Distribution Annual Planning Report

2023 DAPR
December 2023

Endeavour Energy

POWER together

Disclaimer

Endeavour Energy is registered as a Distribution Network Service Provider. This Distribution Annual Planning Report (DAPR) has been prepared and published by Endeavour Energy under clause 5.13.2 of the National Electricity Rules. Its purpose is to notify Registered Participants and Interested Parties of the results of Endeavour Energy's distribution network annual planning review and it should only be used for that purpose.

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1. Executive Summary

Endeavour Energy is a licenced Distribution Network Service Provider (DNSP) serving some of Australia's largest and fastest growing regional economies.

Endeavour Energy is responsible for the safe, affordable and reliable supply of electricity to more than 1 million customers or 2.6 million people in households and businesses across Sydney's Greater West, the Blue Mountains, Southern Highlands, Illawarra and the South Coast.

Amidst the rapidly evolving industry our mission is to lead the way for our customers and communities. To facilitate the move to a clean energy future, we are transitioning from a traditional 'poles and wires' business to a customer-centred distribution system operator where energy flows in two directions and smart meters, batteries and solar generation enable customers to generate, store and sell electricity back into the grid.

Endeavour Energy operates within regulated and unregulated markets. It is subject to the National Electricity Law (NEL) and National Electricity Rules (NER) which regulate the National Electricity Market (NEM). Endeavour Energy is also subject to the statutory and other legal requirements applied to all businesses in NSW.

The distributor's licence conditions, including the network Reliability and Performance Licence Conditions are imposed by the NSW Minister for Energy. The Independent Pricing and Regulatory Tribunal (IPART - Electricity) is responsible for administering licensing within the energy industry and monitoring compliance with licence requirements on request from the Minister of Energy. The Australian Energy Regulator (AER) ultimately determines Endeavour Energy's network revenue and network service pricing within each regulatory control period.

This Distribution Annual Planning Report (DAPR) complies with the NER clause 5.13.2. It reflects the outcomes of the annual planning review of Endeavour Energy's network. Information required for the DAPR is located within this document and the DAPR mapping portal available on https://dapr.endeavourenergy.com.au. The aim of the document and the portal is to inform network participants and stakeholder groups of the proposed development of Endeavour Energy's network, including potential opportunities for non-network solutions and possible investments where the Regulatory Investment Test for Distribution (RIT-D) applies.

Endeavour Energy has adopted an Asset Owner-Asset Manager-Service Provider model to deliver its asset management strategy and achieve its corporate objectives. Distribution network strategy and plans are developed in accordance with the asset management philosophy to achieve the corporate objectives. They are directed and coordinated and through the operation of the Asset Management Committee and the Investment Management Committee.

This DAPR is based on Endeavour Energy's planning processes in accordance with its asset management strategy.

Endeavour Energy recognises the significant role that customers and stakeholders play in shaping the network of tomorrow and we value their insights and feedback. Our Peak Customer and Stakeholder Committee, Regulatory Reference Group and Future Grid Reference Group played an important role in helping to inform the plans set out in this report and we thank them for their valuable contributions.

Key features of the planning outcomes are:

- Continued strategic focus on asset renewal, prioritised and optimised on the basis of asset condition and network risk, and integrated with growth-related investment needs;
- Demand growth, primarily concentrated in North-West and South-West Sydney which are expected to accommodate over 480,000 new dwellings and land for employment for 1,000,000 new residents over the next 25 to 30 years, for which Endeavour Energy is planning to provide up-stream supply infrastructure;

- Joint planning with TransGrid for the provision of supply for the proposed Western Sydney Aerotropolis at Badgerys Creek;
- Continued implementation of demand management strategies and Distributed Energy Resources (DER) integration to defer planned network augmentations where it is economically feasible and practicable to do so;
- Management of reliability performance levels with targeted reliability improvement works where justified to meet licence condition obligations;
- A portfolio of 13 network-need driven projects in the next five years that require the application of the RIT-D, including consideration of non-network solutions;
- A further 18 projects where the estimated constraint date is forecast within the next five to ten years that will likely require application of RIT-D based on our current assessment;
- The identification of 39 high-voltage distribution feeders that are currently at or above maximum planned loading level, that require monitoring, remediation through augmentation, load transfers or load reductions, or combination of responses; and
- Ongoing growth in the connection of embedded solar-photovoltaic (PV) energy generation and battery storage and the integration of these and other emerging end-use demand management technologies with Endeavour Energy's network.

This DAPR provides the market with an understanding of the various investment programs and projects being undertaken by Endeavour Energy to fulfil its obligation as a licensed DNSP in the NEM. It provides a snapshot of the investment expected over the next five-year period. The details contained in this report will change over time as the consideration of new information in the planning process continues to inform planning outcomes in accordance with Endeavour Energy's corporate objectives.

2. Introduction

Endeavour Energy serves some of Australia's largest and fastest growing regional economies. Endeavour Energy owns, develops, operates and maintains electricity distribution assets in NSW, and is subject to the National Electricity Law (NEL) and National Electricity Rules (NER) administered by the Australian Energy Regulator (AER).

The NER require all registered DNSPs to:

- Conduct an annual planning review and publish a DAPR;
- Conduct economic assessments of potential project options under the RIT-D; and
- Implement a Demand Side Engagement Strategy to consult with and engage non-network providers in the development and evaluation of potential solutions to identified network needs.

The annual planning review includes the planning for all assets and activities carried out by Endeavour Energy that would materially affect the performance of its network. This includes planning activities associated with replacement and refurbishment of assets and negotiated services. The objective of the annual planning review is to deliver asset management plans which are designed in the long-term interest of customers. The planning review is also intended to identify possible future issues that could positively and negatively affect the performance of the network to enable Endeavour to plan for and adequately address such issues in an appropriate timeframe. This DAPR reflects the outcomes of Endeavour Energy's 2023 annual planning review.

Endeavour Energy is required to prepare and publish a DAPR that complies with the requirements of the NER Schedule S5.8 Distribution Annual Reporting Requirements to:

- Provide transparency of Endeavour Energy's decision-making processes and provide a level playing field for all stakeholders in the national electricity market in terms of attracting investment and promoting efficient decisions;
- Include information associated with all parts of the planning process including forecasting demand, identification of network needs and the development of credible options to address network limitations;
- To give third parties the opportunity to offer alternative proposals to alleviate constraints. These proposals may include non-network options such as demand management or embedded generation solutions;
- Set out the results of Endeavour Energy's annual planning review, including joint planning, covering a minimum five year forward planning period for distribution assets;
- Inform registered participants and interested parties of the annual planning review outcomes including asset retirement and network capacity needs for sub-transmission lines, zone substations and transmission-distribution connection points and any primary distribution feeder capacity needs that exist or are expected to emerge within the next two years;
- Provide information on Endeavour Energy's demand management activities and actions taken to promote non-network initiatives each year including plans for demand management and embedded generation over the forward planning period; and
- Assist non-network providers, TNSPs, other DNSPs and connection applicants to make efficient investment decisions.

The DAPR covers a minimum five year forward planning period for distribution network sub-transmission assets.

2.1 About Endeavour Energy

We power our customers lives and businesses and support the economic and liveable urban develop of our regions including Greater Western Sydney. Our enduring focus is providing affordable, safe, resilient, sustainable and reliable electricity to the 2.6 million people across our network, and 2.8 million by 2029.

Endeavour Energy plans, builds, operates and maintains the poles and wires and other distribution assets to provide an affordable, safe and reliable power supply to and from households and businesses across Sydney's Greater West, the Blue Mountains, Southern Highlands, the Illawarra and the South Coast.

The timely and efficient provision of these services is fundamental to supporting employment growth, economic development and housing affordability across one of the fastest growing metropolitan and regional economies in Australia.

Our network services communities with some of the highest cultural and language diversity in Australia across the lands of the traditional custodians – the people of the Dharawal, Dharug, Gundungarra, Wiradjuri and Yuin nations. We recognise first peoples' continuing connection to Country, cultures and community. We pay our respect to elders past and present.

Over the next 20 years, these areas will be home to communities similar in size to Canberra. The population of Western Sydney is expected to increase by 1,00,000 by 2036 and we expect more than 20,000 new customers will connect to the network each year.

With change comes the opportunity for accelerated technological adaption, and so we welcome partnerships with government, universities and energy innovators to find new ways to optimise the use of network services to unlock value for customers.

Endeavour Energy is 50.4 percent owned by an Australian-led consortium of long-term investors in the private sector operating the network under a 99-year lease. The private sector consortium comprises of funds and clients managed by Australia's Macquarie Infrastructure and Real Assets, Canada's British Columbia Investment Management Corporation and Qatar Investment Authority. The remaining 49.6 percent is held by the State of NSW via a corporation constituted under the *Electricity Retained Interest Corporations Act 2015*.

This change in ownership in 2017 means we continue to leverage the vast infrastructure management experience of the consortium to transform our business into a world class utility, delivering further improvements in safety, operating efficiency and customer service outcomes.

Figure 1: Endeavour Energy's network – fast facts

20,000 new customers per year in some of the largest and fastest growing regional economies in the state. Over 50% of Sydney's population will reside in Greater Western Sydney by 2036

2.6 million people

25,000 square km across **23** council areas

1 million+ business & residential customers

32,000 life support customers

221,000 customers with renewable energy generation

225,000 streetlights

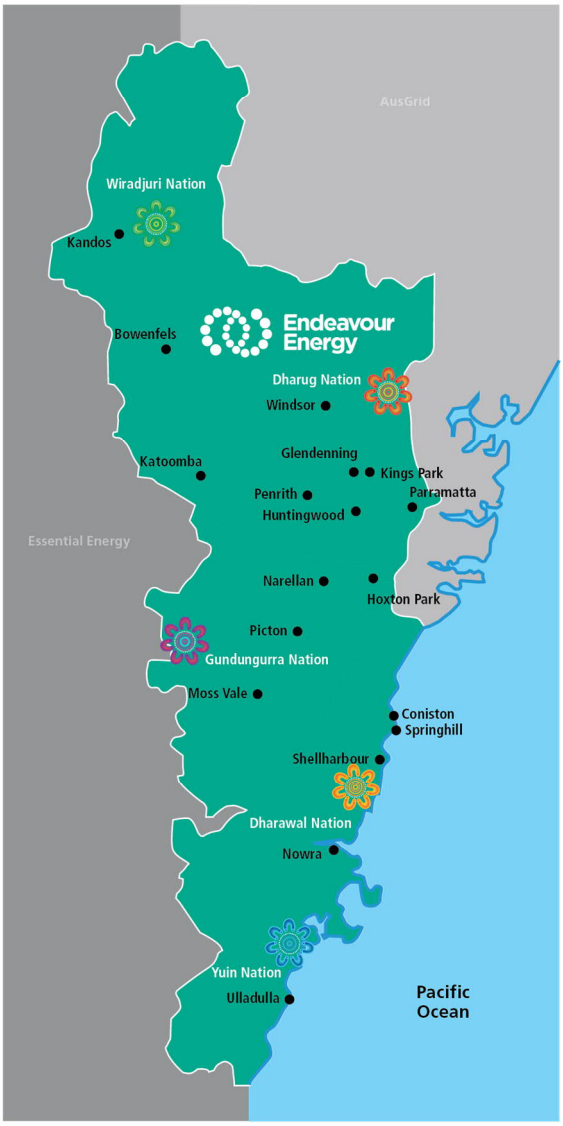
85% of our area is bushfire prone

207 major substations

430,000 power poles

60,000 km of powerlines

- We work across the lands of five nations – the people of the Dharug, Wiradjuri, Dharawal, Gundungurra and Yuin nations.
- We operate across diverse regions in New South Wales
  - Sydney's Greater West
  - Blue Mountains
  - Southern Highlands
  - Illawarra
  - South Coast
- We recognise the diversity of our customers -their heritage, their communities and their energy needs.



2.2 Endeavour Energy's Network

In 2022/23, Endeavour Energy's network supplied 16,883 GWh of electricity to 1,099,182 network-connected customers. Endeavour Energy's distribution area is shown in Figure 1

The bulk of Endeavour Energy's supply of electricity from traditional sources is taken from the generation source through TransGrid's transmission network at 132kV and 66kV. When the energy is transferred into Endeavour Energy's network, the voltage is transformed through 36 sub-transmission and 172 zone substations and distributed to customers through a 22kV, 11kV or 12.7kV high voltage network. Endeavour Energy also has switching substations to provide important connectivity across the network to enhance supply reliability and resilience and also improve operational flexibility. Distribution substations further reduce the voltage to supply customers with a 230V nominal low voltage supply in accordance with Australian Standards. Increasingly, Endeavour Energy's network is accommodating the rapid uptake of residential and industrial scale solar generation, and embedded customer, community and industrial batteries, microgrids, virtual power plants and electric vehicle charging infrastructure.

Table 1: Endeavour Energy statistics as at 30 June 2023

Statistic	Number
Distribution Customer Numbers (total)	1,099,182
Maximum Demand (aggregated system MW)	3,909
Energy Distributed to Year End (Residential) (GWh)	5,805
Energy Distributed to Year End (Non-Residential Including un-metered supplies) (GWh)	11,078
Energy Distributed to Year End (GWh)	16,883
System Losses (%)	4.2
Transmission Substation (Number)	36
Zone Substation (Number)	172
Bulk Supply Point (Number)	15
Distribution Substation (Number)	34,662
Sub-Transmission Overhead (km)	3,011
Sub-Transmission Underground (km)	421
High Voltage Overhead (km)	11,217
High Voltage Underground (km)	5,907
Low Voltage Overhead (km)	8,570
Low Voltage Underground (km)	10,872

Our business is changing fast. What was once a network of poles and wires delivering one-way electricity supply to customers is rapidly evolving into a multi-directional system, where DERs feature, and allow our customers to send excess power back into the grid.

The uptake of rooftop solar by Endeavour Energy's customers is unprecedented. In 2010, there were 24,430 solar systems on rooftops. Now there are over 270,000 systems connected to the network with large, industrial solar an increasing feature across Western Sydney.

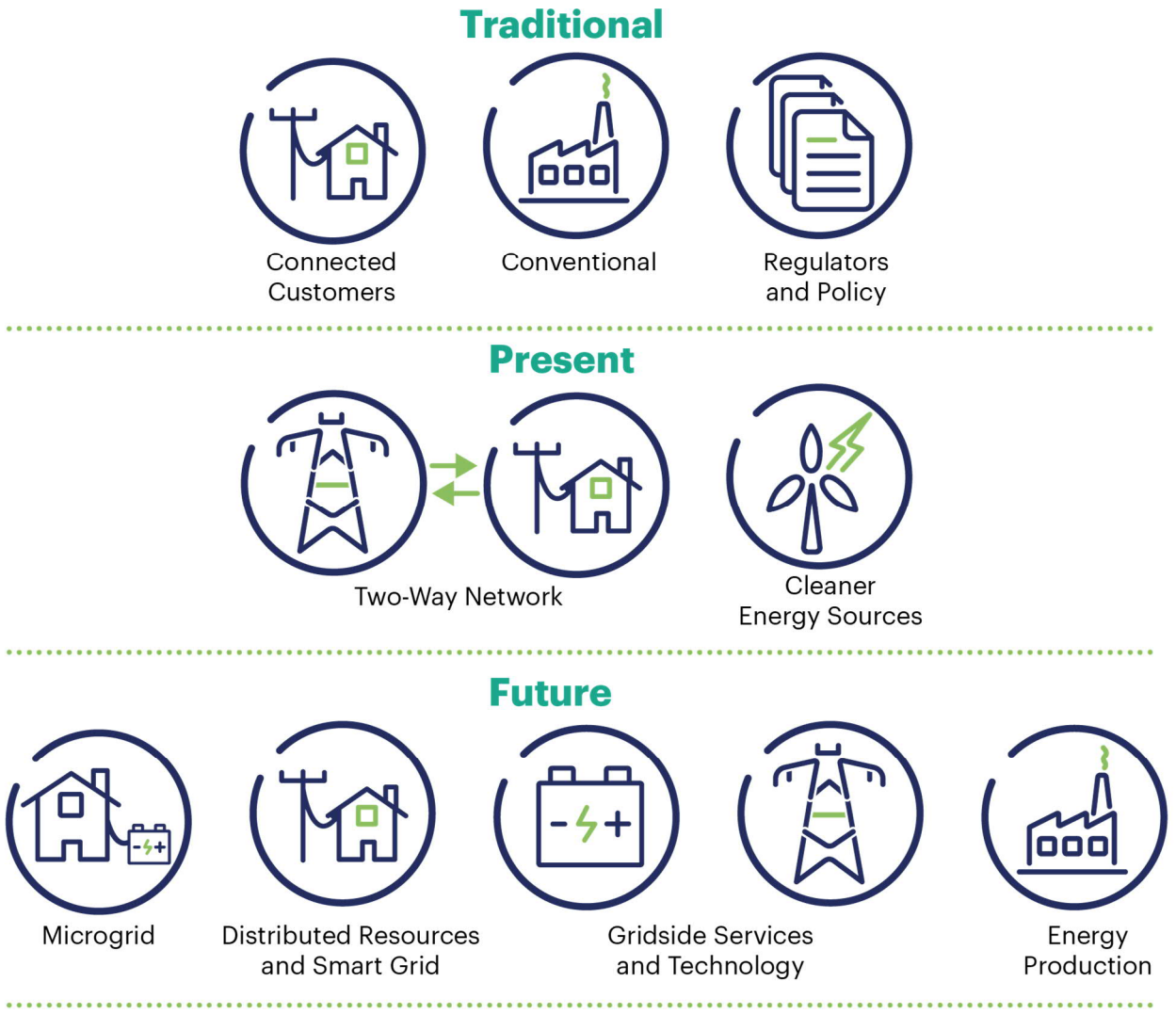
Local councils across our area have also flagged significant interest in community batteries, electric vehicle charging stations, smart street lighting, community solar gardens, microgrids and the need for a more resilient network in the face of climate change. These interests require significant changes to the way we plan for the network of tomorrow.

Rapid technological change, shown in

Figure 2 poses both significant opportunities as well as challenges for Endeavour Energy to manage the safe, affordable and reliable integration of all these distributed energy resources in the network.

If properly managed, solar and storage systems can work together to support the grid, reducing the need for investment in poles and wires infrastructure, and ultimately saving customers money on power bills.

