reliablity.
- Prolonging asset life and deferring major asset replacement wherever it is efficient to do so while maintaining reliability.
- Adopting technology, including best practice data analytics, to improve decision making in asset management and network operations.
- Improving efficiency of capital and maintenance works delivery.
- Building delivery capability and addressing current supply chain challenges.

How We Are Responding

The Network Transition Strategy supports and is guided by our asset management objectives and is underpinned by three key themes:

Energy Reliability – delivering a capable transmission network

Power System Security and Resilience – maintaining a secure and resilient power system

Operability – managing increasing system complexity and risk

How we are responding in relation to these themes is outlined in the following sections.

Energy Reliability

Timely and efficient transmission development is essential to maintain reliability of electricity supply and deliver least cost outcomes for customers.

The following strategies have been adopted to support this:

Strategy 1

Plan and develop the shared transmission network to be ready for a wide range of plausible futures, including electricity demand growth and efficient connection of variable renewable energy resources.

Strategy 2

Actively engage in the national transmission planning process including with policy makers to ensure timely and efficient transmission investment in South Australia.

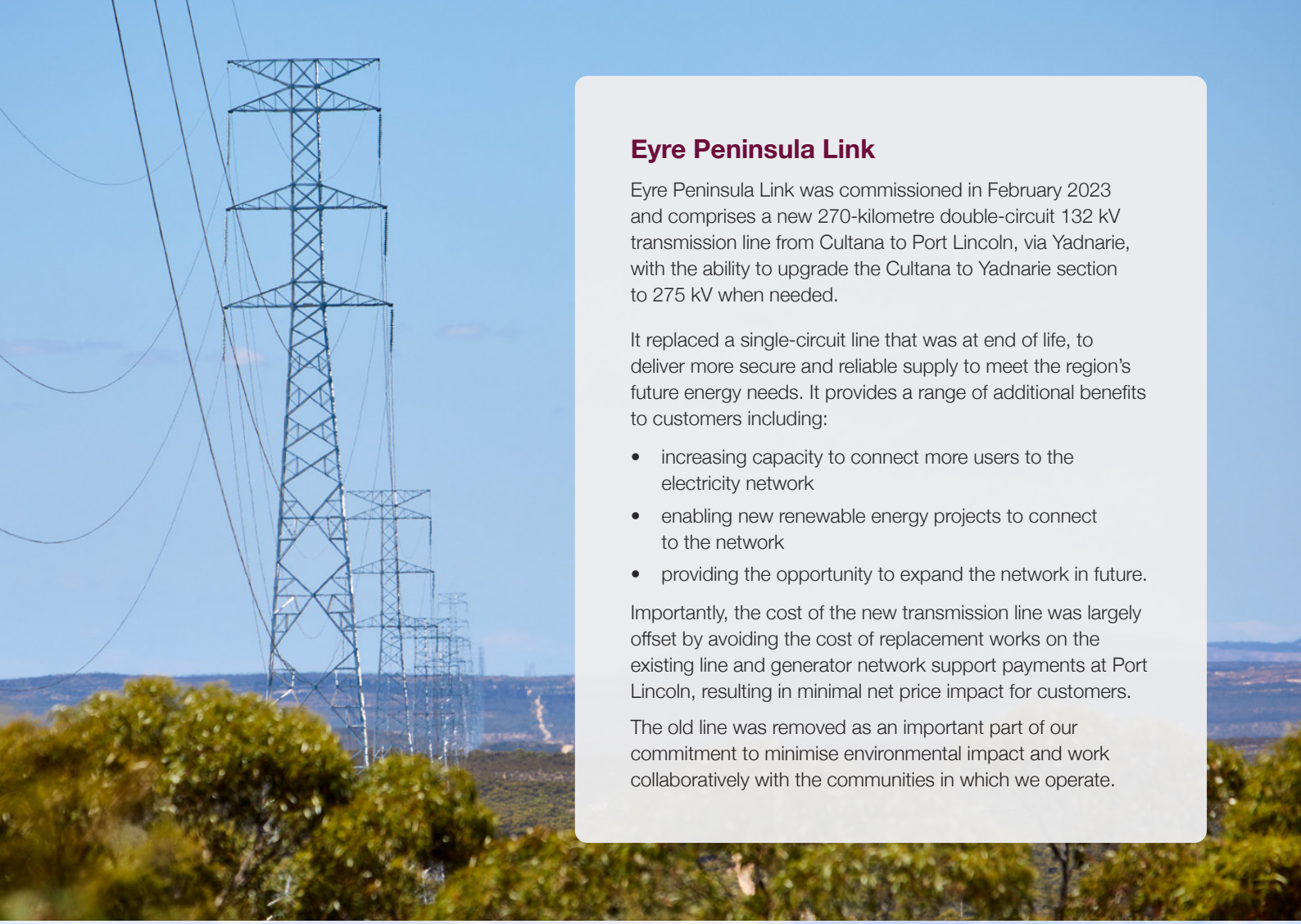
What we have done

To deliver on these commitments we have continued to invest in the transmission needed to energise South Australia's clean energy future. Major investments we have undertaken include:

- Delivering Eyre Peninsula Link, a new double circuit transmission line delivering improved reliability and unlocking future growth on Eyre Peninsula.
- Completing construction of Project EnergyConnect in South Australia, a project to significantly increase power transfer capability between South Australia and New South Wales/Victoria.
- Delivering the Upper North project, a significant private network that unlocks mining and other growth opportunities in the region.

Through these major investments we have delivered over 1,000 km of new transmission lines in South Australia in the past five years. These major projects have been delivered successfully in partnership with our contractors, local communities and Traditional Owner groups.

Our community engagement efforts have been recognised through the South Australia Premier's Energy and Mining Awards – Community Category awarded to ElectraNet in partnership with the Barngarla Determination Aboriginal Corporation for excellence in the delivery of the Cultural Heritage Monitoring Program for Eyre Peninsula Link.



Eyre Peninsula Link

