





# Version Control and Approvals

Table 1 – Version Control

Version #	Date of Issue	Description
4.2	2 November 2022	Revised for FY25-FY29 proposal.

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## 1. Executive Summary

New South Wales (NSW) has an ambitious growth plan for its Greater Sydney and regional areas. Five of the six growth areas in the Greater Sydney metropolitan and Illawarra region are serviced by Endeavour Energy with the biggest growth forecast to be in the Western Sydney corridor. By 2036, half of Sydney's population will reside within Western Sydney, with an estimated total capital cost of infrastructure invested to be around \$100bn. To service this growth requires upfront and sustained investment in electricity infrastructure as availability of electricity infrastructure will be a core enabler to this growth.

To provide a fit-for-purpose response to the growth challenge as well as be consistent with the NER and AER guidelines, Endeavour Energy has segmented the growth into two types, greenfield and brownfield. Table 2 below shows the attributes of greenfield versus brownfield.

**Table 2 - Framework**

Attribute	Greenfield Stage <sup>[Note 1]</sup>	Brownfield Stage <sup>[Note 2]</sup>
Trigger	Connections Volume Driven	Connection Volume Driven or Demand Driven
Growth	New Growth (Step Change in new load)	New Growth or Densification
Ability to utilise economically adjacent network (DAPR Connections Map)	Weak or Average	Good or Average
Identified Need	Reliability Corrective Action	Reliability Corrective Action or Sum of Consumer and Producer Surplus
Sensitivity Analysis	Rate of New Connections	Rate of New Connections or Maximum Demand (MD) Forecast of existing and known new connection
<b>Response</b>	<b>Just in Advance</b> investment to establish network infrastructure headworks to facilitate growth.	<ul style="list-style-type: none"> <li>• Base Case Credible Option for Reliability Corrective Action installed <b>Just in Time</b>, or</li> <li>• No Proactive Intervention</li> </ul>

**Note 1:** All characteristics for the attributes detailed under the column 'Greenfield' need to be true for a project or a stage to be classified as greenfield.

**Note 2:** Brownfield projects or stages can have a mix of attributes. A scoring system is used and if the score is below a threshold than the project / stage is classified as brownfield.

For greenfield stages of projects, Endeavour Energy’s approach to staging includes:

- **Initial Supply to kick off development:** The initial stages of development are typically serviced by utilising existing network assets. The capacity is constrained typically due to development located a large distance away from the existing infrastructure. However, there may be enough capacity to sustain the development while the backbone or minimum infrastructure is established.
- **Build minimum Infrastructure (known as headwork infrastructure):** The headwork infrastructure is the minimum network infrastructure required to service the step change in new load. The identified need for the headwork connection is *Reliability Corrective Action* because of an obligation to provide connection services<sup>1</sup>. Providing this minimum network infrastructure is the credible base case option<sup>2</sup> because “No proactive intervention” will contravene the obligation to provide connection services. Furthermore, this headwork infrastructure will be delivered using “Just in advance” principles. “Just in advance” is the process of delivery of the electrical infrastructure in readiness to facilitate growth.

Table 3 below shows the key point of difference between the approaches to greenfield and brownfield stages of projects.

**Table 3 – Key point of difference between greenfield and brownfield stages**

	Greenfield Stage	Brownfield Stage
Intervention	Need is always identified as Reliability Corrective Action and requires installation of headwork infrastructure, which is addressed with a <i>network only</i> Credible Base Option.	If the need is identified as Reliability Corrective Action, it could be addressed with a network, non-network, or hybrid Credible Base Option

Due to the dynamic nature of the operating environment influenced heavily by external factors (for example, impact on growth rates due to external economic factors and COVID-19) this growth strategy document will be reviewed and updated on an annual cycle.

## 2. Purpose and Scope

The growth servicing strategy has been developed to:

- **Define the growth challenge** for Endeavour Energy including clarifying the characteristics of greenfield and brownfield development.
- **Outline Endeavour Energy’s approach** to investment in augmentation capital that addresses the growth challenge. The approach will inform the development of prudent and efficient cases for investment to service the growth challenge.
- **Provide a line of sight** between Endeavour Energy’s corporate strategy and strategic asset management plan and Department of Planning Infrastructure and Environment (DPIE’s) growth objectives and customers needs.