Figure 2: Electricity Network Transformation - past, present and future



To help plan for these changes, Energy Networks Australia invited customer advocates and energy industry stakeholders to help the CSIRO map out a plan called the Electricity Network Transformation Roadmap.

Endeavour Energy's leadership chaired the group that designed the Roadmap and is committed to its implementation. More recently, the NSW Government has consulted with Endeavour Energy to ensure the smooth implementation of the NSW Government's Electricity Infrastructure Roadmap, which will see the development five renewable energy zones across NSW, with one in the Illawarra region.

Also, The Energy Security Board (ESB), in collaboration with the Australian Energy Market Commission (AEMC), the AER and other market bodies, is transitioning the NEM into a modern energy system fit to meet consumers' evolving wants and needs. The ESB proposed a suite of reforms to meet the needs of this transition. With all the reforms in place, the NEM will allow consumers to benefit from rapidly changing technologies in power system; unlock the value of flexible demand and distributed energy resources; and provide clear signals for timely and efficient investment to deliver reliable, secure, and affordable electricity for consumers.

2.3 Operating Context

Regulatory framework

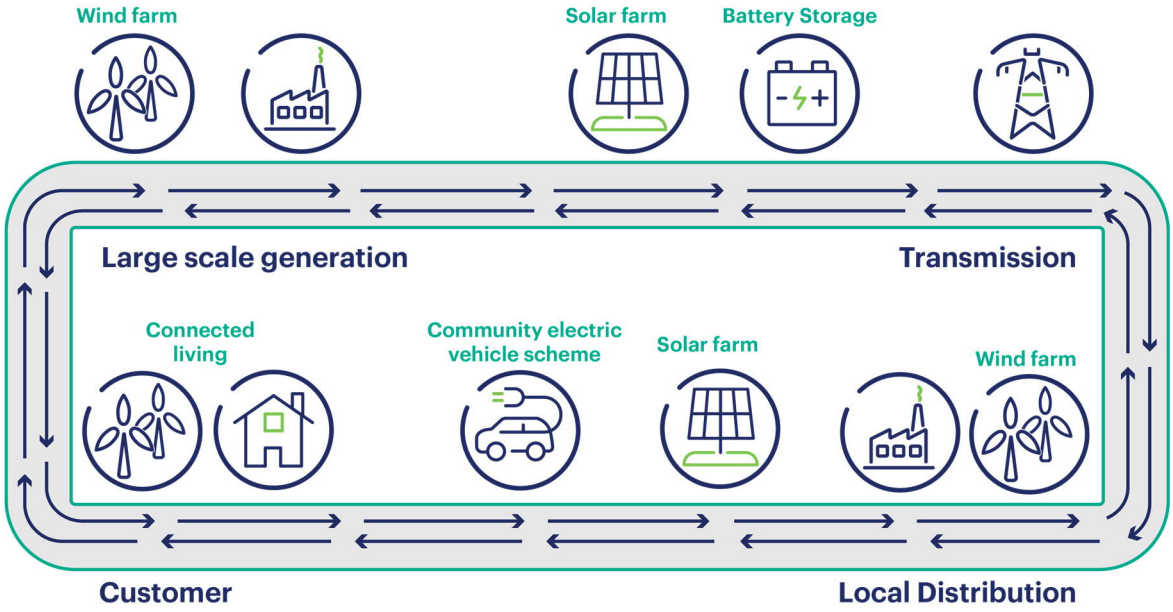
Endeavour Energy is regulated by statutory and legislative requirements including work, health & safety (WH&S), environmental, competition, industrial, consumer protection and information laws, the NEL, the NER, the NSW Electricity Supply Act 1995 and the requirements of its NSW Distribution Network Service Provider licence. Endeavour Energy complies with these laws and regulations through its internal policies, procedures, workplace instructions and industry codes and standards. We operate a common business control framework across these various instruments that allows us to fulfil our obligations through the development and implementation of plans, delegations of authority and associated controls, instruction and training, audits of compliance, and risk identification and management.

In particular, Endeavour Energy's operations are guided by a number of important policies and codes, including a Code of Conduct, a Stakeholder Engagement Framework, our Safety Policy, Environmental Code of Conduct and our Statement of Business Ethics.

Endeavour Energy is managed by a Board of Directors and a Chief Executive Officer (CEO). Endeavour Energy's CEO reports to the Board. The Board is responsible for setting the overall strategic direction and performance targets and monitoring the implementation of the strategy by the organisation. The CEO leads the Executive Leadership Team in delivering the approved strategy and achieving the performance targets set by the Board.

Within NSW, the Network Reliability and Performance Licence Conditions are imposed by the Minister of Energy. The Independent Pricing and Regulatory Tribunal (IPART - Electricity) is responsible for administering licensing within the energy industry and monitoring compliance with licence requirements on request from the Minister. Safety performance and compliance is also administered by IPART in conjunction with WorkCover NSW. The AER is the economic regulator of the distribution and transmission sectors of the NEM under the NEL and NER.

Figure 3: Electricity Industry Structure



There are significant costs in building and maintaining a distribution network of our size and complexity. Our core activities include:

- Safely maintaining distribution lines and substations to keep the lights on
- Building new substations, poles and wires, including in new suburbs
- Responding to emergencies like storms which bring down power lines and poles
- Tree trimming to maintain safety clearances, manage bushfire risk and prevent blackouts caused by falling trees
- Facilitating the connection of new customers to the network
- Researching, trialling, and installing new technology, like batteries, to use as alternatives to poles and wires
- Installing and maintaining streetlights
- Various ‘user pay’ services like meter testing, off-peak conversion and design certification.

Key trends

There are key trends shaping our current and future operational landscape. These are:

- **Customer centrality:** A focus on customers' needs and experiences from high energy users to pensioners to empowered prosumers means customers play a more central role in the operation of the network as networks evolve to be platforms of energy services. Underpinned by new technologies, customer expectations and service needs will evolve. Customers will expect to help shape the direction of the business through deep engagement on regulatory proposals and beyond.
- **Trust, reputation and purpose**: The reliable delivery of an affordable crucial service underpins trust and is core to our purpose. Customers also increasingly expect organisations to align with personal and community values for environmental and social governance (ESG). Purposeful decision making, with an emphasis on ESG outcomes, will be essential to retain social licence, attract investment, and to establish and maintain a high-performance culture.
- **Western Sydney regional growth:** The NSW Government is driving the substantial and rapid growth of Western Sydney, at a rate nearly 40% higher than the rest of Metropolitan Sydney. By 2036, half of Sydney's population will reside within the city's west, supporting a new airport, new industry and manufacturing, and a new science park. This plan is akin to building a new city, from scratch.
- **Economic volatility and cost of living pressures:** International and domestic developments have contributed to rapidly rising inflationary pressures, including in energy prices, with rising concerns about a possible slowdown in the Australian economy. Cost of living pressures are increasingly centre of mind now for all customers small and large. Transitioning the grid to ensure long term value for money services as customers make increasing energy choices in the most efficient way requires balancing in the short and long-term.
- **Climate change and extreme weather events:** Climate modelling suggests that extreme weather events will continue to increase in both frequency and intensity over the coming decades. Climate change-related events damage, destroy and/or compromise the performance of infrastructure, and increase risks to the reliable supply of electricity.
- **A changing grid in a low carbon economy:** The pursuit of a net zero economy will transform the way we generate and consume energy. As customers take up technologies such as solar, batteries and electric vehicles, the network will need to evolve to allow for two-way flows and active participation from customers and third parties. Over time, more sophisticated digital platforms will seek to interact with a more dynamic, integrated network that orchestrates the low carbon energy system.
- **Efficient and effective service in the digital age**: Introduction of digital technologies and enhanced data capabilities create significant operational efficiencies, while transforming the risk, roles, required skills and location of the future workforce. At the same time, cyber-attacks become more frequent and sophisticated, targeted at the disruption of energy supply.

Our Customers

We serve a diverse population with over 1 million customers across 24,980 square kilometres. Most of our customers are households and small to medium businesses located in urban and developing rural areas. We also serve large urban areas, medical precincts and manufacturing and industrial customers who have specific needs for a safe and reliable supply, and we provide high voltage support directly to very large businesses.

Our network includes significant development areas such as the Western Parkland City and the Western Sydney International (Nancy-Bird Walton) Airport and its surrounding aerotropolis. It's also home to Sydney's North West, South West and Greater Macarthur Priority Growth sectors, planned as new release

areas to house communities similar in size to Wollongong and Canberra. By 2036, half of Sydney's population will be expected to reside within Sydney's west with an additional 725,000 dwellings projected.
In addition to population growth, our customers have the third highest energy density and demand density in the NEM. This means that our customers consume a relatively high amount of energy, particularly during peak times (4pm to 8pm). This is largely due to a combination of higher summer temperatures (often up to 10 degrees higher than the Sydney CBD) and energy-intensive economic activity.

As the electricity industry undergoes rapid transformation, many customers are changing the way they interact with the network and we are seeing more small-scale renewable forms of generation connecting to the network. By June 2023, approximately 270,000 customers had connected their own small scale renewable generation (mostly solar panels) to the network, representing a cumulative capacity of around 1GW. Our network will continue to play a critical role in enabling a range of customer benefits from the increasing uptake of distributed energy resources (DER). In Chapter 4, we provide more detail on the way our customers consume and produce energy is evolving.

Endeavour Energy is a signatory to the Energy Charter, an industry and customer led, world-first, whole-of-sector initiative to address customer expectations. Endeavour Energy works to deliver the five principles of the Energy Charter:

1. We will put customers at the centre of our business and the energy system
2. We will improve energy affordability for customers
3. We will provide energy safely, sustainably and reliably
4. We will improve the customer experience
5. We will support customers facing vulnerable circumstances

Our Regions

We manage our operations over three distinct geographic regions:

NORTHERN REGION (NORTH-WEST SYDNEY AND BLUE MOUNTAINS – WIRADJURI AND DHARUG NATIONS)

Most of our customers (and our network infrastructure and assets) are located in Greater Western Sydney which includes the major cities of Parramatta, Blacktown, Penrith, along with the Hawkesbury and the Hills regions located in the Northern region. Combined with other major centres in the Central region, they form the third largest economy in Australia.

Typical of urban expansion, greenfield development within Sydney is largely confined to regions on the city fringe. This suburban development has been primarily driven by the largest coordinated land release in the history of NSW. Development to accommodate this expansion has been concentrated in the North-West and South-West Sydney regions which are entirely captured by our network area. With half of Sydney's population expected to reside within Sydney's west within the next 15 years, our investment plans for the next regulatory period support required growth in these areas.
We also supply customers throughout the Blue Mountains and beyond. This is a World Heritage Area featuring dense vegetation with challenging topography. Managing bushfire risk and reliability is a key focus for this part of our network.

CENTRAL REGION (SOUTH-WEST SYDNEY AND SOUTHERN HIGHLANDS –GUNDUNGURRA, DHARUG AND DHARAWAL NATIONS)

The central area of our network incorporates the major urban centres of Liverpool, Fairfield and Campbelltown. In common with the Northern region, strong greenfield growth has been experienced in areas that were previously low-density rural communities. Large transport infrastructure investments underpin population and economic growth in the area.
This area is also home to Sydney's second international airport at Badgerys Creek, featuring development of an 'aerotropolis'. Set to open in late 2026, we are working closely with planning authorities and developers to support this and other planned development in the surrounding area.
South-west of the Sydney metropolitan region, the rural townships of Picton, Bowral, Mittagong and Moss Vale form the major regional communities of the Southern Highlands.

SOUTHERN REGION (ILLAWARRA AND THE SOUTH COAST – DHARAWAL AND YUIN NATIONS)

Most of our resources in the Southern region are focused in Wollongong and the wider Shellharbour district. After Sydney and Newcastle, Wollongong is NSW's third largest city and is home to approximately 300,000 people. Significant growth is planned for the region, led by the West Lake Illawarra area which will ultimately accommodate an estimated 38,000 new dwellings. This region includes Port Kembla Harbour and an industrial complex that is the largest single concentration of heavy industry in Australia.

The most southern areas of our network are predominantly small coastal communities, popular with holiday tourists and retirees, and often subject to severe weather events. Our growth story extends to this area too, with an estimated 5,000 new homes possibly in the greenfield Moss Vale Road Urban Release Area in the Shoalhaven region.

Never before has the community been so focused on the affordability, reliability and security of their electricity services as the energy industry in Australia undergoes a dramatic transformation. We're committed to efficient investment and giving customers more choice and control.

The challenges to providing a safe, reliable and affordable service are evolving as the NEM is impacted by decarbonisation, decentralised generation and changing energy consumption patterns. We must evolve to keep pace with these trends in order to meet the expectations of our customers into the future.

Western Sydney regional growth

NSW population industrial growth has focused on the urban expansion of Sydney's Greater West. This strategic expansion will drive the substantial and rapid growth of the region, at a rate nearly 40% higher than the rest of Metropolitan Sydney. By 2036, half of Sydney's population will reside within the city's west, centred around new 'satellite cities'. Projections suggest the need for an additional 725,000 dwellings, in a region that is also planned to cater for a new airport, new industry, rejuvenation of manufacturing, and a science park. We will be part of building a new city, from scratch.

Endeavour Energy is responsible for the expansion of the distribution network to facilitate this growth and industry, and to support the NSW Government's planning and development of liveable, productive and sustainable communities that thrive. This focus has been a driver of our investment for several years and it will continue to be in the foreseeable future. To continue to accommodate this growth, new networks must be planned and delivered in a way that both facilitates this vision and futureproofs the network. For residents, small and large business and emerging needs such as datacentres and hydrogen hubs. This requires a focus on:

- **Planning for the future:** This predicted expansion of the asset base is occurring at the same time as the changing nature of the grid. Endeavour Energy will need to work with developers and government to ensure greenfield developments are future-proofed, efficient and remain cost-effective.
- **Ensuring network infrastructure is not a barrier to growth:** The roll-out of new infrastructure across Western Sydney will require significant investment, and the expansion cannot occur without this supporting infrastructure in place. Endeavour Energy will need to work with the Government to ensure the infrastructure expansion meets the growth of the of the community.

2.4 Purpose, Values & Strategy

At Endeavour Energy, our purpose and values form the basis of everything we do and how we do it.

Our purpose is to power communities for a brighter future.

Our vision is to lead the way with smarter energy solutions.

Our values underpin how we work and stretch us to lead. Our five values are:

Be Safe
Put safety first. Care. Always.

Work Together
Listen. Share goals. Work together as one.

Find a Better Way
Stretch for excellence. Innovate. Challenge ourselves. Create value.

Adapt Quickly
Be nimble and flexible. Be open to learn. Embrace opportunities.

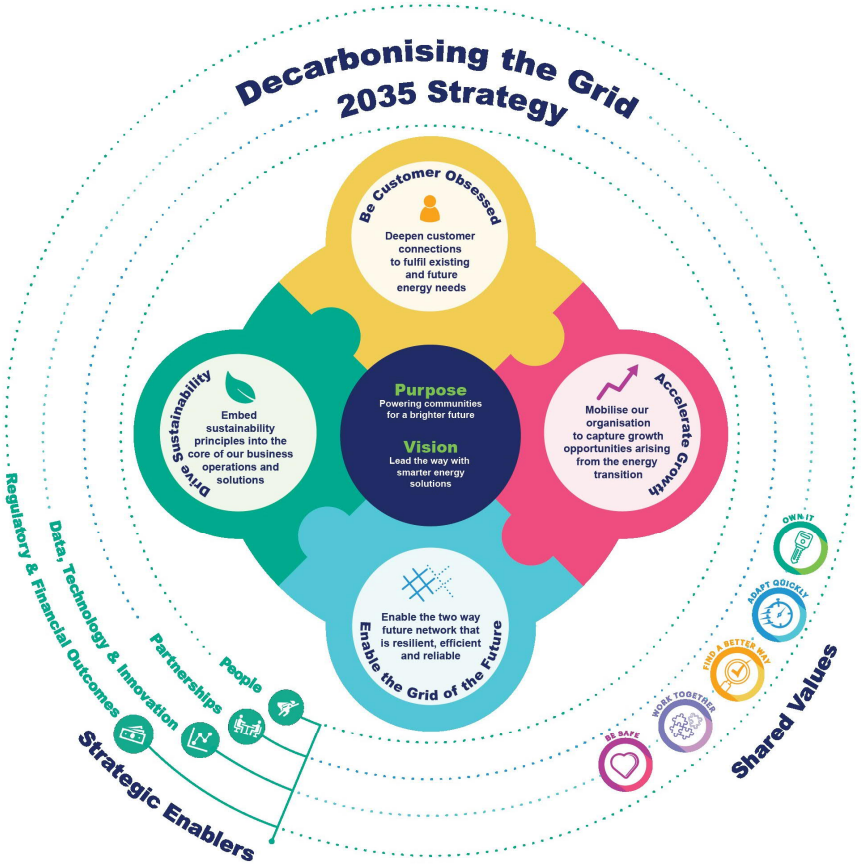
Own It
Do what you say and own the impact of what you do. See it through.

We are trusted and caring, authentic and down to earth. We are collaborative and connected, and sustainable at the core. We pull together to put our customers and community at the heart of everything we do. We make it easy for customers and our partners to do business with us, we drive innovations they need and value, and we empower our people to be their best and deliver excellence.

Endeavour Energy's Corporate Strategy

Endeavour Energy's strategy is to evolve its 130-plus years of electricity distribution network management capability to shape a modern, sustainable network which leads the way in developing new energy solutions for our customers and accelerates the decarbonisation of the grid.

Our Corporate strategy supports the principles of the Energy Charter and is designed to promote the long term interests of our customers, shareholders, people and communities by focussing on four key strategic priority areas illustrated in the figure below.



3.0 Asset Management

3.1 Asset Management Philosophy

Endeavour Energy applies a lifecycle approach to managing its network and the assets that comprise it. The lifecycle approach involves two aspects:

- Considering individual assets and asset populations on a whole-of-life basis in order to achieve optimal outcomes across their entire lifecycle e.g. considering how the cost-benefit trade-off between asset management decisions made at the design and procurement stage may later impact the maintenance stage of the asset lifecycle; and
- Considering the network as a whole in all asset management decisions i.e. will the decision made in relation to any individual asset or asset population result in the best outcomes for the network as a whole.

We develop network and asset plans, proposed investment programs, develop asset standards and management policies, and strategically monitoring and manage network capability and performance.

3.2 Asset Management System

Endeavour Energy maintains an Asset Management System that provides a framework for effectively managing the network and its assets through the complete asset life cycle of planning, program development, design, construction, operation, maintenance, renewal and disposal in accordance with ISO 55001.