Eyre Peninsula Link was commissioned in February 2023 and comprises a new 270-kilometre double-circuit 132 kV transmission line from Cultana to Port Lincoln, via Yadnarie, with the ability to upgrade the Cultana to Yadnarie section to 275 kV when needed.

It replaced a single-circuit line that was at end of life, to deliver more secure and reliable supply to meet the region's future energy needs. It provides a range of additional benefits to customers including:

- increasing capacity to connect more users to the electricity network
- enabling new renewable energy projects to connect to the network
- providing the opportunity to expand the network in future.

Importantly, the cost of the new transmission line was largely offset by avoiding the cost of replacement works on the existing line and generator network support payments at Port Lincoln, resulting in minimal net price impact for customers.

The old line was removed as an important part of our commitment to minimise environmental impact and work collaboratively with the communities in which we operate.

Project EnergyConnect

Construction of the South Australian component of Project EnergyConnect, the new high-voltage interconnector between South Australia and New South Wales, was completed in December 2023.

This transformational project strengthens South Australia's position as a leader in the energy transformation and will play a crucial role in enabling the state to reach its goal of 100 per cent net renewables.

The benefits to customers include:

- improving the security and resilience of the power system
- enabling more renewable energy development and exports from South Australia
- delivering energy price savings

The South Australian component was successfully delivered on time and on budget in partnership with our project partners and the local community.

What we are doing

Our engagement with stakeholders has focused strongly on the rapid changes to the demand and supply outlook in South Australia and developing transmission options to meet our energy needs.

We have engaged with stakeholders on the future requirements we are seeing in our Transmission Annual Planning Report (TAPR) Update released in May 2023 and in our latest TAPR released in October 2023.

The development of major transmission assets typically requires 5–7 years from initial planning to delivery. While there are potential risks for customers in developing the network before it is needed, there are far greater risks in not having adequate transmission in time.

Failure to adequately plan for transmission could put a handbrake on economic development and lead to higher cost outcomes and risks for customers.

Action is therefore required to prepare for the timely transmission developments needed to enable growth in demand and renewable supply and deliver least cost outcomes for customers in the transition to net zero.