The scope of this growth servicing strategy includes:

- **Proposed solutions** in the form of internal projects / programs in the areas serviced by Endeavour Energy’s network.
- **In-scope:** investment in *Augmentation, Customer connections* and *augmentation related Future Grid* projects
- **Out of scope:** Investments in Information and Communications Technology (ICT) and replacement expenditure (REPEX) are excluded from this strategy.

<sup>1</sup> Electricity Supply Act 1995 No 94, Division 4 Requirements relating to customer connection services <https://legislation.nsw.gov.au/view/html/inforce/current/act-1995-094#pt.3-div.4>

<sup>2</sup> Section 3.3 characterising the base case. Application guidelines, Regulatory Investment Test for Distribution (RIT-D)

### 3. Strategic Context

#### 3.1 Current network

Endeavour Energy services over 2.5 million people living and working across Sydney's Greater West, the Blue Mountains, the Southern Highlands, Illawarra, and the South Coast of NSW. To do this, Endeavour Energy manages an electricity network that spans almost 25,000 square kilometres, from the Blue Mountains to the South Coast and through much of Sydney's Greater West and has a Regulated Asset Base (RAB) value of \$6.7Bn (FY19). Endeavour Energy's network has progressively grown since 2015 to service the growing regions. The infrastructure has been built for a diverse range of loads from mainly residential to industrial.

#### 3.2 Transformational change and a growing network

The Greater Sydney Region Plan, *A Metropolis of Three Cities* is built on a vision of three cities, two of which namely Western Parkland City and Central River City are serviced by Endeavour Energy. By 2036, half of Sydney's population will be expected to reside within Sydney's west. Projections suggest the need for an additional 725,000 dwellings, in a region that is also planned to cater for a new international airport, new industry, rejuvenation of manufacturing, and a science park. The Parkland City will account for over 25 per cent of NSW's population growth by 2036, with nearly 1.7 million people<sup>3</sup>.

The growth is widespread and transformational. A significant portion of growth is centred around Sydney's second airport – the Western Sydney International (Nancy Bird Walton) Airport – and a new 23km Metro line (Western Sydney Airport Metro line) with Stage 1 extending from St Marys to the CBD of The Western Parkland City at Bradfield. Government investment in these two projects alone is estimated to be in excess of \$10 billion.

Endeavour Energy is responsible for the expansion of the electricity distribution network to facilitate this growth, and to support the NSW Government's planning and development of liveable, productive, and sustainable communities that thrive. Additionally, the existing network operated by Endeavour Energy across these regions is either distinctly absent or substantially undersized. To accommodate this 'step change' in growth, new networks must be planned and delivered in a way that both facilitates this vision and futureproofs the network. Refer to Section 3.2.1 for the segmentation strategy according to the growth requirements.



**Figure 1 – Priority Growth Areas with transformational change from rural settings to that of an urban metropolis (image credit<sup>4</sup>)**

<sup>3</sup> Western Parkland City Blueprint, 2021, [Draft Blueprint for the Western Parkland City - Western Parkland City Authority \(wpca.sydney\)](https://www.wpca.sydney)

<sup>4</sup> Aerotropolis Precinct Plans 2022

The Illawarra-Shoalhaven area is also undergoing significant growth. The regional plan identifies fifteen regionally significant precincts covering more than 2,300 hectares of land for employment, recreation, culture, housing, and innovation to provide 45,000 jobs and 38,000 new homes.

The growth areas identified in the DPIE regional plans for Greater Sydney<sup>5</sup> and Illawarra-Shoalhaven<sup>6</sup> are shown in the Figure 2.