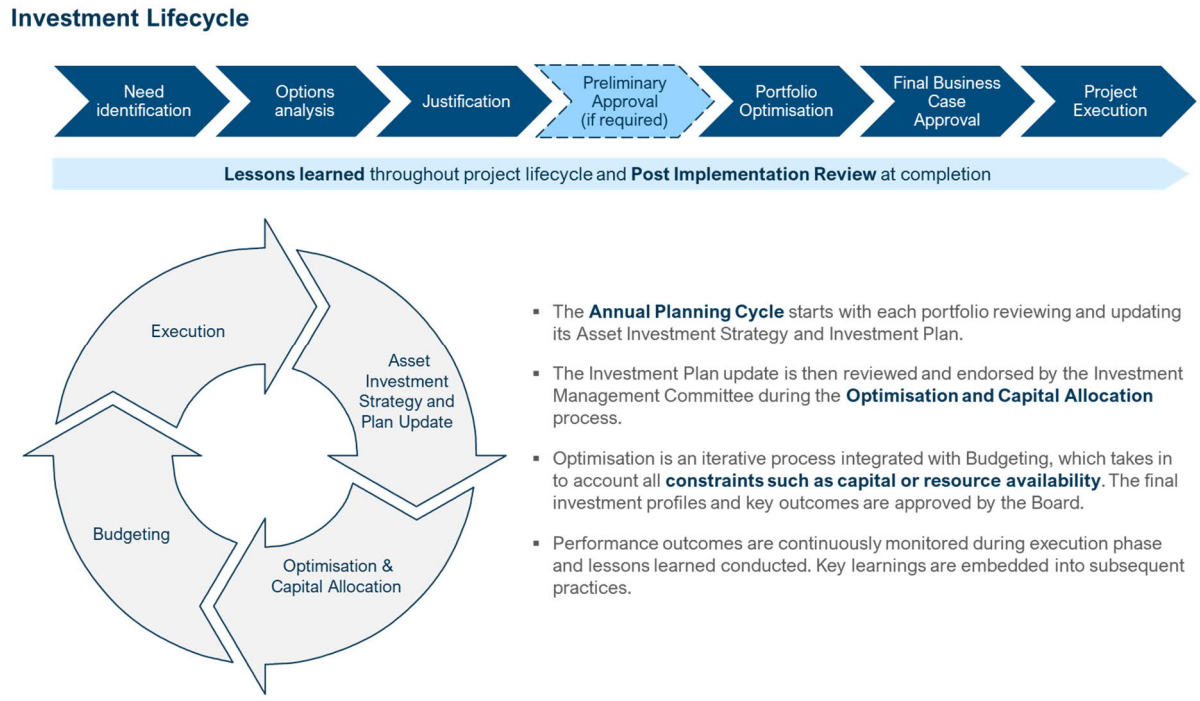
The Asset Management System defines the key documents used to coordinate asset management decision making and ensuring asset management activities are aligned to the organisational objectives.

3.3 Investment Management & Governance Framework

Endeavour Energy's Investment Management Framework has been revised to ensure best-in-class customer investment outcomes and business governance and to adopt our new digital transformation platforms. This includes risk-based approaches to economic benefits quantification and alternative options, risk and uncertainty management.

Figure 4: Investment Management Framework

An annual planning and investment cycle oversees key capital allocation from a management level for optimisation.



3.4 Investment Strategy

Our investment strategy is based on four priority themes that balance affordability for customers with their long-term interests.

The four themes are below:

A **Meeting core customer expectations for a safe, affordable and reliable electricity supply:** We invest in the replacement and renewal of assets across our network to ensure they continue to meet our customers' expectations for a network that is safe for our workers and the community, provides a reliable electricity supply to our customers and is affordable.

B **Supporting the sustainable growth of our communities;** As the ongoing transformation of Western Sydney and our regions continues to drive growth across the Endeavour Energy network, we need to align our investments with other lead infrastructure provisions by facilitating grid technologies that will be adaptable to the evolving needs of businesses and communities.

C **Providing a resilient network for the community adapting to changing climate and external hazards:** Endeavour Energy defines resilience as the ability to anticipate, withstand, quickly recover and learn from major disruptive events. As the effects of climate change become real, our infrastructure needs to meet our high levels of service in an increasingly challenging environment. Our organisation needs to be prepared, enabling our trained personnel to respond to incidents and provide support services to those in need.

D **Enabling customers' future energy choices;** As customers seek to connect more distributed energy resources and increasingly use sophisticated digital platforms, the network and its management must evolve. Our objective is to enable customers' future energy choices for a sustainable future, moving use towards the future integrated and low carbon energy system.

3.5 Investment Decision Making

Our investments are implemented through our Investment Decision-Making (IDM) process which aligns with our Investment Management Framework (IMF) and is a key driver of our Asset Management Framework (AMF). Individual plans in the key network investment areas are developed and supported by detailed analysis that explicitly takes into account:

- externally imposed obligations and requirements including service standards, design standards, safety and environmental obligations, and specific asset performance targets;
- information about the network system including loading, condition of assets, performance variability, current capacity, age and the criticality of key assets;
- forecasts of demand growth and connections by location; and
- inputs obtained from stakeholder engagements.

3.6 Value Framework

To optimise the mix of investments, we apply a consistent approach to quantify risk and benefits, and determine the timing for investments based on the need and the best overall value provided by the portfolio.

This is the basis of the value framework and is underpinned by:

- Using a rational economic approach to allow the comparison of dissimilar investments.
- Using a consistent and repeatable approach to assess all the benefits, risks, and cost of the investment.
- Ensuring that both financial and non-financial benefits are included, where their contributions are aligned to a common scale, and
- Measuring its alignment to the organisation's corporate strategy & risk appetite.

3.7 Licence Conditions

Our licence conditions have a material impact on our asset management framework and capex requirements. As the compliance regulator, IPART conducts frequent audits to demonstrate ongoing compliance with our obligations. These include:

- Distribution reliability and performance conditions: set overall reliability, individual feeder performance and customer service standards that we must comply.
- Critical infrastructure licence conditions: set out requirements regarding our management and operational presence in Australia and data security requirements including privacy of customer information.
- Management systems; our asset management system must be consistent with International Standard (ISO) 55001 and our environmental management system must be consistent with ISO 14001. Our safety management systems must also comply with Australian Standard (AS) 5577 in accordance with the NSW Electricity Supply (Safety and Network Management) Regulation 2014.

3.8 Safety

Continuing advances in workplace health and safety are driving a more integrated view of contributing factors to workplace safety and the business's obligation to ensure a safe place of work. In this regard, safety considerations including safety in design are overtly considered in asset management strategies. Furthermore, Endeavour Energy has a specific strategic plan for Safety and Environment that considers the broader safety and environmental initiatives across the business.

4.0 Planning Approach

4.1 Annual Planning Review

The NER requires that the annual planning review includes the planning for all assets and activities carried out by Endeavour Energy that would materially affect the performance of its network. This includes planning activities associated with the replacement and refurbishment of assets and negotiated services. The objective of the annual planning review is to identify possible future issues that could negatively affect the performance of the distribution network to enable DNSPs to plan for and adequately address such issues in an appropriate timeframe. This DAPR is the outcome of the annual planning review and summarises the findings of our planning review processes.

The DAPR provides an insight into the planning process as well as providing information to registered participants and interested parties regarding the nature and location of emerging constraints within Endeavour Energy's sub-transmission and 22kV and 11kV distribution network. The timely identification and publication of emerging network constraints provides an opportunity for the market to identify potential non-network solutions to those constraints and allows Endeavour Energy to develop and implement appropriate and timely solutions.

4.2 Network Planning Process

Endeavour Energy operates in accordance with the legislative and regulatory framework applicable to electricity DNSPs in NSW.

The network planning and development process for the distribution network is increasingly shaped by extensive customer and stakeholder engagement and is carried out in accordance with the NER Chapter 5, Network Connection Access, Planning and Expansion.

Endeavour Energy carries out network planning at both a strategic and a project level. Endeavour Energy's investment governance process provides continuous review and ongoing assurance that the Company's capital investment is both prudent and efficient as well as being consistent with the longer term strategic planning objectives.

Endeavour Energy's planning process is designed to identify the most efficient ways of ensuring the network business meets customer needs and network performance obligations. Endeavour Energy places emphasis on the planning and project identification stage, assessing our customers' short term and longer-term supply needs, and coordinating these with asset renewal requirements. We are then able to identify and select the optimal solution to meet those needs in a coordinated, risk-optimised way.

All credible options, including non-network alternatives, are considered in determining how to meet our network performance obligations and the objectives of the NEL. A robust selection process is implemented that explicitly trades off alternative expenditure options using quantified estimates of credible option costs and benefits to identify the optimum solution to address the identified need.

In accordance with NER obligations, network investment and non-network options are assessed impartially, using a consistent process for reviewing the costs of each option against the benefits they would deliver. Non-network solutions are evaluated for the extent to which they can facilitate the deferral of network investment or obviate it altogether. This allows various combinations of non-network solutions and deferred investment options to be assessed.

The first stage of the planning process involves gathering the data required to inform the investment process. This includes:

- Recorded actual electricity demand;
- The preparation of demand forecasts;
- The examination of network capacity limits;
- The assessment of asset condition and asset performance data;
- The forecast of new customer connection requirements; and
- The consideration of applicable statutory and regulatory obligations.

The capability of the network is assessed against key criteria which include:

- Meeting statutory and regulatory requirements relating to the safe operation of the network and to environmental impact;
- Addressing capacity constraints to achieve a level of supply security commensurate with reasonable customer expectations;
- Reliability performance against the reliability performance standards set out in the Licence Conditions;
- Asset condition; and
- Customer connection requirements.

When emerging network limitations are identified, a range of credible options are developed to address the need to ensure that supply security is maintained at a level appropriate to maintain reliability of supply. Options considered include both network and non-network solutions. The costs of these options are compared against the risk costs associated with the base case option of doing nothing.

A review including public consultation with interested stakeholders then selects the most economic option (or options). Each major investment is required to be consistent with Endeavour Energy's longer-term network plans and network standards as well with the NEO.

This DAPR document forms part of public consultation and provides notification of the expected future network requirements. It also indicates the required timeframe to address these needs to allow for appropriate corrective network investment or non-network alternatives or modifications to connection facilities to be developed and undertaken. Providing visibility of network requirements prior to starting the RIT-D process allows for development of more mature non-network solutions.

Capital investment requirements in the distribution network are forecast in line with network needs and constraints across the network area.

The spatial demand forecast is a critical process which supports the planning and development of the forecast augmentation investment program. The forecasting process is carried out twice a year and is a critical input into the planning process to identify and understand the capacity needs of the network. The summer and winter loading conditions are analysed to provide understanding of the seasonal variations which are important for identifying optimal network solutions.

Losses are considered when comparing credible options. Endeavour Energy complies with RIT-D guidelines and assesses the cost of losses for each option where the losses are materially different between the options. An increase in network losses makes a negative contribution to the market benefits of a credible option, while a decrease in network losses makes a positive contribution.

4.2.1 Probabilistic Planning Approach

Endeavour Energy applies probabilistic planning techniques to assess supply security constraints. Deterministic (N-1) criteria are used only as a trigger for further investigation. The probabilistic planning approach includes:

- An assessment of the likelihood of failure of network elements;
- An assessment of the consequence in the failure event. This includes expected outage duration and expected unserved energy. The unserved energy can be monetised by applying a Value of Customer Reliability (VCR). Safety risks are also assessed and monetised by applying a value of statistical life (VSL);
- Consideration of back-up capacity at other voltage levels (for example HV distribution feeder capacity when analysing zone substation contingencies);
- A sensitivity analysis for key parameters such as load growth, cost, rate of return and discount rate; and
- A determination of economic timing for network augmentation and renewal and the net present value of options based on demand forecasts and the economic benefits provided by each option.

For greenfield residential development, probabilistic techniques tend to result in a staged approach to provision of supply capacity including the use of distribution feeders, single transformers and temporary and mobile substations being adopted.

4.3 Planning and Investing

Growth in Endeavour Energy's network is being driven principally by new customer connections arising from greenfield development across our regions, but principally across Sydney's north-west and south-west priority growth areas such as the Western Sydney Aerotropolis and Greater Macarthur. Augmenting the network to provide for the growth in demand in these areas at the right time is important to ensure that development can proceed and that significant infrastructure investment by the State Government in water, roads and rail in greenfield areas are not left stranded.

Endeavour Energy evaluates staged options for network augmentation and/or extension in response to developer requests for supply. Further augmentation is undertaken when load growth projections are realised. In some cases, the minimum viable solution may involve a temporary mobile substation that can be moved on to the next greenfield development when its capacity has been outgrown. As the cost and capability of emerging technology solutions improve there is potentially a larger role to play for these technologies in the staged approach of network augmentation. The staged approach to network augmentation provides more optionality for consideration of non-network solutions to meet network needs.

Endeavour Energy has plans in place to utilise mobile or temporary substations where appropriate. The ability to stage investment in infrastructure for growth depends on the rate of growth. In an area which is expected to see a rapid increase in new load (e.g. commercial and industrial subdivisions, or a large new town centre) a staged option may not be economically efficient. Conversely, an area with a lower projected rate of growth (low-density residential only), the onset of the risk of insufficient capacity can take longer thereby facilitating the exploration of lower-cost operational and non-network options to manage this risk.

In general Endeavour Energy identifies limitations in its network capability against an 'N-1' level of supply security at the sub-transmission and zone-substation level, however small or temporary substations (noted above) may operate in a 'non-secure' manner. This approach only serves to identify preferred future network

development options should future limitations be unable to be mitigated through operational response (such as load transfer) or demand management initiatives.

The actual investment timing is confirmed through a probabilistic assessment of the network risk and the optimisation of the economic benefits of any proposed development.

Non-network strategies play a significant role in Endeavour Energy's plans to service the growth in demand, especially in constrained supply areas. Demand management and non-network strategies have a higher likelihood of success in brownfield development locations compared with greenfield release areas due the potential to reduce load from the existing customer base.

4.3.1 Planning and Investing for Asset Renewal

Endeavour Energy takes a risk-based approach to asset renewal planning that matches the investment in the network to the risks posed by individual assets or groups of assets approaching the end of their useful lives.

Risks to the safety of personnel and to the continuity of the electricity supply to our customers as a result of asset failures are quantified and decisions are made to retire from service assets which present excessive risk. Assets proposed to be retired are assessed for the ongoing need for the service they provide. Where that service is still required, an assessment is made as to whether that can be provided by a credible non-network solution or whether replacement of the asset is required. Where asset replacement is required the optimum timing of the replacement of the asset is based on the balance between the annualised cost of replacement and the annualised cost of servicing the asset, including the risk the asset presents.

Furthermore, the risk to the operational management of the network arising from multiple asset failures occurring during a short period of time is factored into the assessment of whether particular classes of assets should be considered for replacement as they near their end of life or whether they are only replaced after they fail in service.

These considerations lead to an approach where an asset group that has non-catastrophic failure modes and an adequate level of network redundancy are more likely to be renewed in a reactive manner after failure. Other asset groups whose failure modes present safety or unacceptable supply security risks, or where the cost of reactive replacement significantly outweighs the cost of planned replacement, are renewed in a planned manner prior to their failure.

Further, some individual programs and projects within the asset renewal investment program are informed by advanced condition monitoring technology allowing for the targeted and efficient replacement of assets just prior to failure. This technology and the application of risk-based economic assessment of the value of each of the elements of our renewal program is resulting in efficient renewal investment which maintains risk and performance outcomes for our customers.

4.3.2 Planning and Investing for Reliability

Endeavour Energy has adopted a Reliability Strategy of maintaining existing levels of reliability, and rectifying poor-performance outliers that have been identified as per Endeavour Energy's Licence Conditions. Targeted investment leverages new technology such as distribution feeder automation schemes, where analysis shows that these are a cost-effective way of improving the Company's response to faults meeting our customers' expectations for network reliability.

4.4 Recent Changes to Planned Projects

Significant changes to planned projects compared to the previous DAPR are detailed in Table 2 below.

Table 2: Significant changes to Planned Projects Compared to the Previous DAPR

RIT-D Project	Change	Comments
South Penrith ZS	Project deferred for several years	Due to changes in the demand forecast, and changes in the underlying network need, this project and any associated investment has been deferred by several years.
Augmentation of Eastern Creek ZS (NPR-000771)	Project deferred for several years	Due to changes in the demand forecast, and reassessment of distribution feeder configuration options, this project has been deferred by several years.
Augmentation required to address load at risk in West Culburra region (NPR-000008)	Project deferred for several years	Due to changes in the demand forecast, and reassessment of distribution feeder configuration options, this project has been deferred by several years.
Southern Macarthur 66kV constraints	Project now likely to require a RIT-D	Due to recent cost increases the project is likely to now exceed the threshold for RIT-D process engagement. Endeavour Energy will issue a non-network options report as required in the future.

5.0 Network Performance

5.1 Network Reliability Overview

Reliability of supply is a key measure of the performance of the electrical network. System Average Interruption Duration Index (SAIDI) is the measure of the number of minutes on average that Endeavour Energy's customers are without electricity each year due to unplanned events. The following two metrics of SAIDI are used to understand reliability performance of the network:

- Normalised SAIDI which excludes incidents which occur on major event days, and incidents that are eligible for exclusion under the AER guidelines; and
- Unnormalised SAIDI which does not exclude any incidents and is representative of the customer felt experience.

Major Event Days are typically associated with adverse weather conditions and are excludable when reporting normalised reliability results. Figure 7 and Figure 8 shows the total SAIDI and SAIFI trend (includes major event day reliability) as well as normalised SAIDI and SAIFI.