We have identified the following near-term network developments for priority action:

- **Mid-North Expansion (Southern)** – following preparatory activities completed in 2022–23 this project should now be progressed as an 'actionable' project[1]. It forms an essential part of the 'network backbone' to enable higher transfers of renewable energy to meet demand growth and ensure security of supply through a diverse transmission path to Adelaide as its supply becomes more dependent on distant renewable sources.
- **Mid-North Expansion (Northern)** – this project should be progressed as an 'actionable' project. This project also forms part of the 'network backbone' in meeting projected demand growth and unlocking renewable energy resources in the northern regions of the state.
- **Eyre Peninsula upgrade** – based on new load interest we are undertaking the Regulatory Investment Test for Transmission to investigate options to increase network capacity to service the growing needs of the region.
- **South-East Expansion** – following preparatory activities completed in 2022–23 this project should be progressed as an 'actionable' project to increase transfer capability and unlock renewable resources in this region.

Longer-term network development priorities have also been identified to meet future potential load growth and release further renewable energy resources.

Other actions we are taking include investing in additional network planning resources to ensure we have capacity to adequately plan required transmission network developments.

[1] 'Preparatory activities' are those undertaken to design and investigate the costs of AEMO identified ISP projects while projects designated as 'actionable' in the ISP are required to be progressed by the responsible Transmission Network Service Provider.

ElectraNet

Power System Security and Resilience

Maintaining the security and resilience of the power system is essential to providing secure and sustainable supply of electricity for customers. The following strategies have been adopted to support this:

Strategy 3

Plan and deliver new investments and system services required to maintain power system security and resilience.

Strategy 4

Invest in protection and emergency control systems and processes to maintain power system security and resilience during the energy transition.

What we have done

To deliver on these commitments we have undertaken a range of initiatives to deliver the system services and systems required to maintain the security and resilience of the power system. We have:

- Installed four large synchronous condensers with two at Davenport and two at Robertstown to meet minimum system strength and inertia requirements.
- Procured additional inertia support services for when South Australia is islanded from the rest of the NEM.
- Upgraded the System Integrity Protection Scheme (SIPS) to the Wide Area Protection Scheme (WAPS) to prevent South Australia from islanding for the non-credible loss of significant generation in the State.
- Implemented an automated Voltage Control Scheme (VCS) at Davenport.
- Undertaken detailed technical studies with AEMO to confirm the requirements for minimum synchronous generation in SA.

The completion of the synchronous condensers in October 2021 has removed constraints on variable renewable generation output and alleviated voltage limits in the Mid North. The synchronous condensers have also significantly reduced costs to customers, by avoiding costs incurred when AEMO directs synchronous generators to operate to provide system services.

A rapidly growing need for system services has been identified across the NEM.

As variable renewable energy continues to replace traditional generation in South Australia, we have worked with AEMO to determine the minimum level of synchronous generation required to operate for the security and stability of the power system.

These investigations have shown that most technical requirements can be met to enable the minimum synchronous generating unit commitment to be reduced from two to one. Operating at such levels is world leading for a power system of our size.

Current limitations to operating with less than two synchronous generators in service include maintaining adequate voltage control in the greater Adelaide area, which ElectraNet is addressing and grid frequency reference requirements, which AEMO is investigating.[1]

What we are doing

As the energy transition continues and the uptake of variable renewable energy grows the complexity of the power system will continue to increase.

Further actions we are taking to safeguard the security and resilience of the transmission network include:

- Ensuring appropriate voltage control on the network by undertaking the Regulatory Investment Test for Transmission to identify the most efficient solution.
- Planning and developing sufficient forward looking system strength and inertia under the new system strength regulatory framework by undertaking the Regulatory Investment Test for Transmission to identify the most efficient solution.
- Ensuring system protection and emergency control schemes are effective for changing system conditions.
- Undertaking targeted investments to maintain power quality.
- Optimising distribution and customer contributions to system security.

[1] AEMO | Operation of Davenport and Robertson Synchronous Condensers

Operability

As the energy transition continues, it is essential that we continue to develop and maintain the capabilities required to manage the increasing complexity and risk of the power system.

The following strategy has been adopted to support this:

Strategy 5

Uplift people and systems capability and capacity for network planning and operations to manage risk in an increasingly complex operating environment.

What we have done

To deliver on this commitment we have implemented a range of measures to develop the increased capabilities and systems required to operate an increasingly complex power system.

Actions we have taken include:

- Established a new Transmission Control Centre and rebuilt the existing one.
- Replaced the old Energy Management System with a new one.
- Implemented a Wide Area Monitoring System (WAMS) to enable enhanced monitoring of the power system.
- Conducted reviews of ElectraNet's network planning and operational people and systems capability required to meet current and future needs.