Figure 5: Organisational SAIDI Trend (Total and AER Normalised)

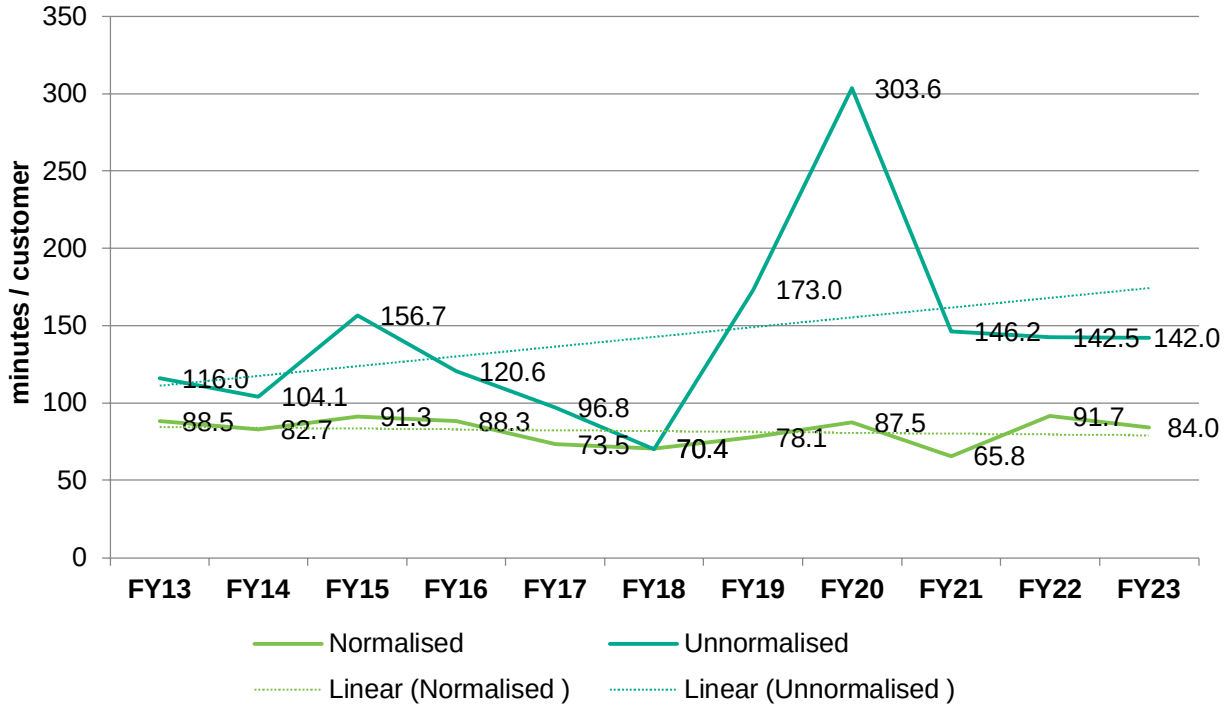
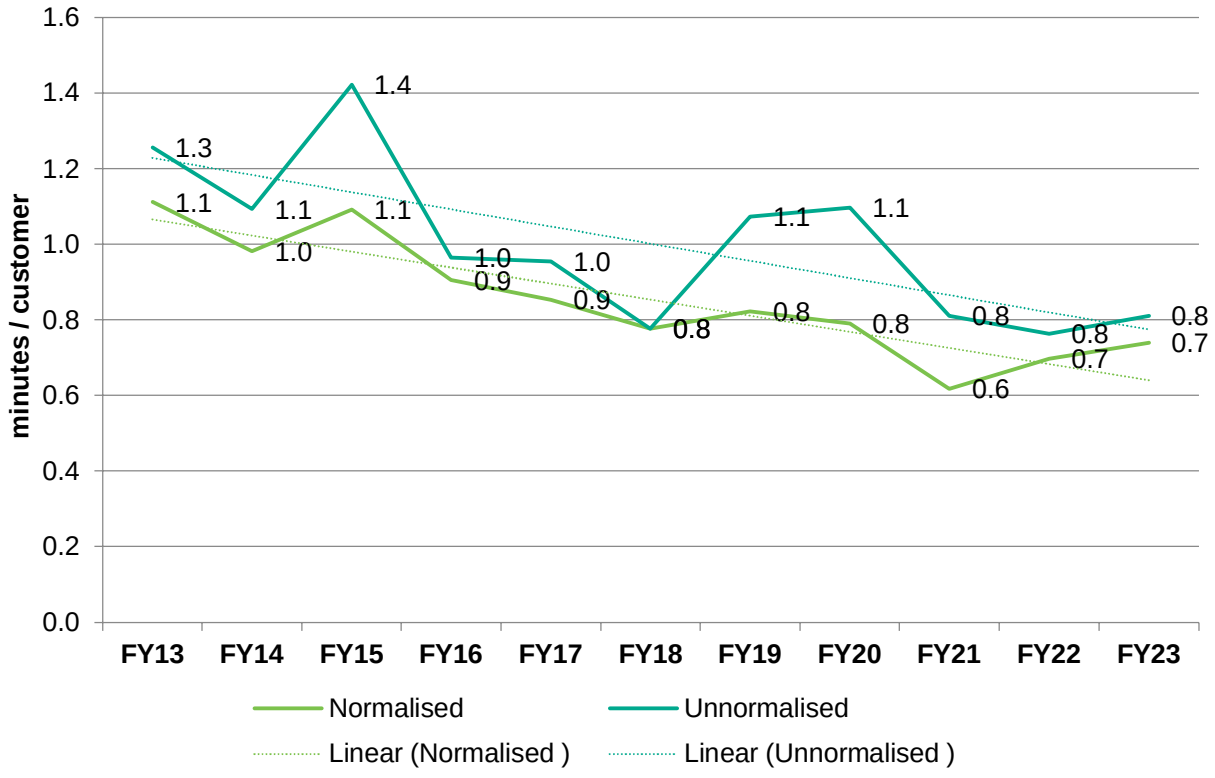


Figure 6: Organisational SAIFI Trend (Total and AER Normalised)



Endeavour Energy's AER normalised and unnormalised SAIFI performance exhibits a stable and improving trend in recent years. Normalised SAIDI has been overall stable, however unnormalised SAIDI has seen a deterioration in performance.

5.1.1 Trends in Reliability Target Performance

The NSW Minister for Energy first imposed licence conditions for the distribution network service providers on 1 August 2005 covering design planning standards, reliability, individual feeder and customer service standards. The conditions were designed to give guidance to the distributors regarding the performance levels expected by the NSW Government.

The current licence conditions were imposed on 7 July 2017, with a minister's variation in February 2019 and September 2022, taking effect in September 2023. Table 3 provides the reliability performance information required by licence conditions 7.3 including:

- Performance against the SAIDI average standards and SAIFI average standards by feeder type, disregarding excluded interruptions; and
- Reasons for any non-compliance by the licence holder with the reliability standards and plans to improve performance.

The data listed in Table 3 is the 'normalised' data set i.e. the overall data with 'excluded' interruptions deducted. 'Excluded' interruptions are defined in Schedule 4 of the licence conditions and are primarily outages of less than three-minute duration or outages caused by directed load shedding, planned maintenance, failure of the shared transmission system or 'major event day' outages.

Table 3: FY23 Annual Network Reliability Performance

		Whole Network and Feeder Category				
		Network *	**CBD +**	**Urban**	**Rural Short**	**Rural Long**
Customer numbers (Average over Year-to-Date)		1,116,269	N/A	769,904	346,071	294
SAIDI	Actual	83.69		60.1	135.5	N/A
	Standard from Licence Conditions	N/A		80	300	
SAIFI	Actual	0.74		0.6	1.1	
	Standard from Licence Conditions	N/A		1.2	2.8	

* Refers to the average performance of the Endeavour Energy's network overall. This measure does not form part of the licence conditions but is needed to calculate the overall NSW result.

+ The definition of a "CBD" area is a formal technical definition in the Reliability and Performance Standards against which Endeavour Energy is required to report. Key commerce centres at Parramatta, Liverpool, and Penrith which are supplied by Endeavour Energy do not fall into the official "CBD" category and hence there are no statistics against this category.

5.2 Quality of Supply

Quality of supply refers to the performance of the network in terms of steady state voltage, sags and swells, voltage unbalance, harmonic distortion, and rapid voltage variation (or flicker).

The quality of supply performance of the network is impacted primarily by the characteristics of customer loads as well as by network events and by the configuration and operation of the network. In recent years steady state voltage has become the most pressing and challenging quality of supply parameter to manage due to the increased adoption of DER, particularly solar PV, which causes reverse power flows in many parts of the network.

Harmonic distortion and rapid voltage variation (or flicker) is managed through detailed assessments of significant customer load applications, particularly commercial/industrial loads and other high voltage customers are formally assessed and provided power quality allocations in accordance with the NER, relevant Australian Standards and ENA Guidelines.

5.2.1 Quality of Supply Standards

Endeavour Energy's adopts limits for power quality parameters as per the planning levels in the AS/NZ61000 series of standards as referred to in the national electricity rules. Emissions allocations are provided to larger customers on a site-specific basis upon receipt of a connection application.

5.2.2 Quality of Supply Compliance

Steady State Voltage

Endeavour Energy has increased its access to power quality data from customer smart meters significantly in recent years. This data is available from Meter Data Providers under commercial terms.

This smart meter data is being processed by an Analytics platform to automatically track and calculate compliance to the steady state voltage limits per AS61000.3.100. Under this standard, a network is determined to be compliant if less than 5% of customers are outside of the steady state voltage limits.

6.0 Demand Forecasts For The Forward Planning Period

The Endeavour Energy transmission and zone substation peak demand forecasts are provided in the DAPR Mapping Portal https://dapr.endeavourenergy.com.au, covering the peak demand forecast by season for the 2022 – 2026 period. The peak demand forecasts provide Endeavour Energy with the basis for identifying network limitations and commencing the RIT-D process to identify and evaluate the credible network and non-network options to address those limitations. They are also informed by longer term area plan forecasts that outline investment needs to service new development areas that are primarily 'greenfield' in nature.

Growth in customers connecting to our network is a key driver of network related capital investment. In the previous decade the growth in demand was fundamentally driven by an increase in residential, commercial and industrial development areas within the priority growth areas of Western Sydney and the Illawarra.

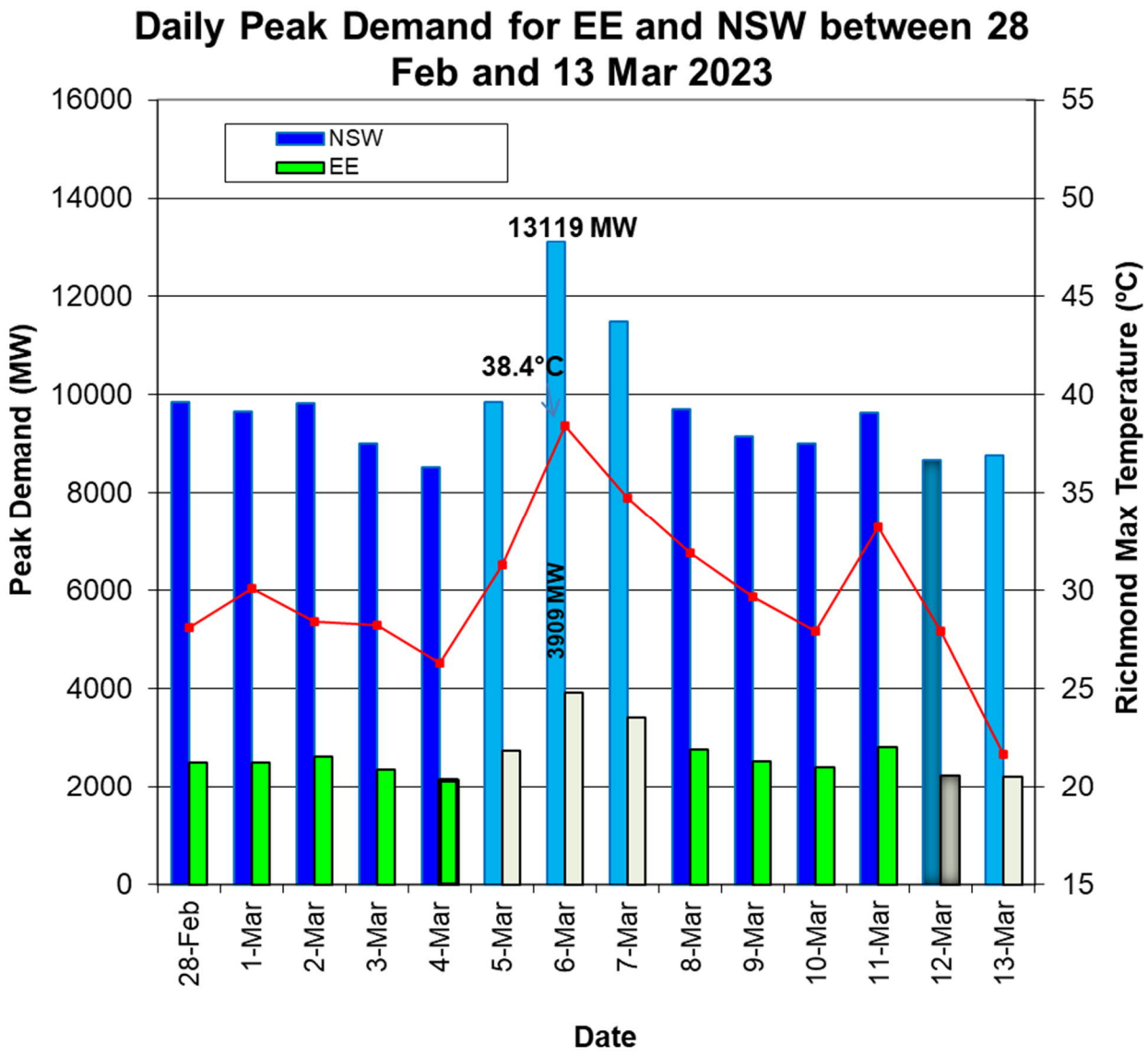
In recent years the penetration of air-conditioning appears to have reached saturation point in some areas of our network, particularly for the residential sector. As a consequence, peak demand growth from existing connections no longer presents a significant driver of network expenditure. Furthermore, demand in recent years has seen a decline due to the effect of energy efficiency measures, the roll-out of roof-mounted photovoltaic systems and reductions in the demand from large industrial customers. It is further expected the energy efficiency measures and the installation of photovoltaic systems, coupled with the forecast increase in battery installations, will continue to influence a reduction in demand over the forecast horizon for established areas. However, the rate of adoption of electric vehicles in the medium term will change the demand profile for the residential sector and could lead to growth in peak demand again.

Strong demand for housing has precipitated the establishment of further priority growth areas, as well as underpinned increasing densification in existing areas around transportation hubs such as the North West and South West Rail Corridors. Furthermore, the establishment of Western Sydney Airport and the unlocking of substantial tracts of employment lands around it has created strong growth in the commercial industrial sector as well. Endeavour Energy is experiencing strong demand for advanced facilities, that are highly electrified, and require higher capacity solutions than what is historically been observed. Strong economic growth is expected in the growth centres over the forecast period, with a series of major transport, health and education projects planned for the region.

The Endeavour Energy Network aggregate demand for the 2022/23 (2023) summer peaked at 3,909 MW at 17:45 on Monday 6th March 2023 corresponding to a temperature of 36.8°C at the same time. The maximum temperature recorded at North Richmond was 38.9°C on Sunday 19 March 2023 and peak demand on this day was 3,479 MW.

Figure 7 shows the time series of the daily maximum temperatures at Richmond and the peak demands on the Endeavour Energy network and NSW during the 2023 summer peak demand period.

Figure 7: Daily Peak Demand for Endeavour Energy and NSW Between 28 Feb 2023 and 13 Mar 2023



Note: Peak demand during non-working days are shown in lighter colours.

6.1 Forecasting Methodology

Peak demand forecasts for proposed assets are derived from longer term area plan forecasts that underpin future asset requirements and associated capital expenditure. These area plan forecasts take into consideration expected land use and associated power density metrics. For residential subdivisions, this takes for form of projected after density maximum demand (ADMD) values by dwelling type; and for commercial and industrial subdivisions this takes the form of power density values such as Volt-Amperes (VA) per square metre varied by expected land use. These forecasts then feed into the network peak demand forecasts where assets are expected to be commissioned within the network demand forecasting period.

For existing assets, Network Peak demand forecasts are prepared for both the summer and winter season. Summer is defined as the five-month period between November and March while winter consists of the four-month period from May to August. The forecast method is based on a bottom-up approach and provides maximum MVA, MW and MVAr loads and the power factor expected for the summer and winter peak periods.

The forecasts are prepared for each zone substation and major customer substation, each transmission substation and TransGrid's Bulk Supply Points (BSP) that supply the Endeavour Energy network. The aggregate Endeavour Energy network peak demand is also forecast.

The forecasts consider planned load transfers, expected spot loads, land release developments and re-developments in the area under consideration. Loads supplied by generation embedded in the network are also incorporated into the calculation of the maximum demand forecasts.

Historical and forecast peak demands at the Endeavour Energy total, bulk supply point, transmission substation and zone substation levels are corrected to normalised figures that represent a specific weather condition. Temperature Corrected Maximum Demand (TCMD) is the estimate of the likely peak demand that could be expected in the reference conditions with 10% and 50% Probability of Exceedance (PoE).

Weather correction is applied to the peak demands at substations where there is a strong relationship between demand and temperature. Summer demands at zone substations in the Blue Mountains and demands of all high voltage customers are not subject to any weather normalisation. However, the Blue Mountains substations are subject to weather normalisation for winter peak demands.

A weather normalisation methodology based on a simulation approach is used to normalise peak demand forecasts for Endeavour Energy's network area. Two reference weather stations are employed for temperature correction of the maximum demand for summer. A weather station at Nowra is used for the South Coast area which covers the Dapto BSP Region and the Richmond weather station is used for the remainder of the network. The temperature correction method utilises two steps:

- Development and updating of a regression model for estimating the relationship between demand, weather and periodic pattern (calendar effects) of demand; and
- Simulation of the demand using multi-years of historical weather data to produce 10% and 50% normalised demand values.

For the summer peak, the regression model uses the most recent six years of daily maximum demand and temperature values to determine the relationship between demand, weather and periodic patterns of demand. Various input parameters are employed in the model. Day-of-the-week variables account for the difference between the daily peak by day of the week and by workday/non-workday. A set of holiday variables are included to describe the load reductions associated with holiday periods. Separate variables are used for special days such as: New Year's Day, Australia Day, and Christmas Day. In addition, a school holiday variable captures the reduced loads which occur in residential Western Sydney during the school holiday period in December and January and the commensurate increase in demand seen in some south coast zone substations during the same period. Monthly and bi-monthly variables capture the key seasonal demand variations. Year variables describe the changes in base load level for each year. Previous hot day effect variables are also included to explain the impacts of successive hot days on the daily peak demand.

From the regression model, daily demands are estimated using 24 years of daily weather data available from the reference weather stations. Annual seasonal maximum demands are derived from the calculated daily demands. The 10% and 50% demand values are computed from the distribution of annual seasonal maximum demands to give the 10% and 50% PoE TCMD values. The TCMD values for the latest year are the starting points for the peak demand forecasts.

The peak demand forecast considers the growth or decline from the existing customers as well as the new customer connections. The forecasting process has two major steps:

- Incorporating the network planner's inputs into the base level forecast.

The inputs include new developments planned to occur (lot releases), new load increases expected from customer applications (spot loads) and information regarding the transfer of load between zone or sub-transmission substations (load transfers).

- Applying post model adjustments (PMA).

PMAs are applied to each year of the forecast for each zone substation based on the zone substation's residential, commercial and industrial customer mix and its peak demand for the season. PMAs are designed and used to capture future changes in the peak demand resulting from solar generation, battery energy storage, electric vehicles and from different state and national energy policies/programs, such as the Minimum Energy Performance Standards (MEPS), NSW Energy Savings Scheme (ESS) and changes to the building code.

The final forecasts for all zone substations are reviewed for consistency with expected demand growth based on local knowledge of load transfers, embedded generation, proposed spot-loads and lot release information.

The forecast at transmission substations and bulk supply points is based on the rolled-up zone substation forecast and calculated using the corresponding historical diversity factors.

The diversity factor is considered to be the ratio between the summation of the individual peak demands of the lower level substations and compared to the measured peak demand of the higher-level substation for the same period.

6.2 Forecast Input Information Sources

For proposed assets, development precinct data is sourced from the Department of Planning & Environment, the Housing Industry Association, connection applications and enquiries received by Endeavour Energy and direct discussions with developers.

For existing assets, demand and temperature data is sourced from Endeavour Energy's Historian and Timescale databases. Data from the SCADA system is used as a substitute where gaps exist in the available metering data in Historian and Timescale. Where neither metering nor SCADA station data is available, the measured current flow readings from the current transformers on individual circuit breakers from SCADA

are used.

6.3 Assumptions Applied to Forecasts

The following probability of exceedance (PoE) parameters have been adopted:

- 1 in 10-year event (corresponding to 10% PoE); and
- 1 in 2-year event (corresponding to 50% PoE).

A 10% PoE figure is estimated to be exceeded once in every ten seasons on average whilst a 50% PoE figure is likely to be exceeded every two years on average.

The installed and firm capacity of each substation and the capacity of the sub-transmission system are shown in the forecast tables are indicated by a single figure. This figure is the summer rating for the sub-transmission system and each substation.

The determination of the load transfer capability for each substation involves the analysis of individual distribution feeders and their ability to carry additional load after network switching occurs. Consequently, this is only performed for substations that are experiencing limitations and may need to be offloaded. The analysis involves determining the load that could potentially be transferred away from the constrained network on a permanent basis.

6.4 Demand Forecast

The capacity, forecast demand and any network limitation on each of the transmission and zone substations on the Endeavour Energy network and on the associated sub-transmission networks are listed in the DAPR Mapping Portal https://dapr.endeavourenergy.com.au. The RIT-D level identified network needs are summarised in Table 5 and Table 6 in the DAPR report.

Limitations are referenced to the design level of supply security at each substation. In general Endeavour Energy assesses its network capability on the basis of providing an "N-1" level of supply security at the sub-transmission and zone-substation level, however small or temporary substations may operate in a non-secure manner and these are marked as limited to N. Generally, these have maximum demands of less than 10 MVA. This approach serves to identify preferred future network development options should future limitations be unable to be mitigated through Demand Management initiatives. The actual investment timing is confirmed through a probabilistic assessment of the network risk and the optimisation of the economic benefits of any proposed development.

The substation total (installed) capacity is the maximum load able to be carried by the substation with all elements in service. The secure capacity of a substation is the capacity with one major element (such as a power transformer or sub-transmission feeder) out of service. This is often referred to as its "Firm" or N-1 rating.

Transmission substations are considered to be constrained when the load exceeds the secure capacity. Suburban zone substations are considered to be constrained when the demand exceeds the firm capacity which is the trigger point for commencing investigations for cost-effective options to address the limitation. The exception are substations whose rating is limited by underground feeders or where exceeding secure capacity will result in the thermal rating of apparatus being exceeded in its normal configuration. In these situations, the load may not exceed the secure capacity of the substation for any period of time.

The voltage levels of Endeavour Energy's sub-transmission substations (termed 'Transmission substations') are nominally 132kV on the primary and either 66kV or 33kV on the secondary. The voltage levels of Endeavour Energy zone substations are nominally 132kV, 66kV or 33kV on the primary and 22kV or 11kV on the secondary.

The forecast is prepared following the end of each peak season. The zone substation rating changes have only been included where the associated project(s) which are influencing the rating have been given approval and are committed at the date of preparation of the forecast.

The forecast power factor readings correspond to the power factor at time of peak load. A dash in this field indicates that the particular transformer was either not commissioned at the time of measurement or is normally unloaded.

Forecast demands for the sub-transmission feeder network are based on its 'N' rating, summer or winter, and the 'N-1' loading, that is, the worst condition load that would appear on the feeder with an adjacent feeder out of service compared to the thermal rating of the smallest conductor or cable on that feeder.

The '95% Peak Load Exceeded (hours)' figure in the Transformer Rating and Substation Details table represents the number of hours the load is above the 95% level of actual peak demand. It is an indication of how peaky the load profile is which is important for designing an effective non-network option.

The 'Actual (MVA)' figure that appears in the summer and winter demand forecast tables is not temperature corrected. It is the actual recorded load. The forecast loads are based on temperature corrected actuals.

The 'Embedded Generation' figure that appears in the Transformer Rating and Substation Details table provides the estimated aggregate level of embedded generation connection to the network supplied from that substation. It includes residential and commercial PV and customer generation. Customer details are withheld for privacy reasons.

The summer 2023 refers to the 2022/23 summer.

The transmission-distribution connection points are termed Bulk Supply Points (BSP) and are owned by Transgrid, the NSW transmission company.

Endeavour Energy evaluates the capability of its sub-transmission network on the basis of load flows modelling different contingencies and network operating configurations. The sub-transmission forecast tables in this document are desktop estimates derived from zone substation load forecasts and are based on an assumed operating configuration and on the present-day network. The loads presented are indicative of the load on the stated feeder in the event of the most likely contingency. Hence, the sub-transmission forecast tables should therefore be treated as indicative loading data in the event of a credible contingency event.

6.5 Analysis and Explanation of Forecast Changes

There have been significant changes occurring within the customer groups that has an effect on demand on the network and the demand forecast. These include:

- An increase in areas prioritised for development by the NSW government. This is reflected in our Growth Servicing Strategy.
- The Western Sydney Aerotropolis showing increased load growth from 2023 onwards.
- continuing focus on redevelopment of existing areas especially along rail corridors; and
- A number of large customer applications and connections in the Western Sydney area, particularly data centres, which has dramatically increased demand forecasts in this area.

Certain areas in the priority growth areas have accelerated their lot release projections as well as densities resulting in increased levels of demand growth. However, all lot release projections are diversified to account for the lag in housing development.

There has been unprecedented and significant rezoning of employment lands, particularly in and around the aerotropolis precinct which needs to be closely monitored together with the electrification plans for commercial vehicle fleets and growth in artificial intelligence infrastructure hosted by data centres.

7.0 Planning Coordination

7.1 Joint Planning with TransGrid

Endeavour Energy and TransGrid have a formal joint planning charter between the two companies. The joint planning working group is overseen by an executive steering committee.

Joint planning is carried with TransGrid on a biannual basis or as required. Agreed actions are minuted and action plans developed by each company as required.

Areas where network limitations and/or network developments affect the electricity networks of Endeavour Energy jointly with TransGrid are discussed below.

7.1.1 Process and Methodology

Endeavour Energy confers with TransGrid on technical matters relating to Endeavour Energy's connections with TransGrid at bulk supply points (TransGrid connection points). These matters include:

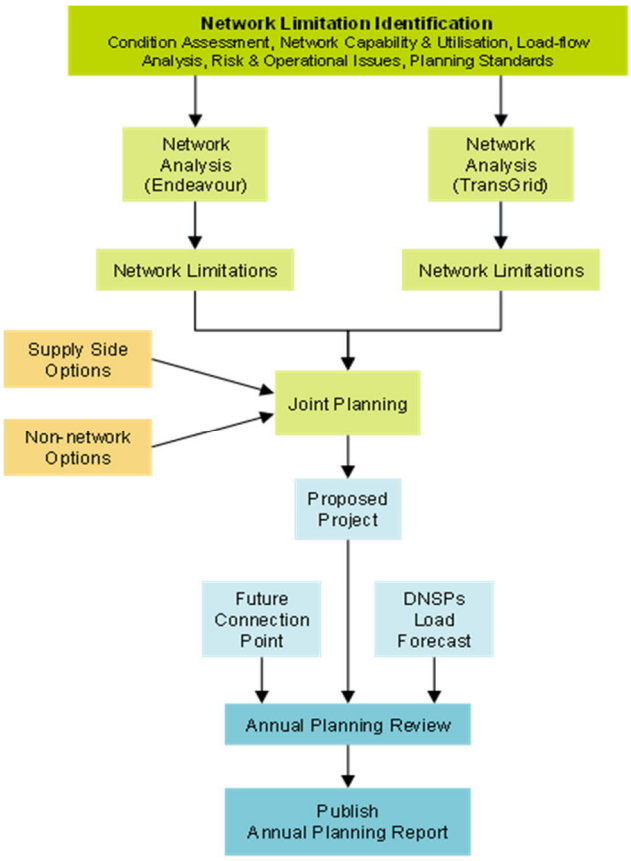
- Forecast loads for all BSPs supplying Endeavour Energy's network;
- Supply capability at all BSPs supplying Endeavour Energy's network;
- Exchange of system modelling data;
- Coordination of loading requirements on individual BSPs and across other BSPs;
- New BSP requirements and connection arrangements;
- Coordination of communication, protection and control requirements; and
- Coordination of other operational requirements.

Clause 5.14.1 of the NER sets out the planning process and consultation requirements and includes requirements on forecasting, annual reviews, regulatory tests and consultations. The principal inputs to the planning process are:

- DNSP supply point load forecasts;
- Review of network capacity and utilisation;
- Planning criteria and indicators;
- Condition, operational and risk assessments;
- Transmission network load-flow analysis; and
- TransGrid planning reviews.

The relationship between the various elements in the planning process is shown in Figure 8.

Figure 8: Joint planning process with TransGrid



Note that Endeavour Energy does not have any assets that are classed as “dual function assets” under the NER.

7.1.2 Overview of Bulk Supply Investments

7.1.2.1 Vineyard 132kV Switchbay (Box Hill Supply)

A project requiring a switchbay at Vineyard Bulk Supply Point for supply to Box Hill is under way.

7.1.2.3 Macarthur 66kV Switchbay (Mt Gilead Supply)

A 66kV switchbay will be required at Macarthur Bulk Supply Point to supply the proposed Mt Gilead Zone Substation by 2028. The project is development driven.

7.1.2.7 Macarthur 66kV BSP Augment

A second 330/66kV transformer at Macarthur Bulk Supply Point has now been installed.

7.1.2.8 Macarthur 132kV BSP Augment

Joint Planning has determined that Macarthur BSP will require a second 330/132kV transformer to address emerging constraints in the supply region between Macarthur and Sydney West. As the certainty of forecast loads in the area matures the firm need dates of this augment will be established. Current timing of this investment is 2025 and is subject to further joint planning and regulatory investment test.

7.1.2.9 Sydney West BSP Augment

The current levels of applications for large spot loads and commercial and industrial growth in the Sydney West supply area requires augmentation of Sydney West by 2027.

Sydney West BSP along with Macarthur BSP provides initial capacity into the rapidly expanding Aerotropolis area. Long term area forecasts for the region lie between 700 and 1100 MVA of new load not including data centres. Considering a high growth scenario with one significant future data centre campus, the anticipated ultimate load for the new Aerotropolis area could be as high as 1360 MVA.

Sydney West BSP is currently forecast to exceed firm capacity beyond 2026 and exhaust installed capacity by 2029.

Joint planning with Transgrid, and options analysis being undertaken by Transgrid indicate that the installation of a sixth 330kV/132kV transformer at Sydney West is likely to be the preferred network option to alleviate forecast constraints at Sydney West. The 6th transformer may also introduce fault level constraints which will need to be managed (most likely through operational configuration).

Further relief for Sydney West BSP is expected to be provided via a project to establish the Kemps Creek Bulk Supply Point.

7.1.2.10 Bulk Supply Point for Western Sydney Priority Growth Area at Kemps Creek

As indicated in the section for Sydney West BSP augment, augmentation of both Sydney West BSP and Macarthur BSP provides for a staged response to the rapidly growing Aerotropolis region in the short term, although it does see the exhaustion of the land provisioned at these sites.

To provide long term energy security to our customers, new investment will be jointly required by Transgrid and Endeavour to continue to provide capacity for growth of the Aerotropolis region as well as historical catchments of Sydney West and Macarthur BSPs.

Joint Planning has determined that a new bulk supply point will need to be established at TransGrid's Kemps Creek 500/330 kV substation by 2031 according to current predictions under a central growth scenario.

Transgrid and Endeavour conducted a number of special joint planning meetings during 2023, with a view to commencing the Regulatory Investment Test process in 2024.

7.1.2.11 Other Future Investments

Discussions are continuing with TransGrid in relation to:

- Managing Voltage, Power Factor and reverse power flows in relation to minimum demand at a number of connection points, notably Vineyard and Macarthur.
- Joint Planning investigations with TransGrid to recommence the deferred Tomerong Bulk Supply point project due to emerging constraints in the South Coast supply network have been put on hold as there are emerging requirements associated with the Illawarra Renewable Energy Zone and significant generation enquiries for the area.
- Joint Planning discussions have been initiated with TransGrid to investigate the feasibility of establishing a Bulk Supply Point at Appin and alternative options for address emerging constraints in Endeavour Energy's 66kV network in the area arising from a need to service substantial new residential developments.
- Protection changes required at TransGrid substations in relation to new zone substations that Endeavour Energy will be commissioning within between Sydney West and Macarthur connection changes.

7.2 Joint Planning with Other DNSPs

Joint planning between Endeavour Energy and Ausgrid and Endeavour Energy and Essential Energy follow the same principles as applied to the joint planning process with TransGrid. However, due to the limited

number of dependencies between the companies' networks, joint planning meetings are generally conducted on a needs basis.

7.2.1 Process and Methodology

Formal joint planning meetings between the planning groups of the companies form the basis of the joint planning process as per the planning process with TransGrid.

7.2.2 Joint DNSP Planning Completed in Preceding Year

Endeavour Energy did not conduct formal joint planning meetings with Ausgrid during the year. A project to connect two of Ausgrid's zone substations to Endeavour Energy's Camellia sub-transmission substation is underway with two of the four 33kV connections now commissioned.

Endeavour Energy did not conduct joint planning meetings with Essential Energy during the year.

Endeavour Energy did not conduct formal joint planning meetings with Sydney Trains during the year.

7.2.3 Planned DNSP Joint Network Investments

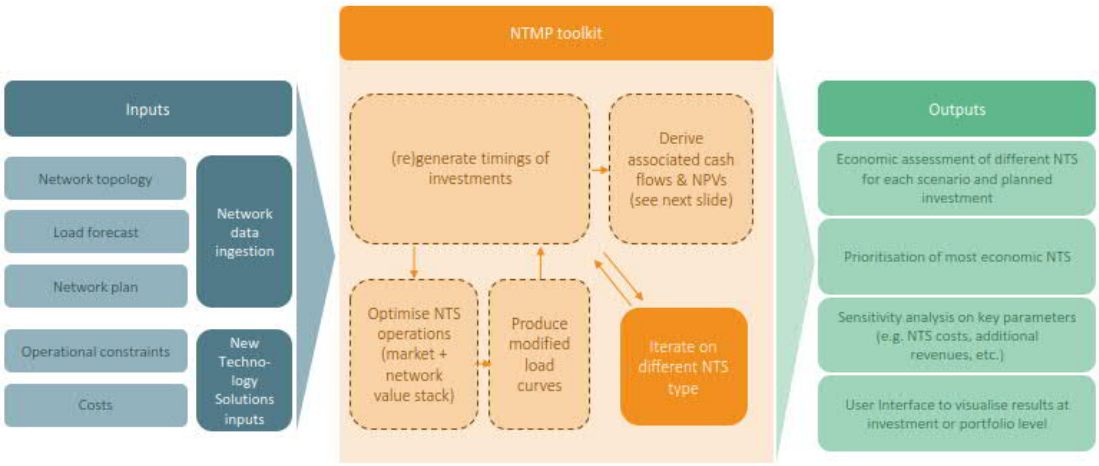
There is currently a project to supply Ausgrid's Auburn and Lidcombe zone substations from Endeavour Energy's Camellia Transmission Substation.

7.3 Consideration of Non Network Alternatives in the Planning Process

Endeavour Energy considers non-network alternatives as an integrated part of network planning. When considering network investments in meeting demand growth, new connections or asset replacement, non-network alternatives are considered to identify opportunities to defer or avoid network investment.

Endeavour screens potential network investments for non-network and new technology solutions to identify and evaluate credible solutions.

Figure 9: New Technology Master Plan Input and Output Model



The NTMP tool allows us to assess network support options such as embedded generation, virtual power plants, grid-scale batteries, commercial customer direct load control and residential behavioural demand response.

This tool integrates existing network data and enables the efficient exploration of the net-benefits of various non-network solutions at a pre-feasibility stage, considering the various uncertainties and sensitivities.

The NTMP tool furnishes Endeavour Energy with the knowledge and business capabilities that will allow for the effective identification of new technology options as potential non-network alternatives.

The NER requires DNSPs to investigate non-network options by utilising a consultation process as part of the planning for major network investments. This is the RIT-D process shown in Figure 10.