These steps provide the foundation for the work to be undertaken to further develop the tools and systems required to manage the increasing complexity and risk of the evolving power system.

The key planning and operational capability uplift requirements identified to date are as follows:

Network planning and operational capability uplift requirements

Capability	Function	Description
Planning	Network planning	Increased rate of change on the network and the potential for demand to fall to very low levels throughout the year requires much more detailed 'what if' analysis to underpin network management plans and to manage the risk of high impact low probability events.
	Outage management	With demand and generation being more volatile and the network more constrained during the year, much more detailed analysis of the system is needed to allow network equipment to be taken offline for maintenance and project work.
	General Power System Risk Review	AEMO's annual General Power System Risk Review requires additional input, analysis and information from TNSPs.
	Protection adequacy	The continued growth of inverter-based technologies on the power system increases the need for regular review of protection schemes to ensure they operate as intended to protect against power system disturbances.
	System strength management	The recent Efficient Management of System Strength Rule includes new obligations for forward looking planning and provision of system strength services by TNSPs.
Situational Awareness	Dynamic monitoring	Analysis of Phasor Measurement Unit data for improved situational awareness and early detection of network risk conditions to support operational decision making.
	Alarm analytics	In a more complex power system, network alarms will occur more frequently and in increasingly complex combinations. Improved alarm analytics is needed to help identify and diagnose problems as they emerge.
	Asset condition monitoring	An uplift is required in real-time monitoring, modelling, and analysis of network critical asset information, including predictive analytics.
	System disturbance analysis	More needs to be done to investigate, analyse and learn from system disturbances given reduced 'safety margins' in a highly variable renewable system.
Network Operations	Control Room	The increasing complexity and variability of system operations and risk of system disturbances places greater demands on Transmission System Operators in the control room requiring deployment of additional resources.
	Operations Systems Development	As the network and therefore the tools used to manage it become increasingly complex, additional specialist engineers are required to support the tools for voltage and contingency analysis, situational awareness and control room information systems.

What we are doing

AEMO's ISP, NEM Engineering Framework and Operations Technology Roadmap all highlight that to ensure the NEM power system can operate securely with a high penetration of inverter-based resources, the system operator and network service providers like ElectraNet need to uplift capabilities in operational systems, processes, real time monitoring and power system modelling.

We are working closely with AEMO and other stakeholders on the systems and capability uplift required to protect the power system from disturbances in an increasingly complex operating environment.

The actions we are taking to ensure the required systems and tools are in place include:

- Developing and implementing sufficient network planning and operations capabilities to manage power system changes and support, encompassing:
  - Realtime operations
  - Near real-time planning
  - Outage planning
  - Longer-term planning.
- Developing a prioritised roadmap of network operational technology enhancements, with a focus on high priority capability that can be delivered quickly.
- Developing strategic implementation capability to deliver the required technology enhancements.

The network operational technology enhancements that have been identified and will be prioritised for implementation are as follows:

Network Operational Technology Enhancements

1. Advanced Forecasting
2. Near Real-Time System Analysis
3. Security Actions
4. Remedial Action Scheme Management
5. Outage Coordination
6. Generation Connection Assessments
7. Protection Adequacy
8. Network Infrastructure Investment Planning

We will continue working to develop these requirements and implement the increased capabilities required.

Taking our Strategy Forward

South Australia has demonstrated that operating at 100% instantaneous variable renewable energy is achievable with this now being experienced regularly and for longer periods of time.

Various challenges, including technical challenges, have needed to be overcome. New challenges are continuing to present themselves and we are finding new ways to manage the increasing complexity of a 100% renewables network.

The Network Transition Strategy helps us to focus on the right activities and to balance affordability with reliability as we enable South Australia's clean energy future.

We look forward to ongoing engagement and feedback on this Network Transition Strategy.

We remain committed to genuine engagement with our customers and wider stakeholders as we continue to navigate the challenges and opportunities of the energy transition.

Your feedback will help ensure we can provide reliable and affordable electricity transmission services and maximise their value to customers while enabling South Australia's clean energy future.

To get involved and have your say we encourage you to reach out to us at:

Comments and suggestions can be directed to:

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ElectraNet