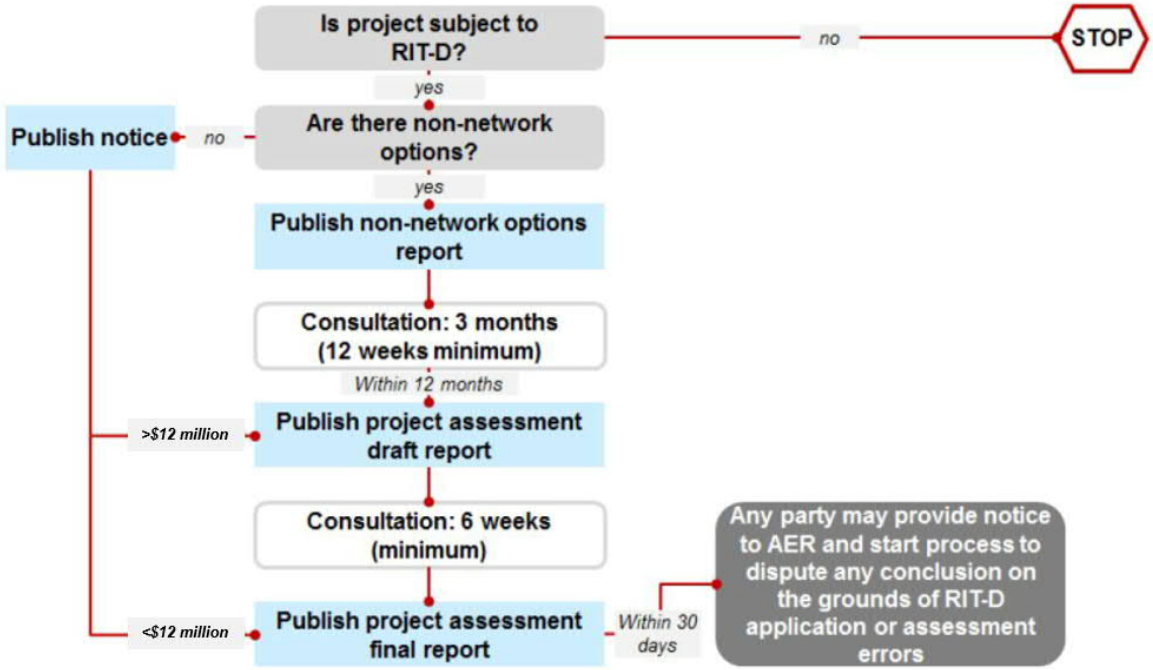
This provides the opportunity for all interested parties and the community to submit options, ideas and comments allowing for the development of cost effective demand management and support non-network alternative options.

Our RIT-D non-network option investigation process is comprised of the following stages:

- A planning review to identify the emerging network constraints and credible network options;
- Screening for non-network options supported by the use of our New Technology Master Plan tool;
- Publish a Non-Network Options Report as part of a market consultation process to obtain proposals for alternative options from interested parties where a demand management approach is determined to be feasible;
- Evaluation of submissions to identify cost-effective credible non-network options;
- Evaluation of all credible options (network and non-network) to identify the most cost-effective option or combination of options; and
- Negotiations with proponents of the successful proposal to implement the program if a non-network option is identified as the most cost-effective option.

All parties registered on Endeavour Energy's register of interested parties are notified when a RIT-D document is published.

Figure 10: Regulatory RIT-D Process



8.0 Identified Network Needs

Identifying network needs is a key element of the network planning process through:

- Network analysis using the latest demand forecasts to identify emerging network capacity or supply security limitations; and
- Asset condition or performance assessments to identify assets approaching their end-of-life.

Network needs that have been identified as being subject to the RIT-D process are outlined in Table 5 and Table 6 and given in Section 8.2. These are within the 5-year planning horizon.

Projects that do not meet the RIT-D criteria and that will be investigated for non-network options are listed in Table 8.

Future network needs that are beyond the 5-year planning horizon have also been identified and presented below. These future network needs are dependent upon demand growth and progress in proposed developments prior to any commitment to network investment. Future network needs are listed in Table 10.

8.1 Definition of terms used in Network Needs

Table 4 below provides definitions of the terms used in the Identified System Limitations tables in Sections 8.2, 8.3 and 8.4.

Table 4: Terms Used in Identified Network Needs

Term	Definition
Critical Season	The season of most critical peak demand (summer or winter) in terms of network limitation.
Existing Capacity (firm)	The firm capacity that the network element can supply with one element of redundancy available. In the case of the 11kV network it is the firm capacity whilst preserving the appropriate level of backup.
Demand Forecast	The next year forecast of peak demand for the most critical season.
Capacity Limitation Rating Reached	Indicates that the load at risk has reached unacceptable limits being either cyclic or emergency rating exceeded or the expected energy at risk is above acceptable limits in the next following year.
Limitation Date	Indicates when both the firm rating of the network supplying the load (F) and its corresponding capacity limitation rating (C) is exceeded.
RIT-D Start Date	The year in which Endeavour Energy anticipates options investigation to commence. RIT-D start is timed to meet capacity limitations.
Load Transfer Potential	The load in MVA that could potentially be transferred away from the constrained network, through the existing network, on a permanent basis. This analysis is performed for constrained assets only.
Required Load Reduction	The required level of load reduction to achieve a one-year deferral of the network limitation.
Potential Solutions	The currently identified credible options to resolve the network limitation including network and non-network solutions (subject to public consultation or a feasibility review).
Asset Retirement	The removal of an asset from service due to the asset reaching its end of life or a condition where the asset can no longer service the network due to performance or safety risks.

8.2 RIT-D Investigations

This section presents the RIT-D augmentation and replacement projects in the 5-year planning horizon that Endeavour Energy will investigate. Endeavour Energy reviews its network needs at least annually and the dates shown may be adjusted from year to year as the underlying customer demand and network need change over time.

Listed in Table 5 are the identified augmentation RIT-D projects and Table 6 details the retirement or replacement RIT-D Projects. The Endeavour Energy project identification number has been included to allow matching to our other regulatory reporting. Identified needs based on place names may change over time and place names are determined by other statutory authorities.

Table 5: Identified Network Need – Augmentation RIT-D Projects

RIT-D Project Name	Critical Season	Existing Capacity (firm) (MVA)	2023/24 Demand Forecast (MVA)	Capacity Limitation Rating Reached	Limitation Date	RIT-D Start Date	Load Transfer Potential (MVA)	Required Demand Reduction (MVA)	Potential Solutions
Southern Macarthur NPR-000002	S	60.0	97.0	Yes	(F) Nov 22 (C) Nov 25	Dec 2023	0	37.0	1.New Feeder 2. NNO
Moreton Park NPR-000061	S	6.0	6.0	No	(F) Nov 24 (C) Nov 26	Jul 2024	0	10.0	1.New ZS 2. NNO
East Riverstone NPR-000048	S	70.0	75.4	Yes	(F) Nov 23 (C) Nov 26	Jul 2024	0	10.0	1.New ZS 2. NNO
West Appin NPR-000069	S	5.0	7.4	Yes	(F) Nov 23 (C) Nov 26	Jul 2024	0	10.0	1.New ZS 2. NNO
Lowes Creek NPR-000044	S	45.0	51.7	Yes	(F) Nov 24 (C) Nov 28	Jul 2025	0	10.0	1.New ZS 2. NNO
Box Hill Augmentation NPR-000070	S	36.0	17.4	No	(F) Nov 28 (C) Nov 28	Jul 2025	0	10.0	1.Augment ZS 2. NNO
Mt Gilead NPR-000049	S	8.0	4.2	No	(F) Nov 26 (C) Nov 27	Jul 2025	0	10.0	1.New ZS 2. NNO
Austral NPR-000053	S	50.0	59.8	Yes	(F) Nov 27 (C) Nov 28	Jul 2026	0	10.0	1.New ZS 2. NNO
Parramatta 132kV capacity constraints NPR-000533	S	93.0	72.0	No	(F) Nov 26 (C) Nov 28	Jul 2026	0	30.0	1.New Feeder 2. NNO
West Dapto NPR-000013	S	11.0	8.0	No	(F) Nov 27 (C) Nov 28	Jul 2027	0	10.0	1.New ZS 2. NNO
North Kemps Creek NPR-000805	S	90.0	78.4	No	(F) Nov 26 (C) Nov 29	Jul 2028	0	10.0	1.New ZS 2. NNO
North Agribusiness NPR-000068	S	45.0	5.8	No	(F) Nov 29 (C) Nov 29	Jul 2028	0	10.0	1.New ZS 2. NNO

Table 6: Identified Network Need – Retirement or Replacement projects

RIT-D Project Name	Existing Capacity (firm) (MVA)	2023/24 Demand Forecast (MVA)	Retirement or Replacement Date	RIT-D Start Date	Retirement or Replacement Details
Parramatta area 132kV oil insulated cables	NA	NA	2029	Jul 2026	End of life of multiple aged oil filled cables 9J8, 22U, 22W, 226, 228 and 233.

Table 7 provides the RIT-D process timetable for each proposed project. Additional details for these RIT-D projects are provided in the DAPR Mapping Portal https://dapr.endeavourenergy.com.au.

Details are provided for each identified project including the constraint and the time frame over which a non-network investigation and program implementation would be expected to operate to successfully address the constraint.

If a screening test identifies that a non-network option is feasible then Endeavour Energy will issue a Non-Network Options Report. All registered participants on Endeavour Energy's register of interested parties will be notified of the release of the document.

If a screening test identifies that non-network options are not feasible, Endeavour Energy will publish a notice of the screening result on its website and all registered participants will be notified.

Table 7: RIT-D Projects Timetable

RIT-D Project Name	Constraint or Network Need	Timetable		Constraint
RIT-D Augmentation Projects				
Southern Macarthur NPR-000002	66kV supply capacity constraints in the Southern Macarthur area and unable to supply the growing residential and enterprise demand in the area.	Investigate Results Decision	Dec 2023 Jul 2024 Nov 2024	Dec 2026
Moreton Park NPR-000061	Residential and employment lands with enterprise land use requiring an augmentation to the existing temporary mobile zone substation.	Investigate Results Decision	Jul 2024 Feb 2025 Jun 2025	Nov 2027
East Riverstone NPR-000048	Growth in residential development area in north west Sydney requiring increased supply and connection capacity.	Investigate Results Decision	Jul 2024 Feb 2025 Jun 2025	Nov 2027
West Appin NPR-000069	Increase in residential development in the Appin area requiring increased supply capacity and connection capacity.	Investigate Results Decision	Jul 2024 Feb 2025 Jun 2025	Nov 2027
Lowes Creek NPR-000044	New residential development area in south west Sydney requiring increased supply and connection capacity.	Investigate Results Decision	Jul 2025 Feb 2026 Jun 2026	Nov 2028
Box Hill Augmentation NPR-000070	Growth in the residential development area in addition to enterprise land use requiring augmented supply and connection capacity at the existing substation site.	Investigate Results Decision	Jul 2025 Feb 2026 Jun 2026	Nov 2028
Mt Gilead NPR-000049	New residential development area in south west Sydney requiring increased supply and connection capacity.	Investigate Results Decision	Jul 2025 Feb 2026 Jun 2026	Nov 2028
Austral NPR-000053	New residential development area in south west Sydney requiring increased supply and connection capacity.	Investigate Results Decision	Jul 2026 Feb 2027 Jun 2027	Nov 2029
Parramatta 132kV capacity constraints NPR-000533	Growth in the Parramatta CBD and surrounding areas requiring increased supply at 132kV into the area to support distribution.	Investigate Results Decision	Jul 2026 Feb 2027 Jun 2027	Nov 2029
West Dapto NPR-000013	Growing residential area to the west of Lake Illawarra requiring increased supply capacity.	Investigate Results Decision	Jul 2027 Feb 2028 Jun 2028	Nov 2030
North Kemps Creek NPR-000805	Growth in the enterprise area at North Kemps Creek requiring increased supply and connection capacity.	Investigate Results Decision	Jul 2028 Feb 2029 Jun 2029	Nov 2031

RIT-D Project Name	Constraint or Network Need	Timetable		Constraint
North Agribusiness NPR-000068	Provide supply and connection capacity to the Agribusiness precinct in the Aerotropolis.	Investigate Results Decision	Jul 2028 Feb 2029 Jun 2029	Nov 2031
RIT-D Retirement or Replacement Projects				
Parramatta area 132kV oil insulated cables NTM-000009	End-of-life Replacement of aged oil filled cables supplying parts of the Parramatta area.	Investigate Results Decision	Jul 2026 Feb 2027 Jun 2027	Jun 2029

8.3 Projects That Do Not Meet the RIT-D Criteria

Endeavour Energy also plans to investigate non-network options for some network needs that are below the RIT-D threshold of $6 million these are shown in Table 8.

If a non-network option investigation identifies that a demand management option is feasible for a project below the RIT-D threshold, Endeavour Energy may issue a public tender document to provide interested stakeholders and service providers the opportunity to submit proposals to address the need. All registered participants on Endeavour Energy's register of interested parties will be notified when a tender document is issued.

Table 8: Identified Network Needs – Projects That Do Not Meet The RIT-D Criteria

Project Name	Critical Season	Existing Capacity (firm) (MVA)	2023/24 Demand Forecast (MVA)	Capacity Limitation Rating Reached	Limitation Date	Load Transfer Potential (MVA)	Required Load Reduction (MVA)	Potential Solutions
Eastern Creek Augmentation NPR-000771	S	45.0	36.2	No	(F) Nov 25 (C) Nov 29	0	10.0	1. DM 2. Augment ZS

Table 9: Investigation Timetable – Projects That Do Not Meet The RIT-D Criteria

Project Name	Constraint or Network Need	Timetable		Constraint
Eastern Creek Augmentation NPR-000771	Continuing growth in the Eastern Creek enterprise area will require an increase in supply capacity to the existing Eastern Creek zone substation service area.	Investigate Results Decision	Jun 2027 Mar 2028 Aug 2028	Nov 2029

8.4 Future Network Needs

Endeavour Energy's future network needs presented below are major supply requirements in the 5 to 10 year ahead planning period.

In the early stages of these developments the proposed timing is uncertain, however the estimated constraint date is based on the best available information. These identified future network needs are shown in Table 10.

Table 10: Future Network Needs

Project Name	High Level Description of Network Need	Estimated Constraint Date
Kemps Creek BSP Connection Works NPR-000043	Provide connection of Transgrid's proposed augmentation of their Kemps Creek BSP to the local area and customer base. Likely to provide connection to the Aerotropolis area and the South West Sydney residential growth area.	Jul 2029
Westmead Augmentation NPR-000065	Growth in Westmead area including the hospital, health and allied services precinct and increasing medium and high density residential housing will require and augmentation to existing supply to the area. Likely to require establishment of a new ZS in proximity to the growth areas.	Jun 2031
Catherine Park ZS Augmentation NPR-000054	Growth in residential area requiring augmented supply capacity from the temporary mobile ZS on the site.	Jun 2031
East Parramatta NPR-000451	Growth in the Parramatta CBD and surrounding area requiring augmented supply and connection capacity at the existing switching station site.	Jul 2031
Bringelly ZS Augmentation NPR-000050	Growth in the Aerotropolis Core Precinct requiring augmented supply capacity.	Jul 2031
Bradfield City NPR-00007	Provide supply to the Bradfield City CBD.	Jul 2031
Nepean ZS Augmentation NPR-000055	Growth in the local area requiring augmented supply capacity.	Jul 2032
Cambewarra NPR-000052	Growth in the Bomaderry area requiring increased supply and connection capacity.	Jul 2032
Vineyard BSP Minimum Demand Constraints NPR-000873	Address the minimum demand condition related constraints in relation to power factor and voltage management.	Jul 2032
Collimore Park Liverpool Area NPR-000040	Growth in demand in the Liverpool CBD area will require an increase in supply and connection capacity.	Jul 2032
Tomerong BSP Connection Works NPR-000074	Provide connection of Transgrid's proposed BSP to the local area and customer base.	Nov 2032
South Penrith NPR-000047	Continued growth in the Penrith CBD and surrounding areas from business and residential customers will require increased supply and connection capacity.	Jun 2033

Project Name	High Level Description of Network Need	Estimated Constraint Date
Culburra Beach NPR-000008	Residential land release requiring increased supply and connection capacity.	Jul 2033
East Wollongong NPR-000062	Provide increase in supply capacity to the Wollongong CBD and surrounding areas.	Jul 2033
North Wilton Area NPR-000955	Growth in the residential demand in the North Wilton and Appin areas will require an increase in supply capacity.	Jul 2033
Holsworthy Area NPR-000041	Growth in the residential demand will require increased supply capacity.	Jul 2033
South Gilead NPR-000051	New residential release area in south west Sydney requiring increased supply capacity.	Jun 2035
North Catherine Fields ZS NPR-000046	Growth in residential development in the south west area of Sydney requiring increased supply and connection capacity.	Jun 2035

8.5 Impact on Transmission – Distribution Connection Points

Table 11 details constraints in the network which impact on the capacity of transmission – distribution connection points.

Table 11: Transmission – Distribution Connection Point Constraints

Network Constraint	Constraint Date	Impact on Transmission-Distribution Connection Point
Under certain outage scenarios, TransGrid has modelled voltage issues and possible voltage collapse at Vineyard Bulk Supply Point	2025	Possible voltage collapse at Vineyard BSP for an outage of one TransGrid feeder to Vineyard BSP.
Connection of additional load overloads Feeder 9L1 and Macarthur 330/132KV transformer in contingency situations.	2025	Macarthur 330/132kV transformer will be overloaded.
Connection of major customers and additional load to Sydney West Bulk Supply Point will cause Sydney West BSP to exceed firm capacity in future	2025	Firm capacity at Sydney West exceeded, followed by installed capacity exceeded 3-4 years later.

8.6 Primary Distribution Feeders

For any primary distribution feeders for which Endeavour Energy has prepared forecasts of maximum demands and which are currently experiencing an overload situation, or are forecast to experience an overload within the next two years, Endeavour Energy must set out:

- The location of the primary distribution feeder;
- The extent to which demand exceeds, or is forecast to exceed, 100% of the normal cyclic rating (240A) of the feeder (or a lesser percentage of the cyclic rating of the feeder where maximum utilisation factors are employed), under normal conditions during summer and/or winter periods;
- Endeavour Energy employs a utilisation factor of 80% for the distribution feeder cables exiting a zone substation to allow 20% of the thermal rating of the feeder to be available for transfer of load from an adjacent feeder under first level emergency conditions;
- The types of potential solutions that may address the constraint or forecast constraint; and
- Where an estimated reduction in forecast demand would defer the constraint for a period of 12 months, including:
    - An estimate of the year and month in which the constraint is forecast to occur;
    - A summary of the location of relevant connection points at which the estimated reduction in forecast demand would defer the constraint; and
    - The estimated reduction in demand required to defer the forecast constraint.

Options that are considered for all forecast constraints include:

- Non-network solutions.
- Augmenting the network.
- Rearranging the network by switching and load transfers; and
- Monitoring the situation if the forecast constraint is not significant.

Details of Endeavour Energy's primary distribution feeders which are currently overloaded can be located in the DAPR mapping portal https://dapr.endeavourenergy.com.au.

8.7 Other Factors Impacting Network Needs and Solutions

There are a number of factors that are impacting network needs and solutions that go beyond the traditional and well established business as usual practices of operating the network.

Each of these factors are further discussed below.

8.7.1 The evolving grid within a low carbon economy

Governments, businesses and communities are setting increasingly ambitious emissions reduction targets to limit the impacts of climate change.

This requires fundamental changes to the way we produce and consume energy and changes the nature of the energy system. Our electricity networks will underpin this evolution, and we must keep pace with the change.

In the coming years, our network needs to cater for the growing customer uptake of clean and distributed energy resources such as solar PV, battery storage, and electric vehicles. As our customers take up these technologies they will participate more actively in the energy market and unlock more value from their investments.

Sophisticated digital platforms will increasingly underpin and automate more responsive users, coordinated by energy 'aggregators' such as virtual power plants. These changes form part of the solution to limit the impacts of climate change, and the augmentation of our network must reliably and affordably deliver the capability to balance dynamic, responsive, bi-directional flows.

These new technologies, and the changes to the way our communities will choose to use and share electricity, will change the role of the network. Open, real-time data sharing will become critical to the successful operation of a network, allowing and incentivising customers and third-parties to use their technologies to help balance the system. The network will become a platform of energy trade, and underpin the modern, low carbon way of living.

Below we provide more detail on these new developments and technologies and how each of them impact our network.

8.7.2 Data Centre Developments

There has been a large step increase in the development of data centres within Endeavour Energy's network including western Sydney and also extending to the southern highlands. These data centres require connection to the network and have impacts on the distribution network and upstream into TNSP and electricity generation sectors. The step change in data centre connection requirements and electricity demand is driven by underlying technological developments in cloud computing, streaming services and artificial intelligence and these rapid developments are at a faster pace than the development of many key electricity network components. Many of the proposed data centres are planned to be located in greenfield areas with existing low capacity electricity supply networks that are not capable of supplying large scale data centres. Endeavour Energy is working with data centre proponents and their connection requirements and other key stakeholders including government and agencies to respond to these rapid developments.

8.7.3 Solar Photovoltaic (PV) Generation

The uptake of Solar PV systems by households and businesses on Endeavour Energy's network is forecast to increase rapidly in the coming years. Currently, more than 20% of Endeavour Energy's customers have installed Solar PV systems to supplement their energy requirements. By 2030, this figure is projected to reach 55%.

The changing profile as a result of the high penetration of solar PV creates network wide and localised issues which will need to be addressed. At the network scale, this includes the "duck curve" whereby solar

input reduces the demand for electricity during the day at the same time as growth in electricity use increases night time peaks.

PV systems can also impact the quality of supply. Traditionally, distribution networks were designed to accommodate voltage drops arising from the flow of power in one direction, from the high voltage system through to the low voltage system and connected customers. However, the large volumes of rooftop solar PV connected at customer's premises in some locations results in power flows in the reverse direction from the LV to HV at times of peak solar generation and overall low system demand. This reverse power flow situation is often not predictable and can lead to both voltage rise and voltage drop situations in various parts of the network having to be managed simultaneously to ensure voltage at the customer's premises remains within statutory limits.

8.7.4 Battery Energy Storage Systems

As more variable renewable energy sources feed into the grid, such as solar PV, energy storage will play an increasing and crucial role to balance supply and demand. As costs of battery energy storage technology decline the installation of battery storage is expected to increase rapidly across our network.

Storage will be delivered at the household, local and grid-scale, and will be a vital contributor to the management of seasonal, daily and micro variations in supply and demand. These services can only be delivered via the active participation of customers and third parties, which requires a dynamic and digital capability and necessitates the more central role of the grid.

Household

As the costs of battery storage decline, more customers are choosing to install privately-owned, behind the meter storage systems. In its simplest use, battery storage allows customers to store the solar energy otherwise fed into the grid during the day and consume that energy at night when it is needed.

Grid-scale

There are several energy storage solutions that are becoming increasingly viable at the system level, from Battery Energy Storage Systems to the Seasonal Hydrogen Storage Systems. These technologies enable distributors to more accurately manage the demand and supply of energy across the network.

Aggregation and Virtual Power Plants (VPPs):

Sophisticated digital platforms and energy 'aggregators' (such as VPPs) unlock value for households by accessing wholesale markets. This transforms households into energy market participants, responding to price signals and delivering market services. However, this can create local network capacity issues, as households become orchestrated in their supply and demand from networks

A residential battery energy storage system trial completed in 2019 demonstrated that battery systems provide opportunities for Endeavour Energy to utilise stored energy during critical peak times to defer investment in the augmentation of the network. Several battery systems can be aggregated into a single or multiple virtual power plants (VPP) in order to deliver the network capacity required. The capacity from the VPP can be dispatched using third party aggregation platforms.

8.7.5 Electric Vehicles

Endeavour is closely monitoring the current and projected uptake of electric vehicles and the impact on demand levels across the network both in aggregate and locationally specific to ensure that adequate supply capacity is in place to cater for this major change towards the electrification of transport. The electrification of transport, in many ways, is similar to the rise of air conditioning in the past few decades where the widespread adoption led to the need to cater for this with widespread augmented network supply capacity.

The electrification of transport will have impacts on the distribution network both due to the large demand when the vehicles are being recharged and also for the potential for the batteries in the vehicles to be used to support the electricity network during periods of peak network demand.

Endeavour has assisted the NSW Department of Planning, Industry and Environment in the development of an EV charging infrastructure map to support the objectives laid out in the NSW Electric and Hybrid Vehicle Plan. The objective of the map is to inform the market about potential locations for EV fast charging infrastructure. Preferred locations include those with adequate network capacity for fast charging stations.

Endeavour is a DNSP partner in a large scale electric vehicle trial led by a retailer and funded by the Australian Renewable Energy Agency (ARENA). The trial aims to assess the value of EV charging orchestration using managed smart chargers installed in participants' homes. Two emerging EV orchestration technologies that have significant commercial potential, Vehicle-to-Grid (V2G) and Vehicle Application Programming Interface (API) integration, will also be assessed as part of the trial.

By 2029 there are 200,000 EVs expected in households connected to the Endeavour Energy network, up from 2,000 currently.

EVs are an emerging consumption on the network, and a changing profile of demand. The contribution of 200,000 EVs to peak load increase from 1MW in 2023 to approximately 60MW by 2029. This will result in requests for new connection points and will likely require network augmentations and many local levels.

However, EVs will also represent the opportunity for mobile (battery) storage. The rise in EVs will rapidly enhance the flexibility of consumption and will form a crucial component of the dynamic architecture of the future network. They will become a very useful tool to balance loads, but will require sophisticated, transparent, digital capabilities operating with a proliferation of third-parties to optimise this value.

8.7.6 Demand response and flexible demand

When managing the capacity of the grid, the focus has historically fallen on the energy generators to ensure the supply to the grid matches demand. But with changes in consumer behaviour affecting when, where and how people access the grid, there's a growing opportunity to manage capacity by tackling the demand for energy.

A shift to a more dynamic and transparent tariff regime will further incentivise these behaviours. In a system with abundant, but variable, renewable energy, households and businesses will benefit from the ability to reduce demand or transition to more flexible operations. This is part of the solution to balancing the low carbon, variable energy system.

Demand response is the voluntary reduction or shift in the customer's use of electricity. This is typically achieved by financially incentivising consumers to switch their use of power to off-peak periods to ease the demand on the network.

Flexible load refers to the coordination of electricity consumption used for existing loads. For households this includes water heaters, air-conditioning systems and pool pumps. For business and industry, this includes flexible production which can lower individual production costs and balance loads on the network.

The role of the network is to facilitate the ability of customers to participate in such a way. In this light, the value of the network shifts more in favour of its capacity to allow participation, rather than the electricity demanded. This change requires re-consideration of tariff structures to reflect the alternative value of the network (such as capacity charges).

8.7.7 Large Scale Renewable Energy Generation

Decarbonising Australia's economy will be challenging, involve a variety of alternative fuels developed through multiple different pathways, and approaches will vary within and across industries and use cases based on needs and opportunities. Hydrogen, which is very similar to natural gas and can be produced from renewable electricity, represents one such option.

The NSW Government through its Electricity Infrastructure Roadmap and Hydrogen Strategy is aggressively pursuing the activation of new renewable energy zones to drive decarbonisation of its electricity generation and establishment of a hydrogen industry, for both domestic and export markets. This will drive significantly more variable renewables into the generation mix and may add considerable load to the distribution network.

The scale of electricity generation associated with large-scale hydrogen production dwarfs that of Australia's current demand. NSW is targeting 12GW of renewables to deliver 110,000 tonnes per annum of hydrogen by 2030. It is focusing on production in two key hubs, Illawarra and the Hunter Valley (with Wagga Wagga considered a strategic location mainly for transport).

The wave of renewables will create system challenges, but also new opportunities. Hydrogen may act as a flexible way to lift minimum demand and store excess energy. It may also play a role in decarbonising gas networks, with localised production, storage and potentially generation, supporting grid stability.

However, with the commercial pathway to hydrogen production still some way off, we will need to prepare for scenarios where we see large scale electrification, a hydrogen economy emerge, or something in between.

8.7.8 Microgrids and Stand Alone Power Systems

Microgrids and Stand-Alone Power Systems (SAPS) are essentially a group of localised energy sources and loads that are capable of functioning autonomously in times of need. Thus, they require less or no connection to the traditional electricity network, mitigating the need for new, or significant augmentation or replacement of existing, connections to communities. The transformation of the grid will lead to a more 'compartmentalised' network, with many localised networks functioning like microgrids, and interacting in a broader system.

The increasing value that can be derived from microgrids and SAPS is two fold. Firstly, with the decreasing cost of distributed generation and storage technologies, as well as the increasing costs of providing traditional network connection, SAPS are becoming more commercially feasible. Secondly, and in addition to the potential commercial value, SAPS can avoid the need for long, stringy connections. In the face of increasing extreme weather events, this will reduce the risks to the safety and reliability of the network.

In addition to these two benefits, microgrids can offer communities a chance to help co-design their energy system, specifically creating elements for their unique values and needs.

For Endeavour Energy, microgrids, in particular, present new opportunities to deliver growth and replace assets more affordably, with lower risks. With a huge range of different areas for our network to cover, and that creates many different challenges for both existing locations and newly developing areas, designing and maintaining a network that is safe and reliable, but also makes best use of all locally generated renewable energy is what we are striving to achieve with microgrids.

However, any use of SAPS and microgrids will need to align with the guidance from the AEMC and AER regarding appropriate distributor-led use.

8.7.9 Asset Ratings

Endeavour Energy investigates potential cyclic or emergency rating of assets to identify the actual capacity of the network and to accurately forecast the emergence of constraints. This ensures optimal utilisation of existing network assets and presents opportunities for deferral of investment in augmentation of the network.

8.8 Embedded Generation Connections

Our non-network option consultation process will provide an opportunity for embedded generation proposals to be submitted and considered for each constrained location.

During 2023 we received 708 applications for non-micro embedded generator connections and 38,271 micro embedded generator connection applications. We had an average turnaround time for micro embedded generator applications of less than 1 day.

At the end of 2023, there was a total of 271,980 PV generators connected to Endeavour Energy's network with a total combined capacity of over 1,610 MW.

There were no significant issues recorded as arising from the connection of these generators to Endeavour Energy's network.

Endeavour Energy received fifteen (15) large embedded generation connection applications and enquiries in 2023.

9.0 Network Investments

Endeavour Energy's major network investments follow the RIT-D process and include a screening process to identify feasible non-network options.

This section provides detail on the major network investments evaluated in the previous year.

9.1 Non-network Option Screening activities in the Preceding Year

Endeavour Energy screens all major network investments for non-network options.

9.1.1 Screening for Non-Network Options

Endeavour Energy investigates non-network options as part of planning for major network augmentations and asset replacements. This includes determining whether non-network options will be technically and economically feasible in deferring or avoiding network investments and also to utilise market and public consultation in sourcing possible non-network options.

In support of this determination we have conducted feasibility testing of non-network options using the New Technology Master Plan (NTMP) tool.

When screening for non-network options Endeavour Energy considers the following:

- Any measure or program targeted at reducing peak demand, including:
  - Improvement to or additions of automatic control schemes such as direct load control and air conditioner cycling;
  - Energy efficiency programs that target appliances that contribute to peak demand;
  - The installation of smart meters to accommodate a demand response program;
  - Existing load transfer capacity;
  - Installation of technology capable of reducing peak demand; and
  - Load curtailment, load shifting or demand response
- Increased local or distributed generation/supply options including:
  - Capacity for standby power from existing or new embedded generation;
  - Capacity of micro embedded generation; and
  - Capacity of energy storage systems.

Endeavour Energy understands that credible solutions may include a variety of different measures combined to form one integrated program when determining whether a non-network option could constitute or be part of a credible option.

In determining the feasibility of a non-network option, the analysis focuses on the following areas:

- The ability to address the identified need in terms of the level and timing of demand reduction;
- Commercially feasibility;
- Technical feasibility; and
- Implementation timeframe to meet the network need.

9.1.2 Screening Tests

The network needs and investments screened for non-network options during 2023 are shown in Table 12 below.

Table 12: Screening Test Results

Network Need	Description of Network Need	Screening Test Result	Notice date
Supply to the Berrima Junction enterprise development area.	Provide supply capacity and customer connection capability to support the development of the Berrima Junction enterprise growth area.	Non-network options deemed feasible. Publish Non Network Options Report.	May 2023
Supply to the Burra Park development area.	Provide supply capacity and customer connection capability to support the Burra Park development area.	Non-network options deemed not feasible. Screening Notice published.	November 2023

9.1.3 Screening Test Result Details

The following section summarises the screening test results.

9.1.3.1 Supply to the Berrima Junction Enterprise Area

The Berrima Junction Enterprise Area includes land that is zoned for enterprise land-use on the Southern Highlands. The area is in close proximity to the Hume Highway and is expected to include transport, logistics and light industry customers. Endeavour determined that non-network options may be feasible and a Non Network Options Report was issued which provided the requirements for a non-network option. Proposals for non-network options are being evaluated.

9.1.3.2 Supply to the Burra Park development area

The Burra Park development area is located in the Western Sydney Aerotropolis and in close proximity to the Western Sydney Airport. The area is zoned for enterprise land use and is expected to be a hub for transport and logistics customers who will utilise the airport and major roads for their business operations.

The identified need for this investment is ‘reliability corrective action’ because the investment is required to comply with our NER obligations to connect customers.

Our screening test concluded that a non-network solution is unlikely to form a potential credible option on a standalone basis, or form a significant part of a potential credible option. This is due to the extent of forecast demand in the area, the expected cost of non-network options and the capacity of the existing network to facilitate non-network technologies.

9.2 Active Non-Network Programs and Trials

Endeavour Energy had the following non-network programs and trials active during 2023:

- PowerSavers
- E-Bus Depot Energy Management
- Bawley Point & Kioloa Community Microgrid
- Gridsight

These are summarised below.

9.2.1 PowerSavers

The *Power*Savers program, designed and implemented by Endeavour Energy, is a comprehensive suite of customer technology applications and services to manage demand and other network constraints.

The *Power*Savers program for residential customers has been established to manage a range of smart load devices including air-conditioning units, water heaters, EV chargers and assets comprising solar and battery unit combinations.

The purpose of this specific program is to provide customers with maximum choice by including an expanded list of devices compared to those included in earlier programs.

One of the outcomes of earlier demand management programs was the need for a more comprehensive and complete product which comprises full integration of a customer engagement application, software applications to fully manage the customers' end devices and configurable customer notifications to provide customer flexibility to opt out of Event days or join more programs with a wide range of customer incentives.

The scope of the project also comprises comprehensive data reporting functionality to measure the customer and network benefits progressively through the trial and at completion.

The aims of the *Power*Savers program are as follows:

- Efficiently manage the demand management programs for residential customer smart load devices including air-conditioning units, electric water heaters, EV chargers and assets comprising solar and battery unit combinations.
- Provide analysis:
    - To understand customer behaviour and anticipate the impact of demand management programs to incentives; and
    - On the impact of demand management programs to the distribution network to support the efficient deployment of non-network solutions.

The expected outcomes include:

- Well-developed understanding of participants' interest in the program and the penetration of controllable devices across the Endeavour Energy network;
- Capturing actual/estimated energy reduction per customer and the prevailing weather conditions during Event days;
- Confirming average and total energy reduction for all participants;
- Identifying any issues captured during the Event period including those who discontinued their participation and archiving of all raw data collected; and

- Suitability of the application to be applied more widely across the Endeavour Energy network to manage system demand efficiently with our existing network support resources and services.

9.2.2 E-Bus Depot Energy Management

Endeavour Energy is collaborating with Busways and Evenergi on an innovative trial to integrate electric bus charging with demand signals on the energy grid. As more electric vehicles join the road, demand for electricity increases, putting added pressure on the grid.

Without smart charging, there is an increased risk of peak demand worsening, requiring costly upgrades to grid infrastructure. The joint trial in Penrith aims to avoid this issue and alleviate the added pressure on the grid by feeding real-time demand data into control algorithms that help determine the optimal time to charge.

Endeavour Energy has committed to installing 17 distribution transformer monitors on relevant distribution transformers to gain full real-time visibility on the upstream low voltage and high voltage network the bus depot is connected to. By collaborating with Evenergi, this live data can be used to inform and optimise the control systems that are used to charge the buses. When demand is low or there is a surplus of solar power on the network, buses can charge without adding to peak demand, better utilising the existing grid.

9.2.3 Bawley Point & Kioloa Community Microgrid

The Bawley Point, Kioloa and Termeil communities are located at the extreme southern end of Endeavour Energy's franchise area. The area is a popular tourist destination, and this means that energy demand can increase four to five-fold during peak holiday periods. Being at the very end of the Endeavour Energy network, electricity services at Bawley Point and Kioloa experience relatively high SAIDI and SAIFI values. Load has also increased to near capacity with regional permanent population movements, in part due to COVID-19. Additionally, the network is voltage constrained – facing low voltage during peak periods, and high voltage during the low demand periods, which will in the longer-term result in poor power quality and curtailment of customers' DER.

To assist in addressing emerging network needs, Endeavour Energy had previously installed a 1MVA diesel generator between Bawley Point and Kioloa to supplement the existing network, but this solution faces ongoing operational costs and is aging. The largest customer in the network is Willinga Park, who have privately installed a considerable amount of behind the meter generation assets (including solar PV/battery/diesel generators) to allow for standalone operation. Currently only the PV system exports into the network, with the remaining assets only providing a back-up supply for the facilities (or zero export peak demand reduction).

The increasing capabilities and viability of DER - both at a residential and community level - have since made an alternative new technology solution credible when compared to a traditional network solution. This alternative solution would involve the development of a microgrid, with elements co-funded and co-designed with the community.

The major features of the project involve:

- Community co-design, and integration of community owned assets;
- Turnkey supply and installation of a new ~3MVA/3MWh Battery Energy Storage System (BESS);
- Roll out of residential batteries and solar (funded through the NSW Government's Bushfire Livelihoods Economic Recovery program);
- A Distributed Energy Resources Management System (DERMS) to enable control of local generation and storage; and
- Demand management programs (smart streetlights, smart metering and Off-Peak Plus), and the integration of larger customer assets to assist in supporting the network.

The aims of the program include:

1. Address the vulnerability of the Bawley Point and Kioloa communities' network reliability and resilience, and to address the growing demand requirements;
2. Demonstrate new planning approaches, including how we can partner and work closely with our customers and communities, and utilise participatory design processes;
3. Accelerate decarbonisation, through accessing and incentivising sustainable and renewable energy in our network;
4. Establish the first microgrid in Endeavour Energy's network as a new technology solution for edge-of-grid customers, and apply learnings to opportunities in diverse and metropolitan environments; and
5. Develop a cornerstone project that combines multiple Future Grid technologies such as DERMS, VPPs and community-scale grid batteries.

9.2.4 Gridsight

Endeavour Energy is collaborating with Gridsight to develop a platform capable of providing tools to enhance LV visibility and leverage AI to generate data-driven insights surrounding network performance, CER detection and Safety Hazard detection.

As customers seek to connect more customer energy resources (CER) and increasingly use sophisticated digital platforms, the network and its management must evolve. Endeavour Energy's objective is to enable customers' energy choices for a sustainable future, moving us towards the future integrated and low carbon energy system. Low Voltage Visibility and Analytics is one of the key enablers of this objective.

Gridsight's analytics platform utilises customers' meter data to provide visibility of and insights on, existing and emerging constraints, which enables a better understanding of customer usage patterns, improved tariff designing processes, and better consideration of non-network solutions to demand management. This bottom-up approach places the customer as the focus.

The platform ingests smart meter market data from some 416,000 sites. From this population, Endeavour Energy is purchasing power quality data of approximately 50,000 sites. Basic meter data is ingested for all other customers.

The Gridsight platform aims to serve the following use cases:

- **Provide optimal data-driven Dynamic Operating Envelopes** (DOEs) to unlock additional hosting capacity without the need for network investment.
- **Provide load estimation tools to help proactively identify equipment capacity issues** through aggregating downstream customer data and creating data-driven estimates.
- **Identify and validate customer energy resources** including customer solar PV, battery storage systems and electric vehicle chargers to increase compliance efforts and minimise network spend.
- **Detect customer energy resource performance** including analysis on self-consumption of solar, detection of inverter disconnections and solar curtailments due to overvoltage issues and network voltage unbalance.
- **Proactively identify safety issues** on the network including broken neutral connections such that they can be rectified proactively.

9.3 Public Consultation for our Major Investments

The public consultation for our major network investments occurs through the RIT-D process which includes the issuing of the following reports:

- Non-Network Options Report;
- Draft Project Assessment Report; and
- Final Project Assessment Report.

9.3.1 Summary of Non-network Options Reports

The network needs where a Non-network Options Report was published in 2023 are shown below in Table 13.

Table 13: Non-network options reports

Network Need	Description of Network Need	Non-Network Options Issue Date	Timing of Constraint	Load Reduction (MVA)	Defer Years
Supply to the Berrima Junction enterprise growth area.	Provide supply capacity to support the Berrima Junction enterprise growth area.	May 2023	FY2026	15.0	1 or 2 year deferral was sought in the Non Network Option Report.

9.4 Summary of Draft Project Assessment Reports

The Draft Project Assessment Reports (DPAR) that were published in 2023 in accordance with the RIT-D regulatory requirements are detailed in Table 14 below.

Table 14: Draft Project Assessment Reports

Network Need	Description of Network Need	Preferred Option in the Draft Project Assessment	Status	Notice Date
Supply to the Burra Park development area.	Provide supply capacity and customer connection capability to support the Burra Park development area.	Proposed establishment of a 132/22kV Zone Substation in close proximity to the development area.	Published	November 2023

9.4.1 Summary of Final Project Assessment Reports

The Final Project Assessment Reports (FPAR) that were published in 2023 are detailed in Table 15 below.

Table 15: Final Project Assessment Reports

Network Need	Description of Network Need	Preferred Option in the Final Project Assessment	Status	Notice Date
Supply to the Aerotropolis Core Precinct.	Provide supply to the Aerotropolis Core Precinct in the development area to the north of the proposed Bradfield CBD.	Establishment of the North Bradfield Zone Substation with 2 x 45MVA transformers and 2 x 132kV supplies with 22kV distribution works to enable customer connections.	Published	Aug 2023
Supply to the Badgerys Creek Enterprise Precinct	Provide supply to the Badgerys Creek enterprise precinct including a major business park and a water recycling facility.	Establishment of the Badgerys Creek Zone Substation with 2 x 45MVA transformers and 2 x 132kV supplies with 22kV distribution works to enable customer connections.	Published	Dec 2023

9.5 RIT-D Projects Completed or In Progress

9.5.1 Projects in Progress

Table 16 below provides a summary of the RIT-D projects which are currently in progress.

Table 16: RIT-D Projects in Progress – Summary

RIT-D Project	RIT-D Status	Cost of Preferred Option ($M)	Construction Timetable	Credible Options
Supply to the Burra Park development area.	DPAR is open for comments until January 2024.	30.0	FY24-FY26	Construction and commissioning of a new 132/22kV zone substation with 22kV distribution network to supply the development area. Different locations and staging of the network options have been identified.
Supply to the Berrima Junction development area.	Currently evaluating options including a non-network option to defer part of the network option.	16.0	FY24-FY26	Augmentation of the existing Berrima Junction Zone Substation including an additional 33kV feeder.

9.6 RIT-D Projects with Public Consultation Completed

The consultation process for RIT-D projects where a Final Project Assessment Report was issued in the preceding year is considered to be complete. These projects are detailed in Table 17.

Table 17: RIT-D Projects Completed – Summary

RIT-D Project	Cost of Preferred Option ($M)	Planned Commissioning Year	Preferred Option	Net economic Benefit ($M)
Supply to the Aerotropolis Core Precinct.	48.5	FY26	Establishment of the North Bradfield Zone Substation with 2 x 45MVA transformers and 2 x 132kV supplies with 22kV distribution works to enable customer connections.	37,512

9.7 Asset Retirements and Potential Regulatory Investment Tests

9.7.1 Asset Retirements (Project Based)

Endeavour Energy has a range of project based planned asset retirements which will result in a system limitation or de-rating. Table 18 below summarises these planned asset retirements for the forward planning period. Some of these needs may be addressed by options that are yet to be determined and which could trigger the requirement to undertake a RIT-D assessment.

Table 18: Asset Retirements (Project Based)

Reference	Asset	Location	Rationale for Retirement	Retirement Date	Change to Retirement Date
NTM-000535	132kV oil insulated cables	Guildford/Merrylands/ Parramatta	Sheath oil leaks and dissolved gas levels indicating end of life of the cables: 9J8, 22U, 22W, 226, 228, 233.	2029/30	No
RTM134	Wollongong - Port Kembla copper pilot cables	Wollongong – Port Kembla	Increased experience of failures at joint boxes leading to failures of the high speed 33kV feeder protection schemes. Risk to public safety due to slow clearing of feeder faults.	2029/30	No.
NTS-000441	Carlingford Transmission Substation control building replacement	Carlingford	Failure of roof of control building. Deterioration of protection and control services. Asbestos contamination of control building. Risk of loss of protection and control. WH&S risks.	2024/25	Yes. Project work commenced following RIT-D completion.

9.7.2 Asset Retirements (Program Based)

The following list of programs will result in the retirement of various asset types across the Endeavour Energy network. The rationale for the retirement for some asset classes is defined by an economic evaluation in a case for investment and for other asset classes by Endeavour Energy Standards which set out conditions and health indices used to determine the need for the retirement of those assets.

Table 19: Asset Retirements (Program Based)

Reference	Asset	Location	Rationale for Retirement	Retirement Date	Change to Retirement Date
RAU004	Substation SCADA Remote Terminal Units	Zone and sub-transmission substations	Increasing likelihood of failures leading to loss of control of the substation. Reliability risk.	2023/24 - 2030/31	No.
RDS005	Distribution poles	Across the network	Inspection and test criteria indicating risk of failure Safety risk to the public. Reliability risk.	2023/24 - 2030/31	No.
RDS006	LV CONSAC distribution cables	Across the network	Failures of joints in pillars and columns and of the CONSAC cable. Shock hazards to the public and electricity workers.	2023/24 - 2030/31	No.
RDS007	LV service wires	Across the network	Deterioration of insulation. Safety risks to public and electricity workers.	2023/24 - 2030/31	No.
RDS011	HV distribution steel mains	Bushfire prone areas	Corrosion of steel conductor indicating failure risk. Risk of initiating a bushfire. Safety risks for the public and electricity workers.	2023/24 - 2030/31	No.
RDS014	LV underground cable network	Across the network	Failures of in-ground joints. Shock hazards to customers and electricity workers.	2023/24 - 2030/31	No.
RDS301	Distribution ground substations	Across the network	Poor condition of the substation assets. Safety risks due to exposure of conductors and inadequate clearances.	2023/24 - 2030/31	No.

Reference	Asset	Location	Rationale for Retirement	Retirement Date	Change to Retirement Date
RDS302	Distribution transformers	Distribution substations across the network	Poor condition of transformer due to cracked bushings, oil leaks and corrosion. Risk to safety, environment and reliability.	2023/24 - 2030/31	No.
RDS307	MD4 epoxy switchgear	Distribution substations across the network	Discharge over surface of resin. Risk of flash-over and substation fire. Safety risk to the public and electricity workers.	2023/24 - 2030/31	No.
RDS315	Low voltage switchgear	Distribution substations across the network	Insulation deterioration leading to arc-flash incidents. Safety risk to electricity workers.	2023/24 - 2030/31	No.
RDS405	Air break switch	Across the network	Failure of switchgear resulting in inability to be operated. Safety risks to electricity workers and the public.	2023/24 - 2030/31	No.
RDS415	LV mains	Across the network	Deterioration of insulation. Safety risk to public and electricity workers.	2023/24 - 2030/31	No.
RDS417	Distribution access track reconstruction	Across the network	Access tracks in deteriorated condition which are unsafe for use. Safety, reliability and environmental risks.	2023/24 - 2030/31	No.
RPS008	Substation electro-mechanical, electronic and early numerical protection relays	Zone and sub-transmission substations	Increased risk of malfunction. Reliability risk. Safety risk to the public.	2023/24 - 2030/31	No.
RTM012	Sub-transmission poles	Across the network	Failure of inspection and test criteria with risk of failure. Safety risk to the public.	2023/24 - 2030/31	No.

Reference	Asset	Location	Rationale for Retirement	Retirement Date	Change to Retirement Date
			Reliability risk.		
RTM014	Renewal of 33kV and 66kV gas and oil filled cables	Carlingford and Outer Harbour	Poor oil and paper condition indicating end of life. Reliability risk.	2025/26 - 2030/31	No.
RTM015	Sub-transmission steel towers	Across the network	Corrosion of steel structures indicating risk of failure. Safety and reliability risk.	2023/24 - 2030/31	No.
RTM171	Corroded overhead steel earthwires	Across the network	Corrosion of steel earthwire indicating risk of failure. Bushfire start risk. Safety risk to the public. Reliability risk.	2023/24 - 2030/31	No.
RTM174	Hardex earthwires	Across the network	Risk of burn-down during faults. Safety risk due to the public due to slow clearing of faults and due to conductors down.	2023/24 - 2030/31	No.
RTS004	132kV circuit breakers	Zone and sub-transmission substations	Poor diagnostic test results and defect history indicating destructive failure risk. Reliability and safety risk.	2023/24 - 2030/31	No.
RTS005	33kV circuit breakers	Zone and sub-transmission substations	Poor diagnostic test results and defect history indicating destructive failure risk. Reliability and safety risk.	2023/24 - 2030/31	No.
RTS007	11kV circuit breakers	Zone and sub-transmission substations	Poor diagnostic test results and defect history indicating destructive failure risk Reliability and safety risk	2039/40	Deferred due to reassessment of risk.

Reference	Asset	Location	Rationale for Retirement	Retirement Date	Change to Retirement Date
RTS008	Substation batteries	Zone and sub-transmission substations	Deteriorating test results. Risk of failure and loss of protection systems at the substation. Reliability risk as substation is remotely switched off until battery is replaced and control restored.	2023/24 - 2030/31	No.
RTS009	Auxiliary switchgear	Zone and sub-transmission substations	Risk of catastrophic failure. Reliability and safety risk.	2023/24 - 2030/31	No.
RTS015	Surge arresters	Zone and sub-transmission substations	Breakdown of seals on porcelain housing, moisture ingress leading to failure. Reliability and safety risk.	2023/24 - 2030/31	No.
RTS016	VT and CTs	Zone and sub-transmission substations	Oil leaks, degradation of seals, corrosion leading to risk of destructive failure. Reliability and safety risk.	2023/24 - 2030/31	No.
RTS055	66kV circuit breakers	Zone and sub-transmission substations	Poor diagnostic test results and defect history indicating destructive failure risk. Reliability and safety risk.	2023/24 - 2030/31	No.
RTS086	Busbars, disconnectors and/or support structures	Zone and sub-transmission substations	Corrosion of reinforcing steel and cracking of support insulators indicate risk of failure. Reliability and safety risk.	2023/24 - 2030/31	No.
RTS173	11kV oil circuit breaker trucks	Zone substations	Risk of failure to clear faults leading to catastrophic failure. Reliability risk. Safety risk for electricity workers.	2023/24 - 2030/31	No.

Reference	Asset	Location	Rationale for Retirement	Retirement Date	Change to Retirement Date
RTS600	Power transformers	Zone and sub-transmission substations	Poor paper insulation, bushing and tap changer condition, oil condition indicates risk of failure. Reliability risk.	2023/24 - 2030/31	No.

9.8 Urgent and Unforeseen Investments

There are currently no issues which are sufficiently urgent or unforeseen that they have not been able to be addressed through the normal investment planning process.

Table 20: Urgent and Unforeseen Network Issues

Project Number	Project Name	Description Purpose	Estimated Cost ($m)	Approval Date	Completion Date	Alternative Options
Nil entry						

9.9 Information Technology Investment

Table 21 provides information on the investment in information technology systems within the network for the preceding year and that proposed for the forward planning period.

Table 21: Information Technology Program

Project Name	Period	Description
Optimus Program	2018/2019 onwards	This program includes a refresh and consolidation of 40 information systems including the ERP and Billing platforms, rationalisation of applications, improving data and reshaping operations and processes. The establishment of a modern technology platform will improve productivity and safety outcomes.
Advanced Distribution Management System (ADMS)	2018/19 onwards	This program aims to provide Endeavour Energy with an Advanced Distribution Management System to provide an end to end integrated real-time view of the entire distribution network. The program will replace the company's existing OMS system and enable efficiencies and safety improvements in field operations. Additionally, through the greater understanding and control of the Endeavour Energy network this program will enable customers to take up smart technologies and renewable sources of energy.
Lights Up Program	2019/20 onwards	The Lights Up program has delivered enhanced software, new hardware and improved customer-support technology. The program delivered tools such as Office365 and Windows 10 and refreshed network and infrastructure hardware to support Optimus and ADMS programs. A technology capital program extends this project underpinned by a new technology strategy.
Copperleaf	2019/20 onwards	A software tool for asset investment planning decision support (Predictive Analytics) and portfolio optimisation (Copperleaf Portfolio).

Appendices

Appendix A: Glossary

Abbreviation/Phrase	Definition
AEMC	The Australian Energy Market Commission is the rule maker and developer for Australian energy markets
AER	Australian Energy Regulator
DAPR	Distribution Annual Planning Report prepared by a Distribution Network Service Provider under clause 5.13.2 of the National Electricity Rules
DNSP	A Distribution Network Service Provider who engages in the activity of owning, controlling, or operating a distribution system, such as Endeavour Energy, Ausgrid and Essential Energy
GJ gigajoule	One gigajoule = 1000 megajoules. A joule is the basic unit of energy used in the gas industry equal to the work done when a current of one ampere is passed through a resistance of one ohm for one second
GWh gigawatt hour	One GWh = 1000 megawatt hours or one million kilowatt hours
HV high voltage	Consists of 22kV, 12.7kV and 11 kV distribution assets (also referred to as medium voltage in some sections of this report)
HVC	High voltage customer
kV kilovolt	One kV = 1000 volts
kW kilowatt	One kW = 1000 watts
kWh kilowatt hour	The standard unit of energy which represents the consumption of electrical energy at the rate of one kilowatt for one hour
LV low voltage	Consists of 400V and 230 volt distribution assets
Major Event Day	Any day that exceeds a daily SAIDI threshold
MW megawatt	One MW = 1000 kW or one million watts
MWh megawatt hour	One MWh = 1000 kilowatt hours
NER	National Electricity Rules
Primary distribution feeder	Distribution line connecting a sub-transmission asset to either other distribution lines that are not sub-transmission lines, or to distribution assets that are not sub-transmission assets. An example is the first distribution feeder out of a zone substation
RIT-D	Regulatory Investment Test for Distribution
Sub-transmission	Any part of the electricity network which operates to deliver electricity from the transmission system to the distribution network and which may form part of the distribution network, including zone substations
Sub-transmission system	Consists of 132kV, 66 kV and 33 kV assets
V volt	A volt is the unit of potential or electrical pressure
W watt	A measurement of the power present when a current of one ampere flows under a potential of one volt

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