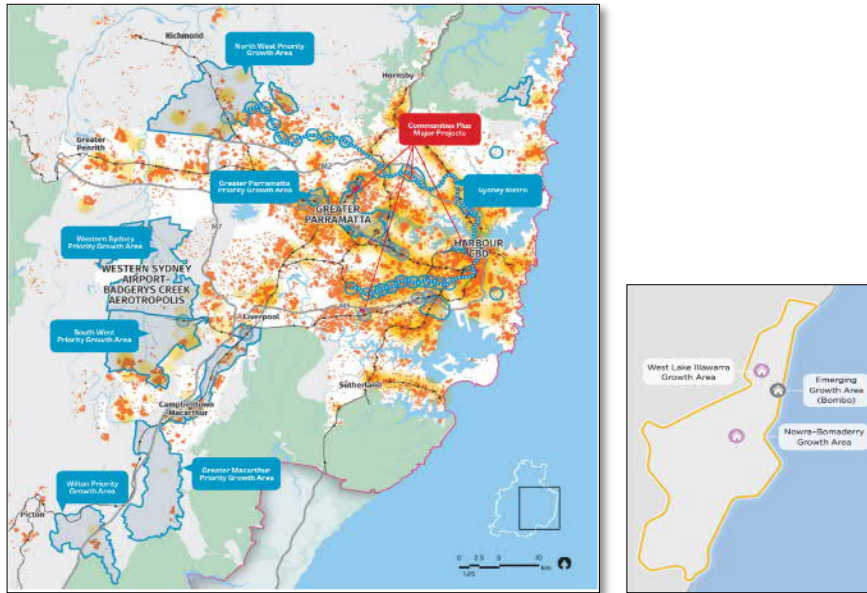


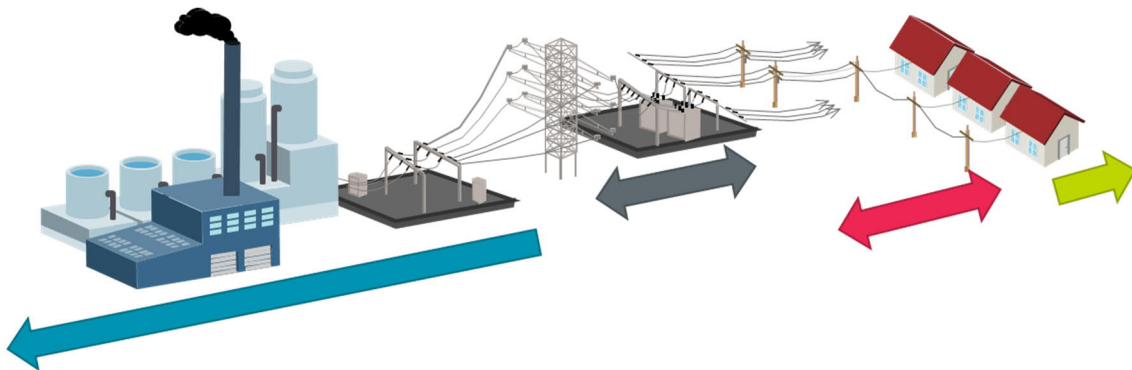
Figure 2 - Growth Areas as included in the DPIE plans

<sup>5</sup> Western Parkland City Vision, <https://www.greater-sydney/metropolis-of-three-cities/vision-of-metropolis-of-three-cities/western-parkland-city-vision>

<sup>6</sup> Illawarra Shoalhaven Regional Plan 2041, <https://www.planning.nsw.gov.au/-/media/Files/DPE/Plans-and-policies/Plans-for-your-area/Regional-plans/Illawarra-Shoalhaven-Regional-Plan-05-21.pdf>

### 3.3 Broader context of infrastructure investment and the interaction with the Connection Policy

Endeavour Energy’s growth servicing and augmentation expenditure plans sit within a much broader context of electrical infrastructure development. The following provides an informative to the placement of this Strategy within the broader context and the interaction with the Connection Policy.



Generation and Transmission Assets (shown in blue “←”) supplying into the Endeavour Energy network are funded by Transmission Network Service Providers or private operators of generators. This part of the network is experiencing considerable investment and while not quantified the likely investment over the coming years is in the order of billions.

The other end of the network are commercial, industrial, and residential installations (shown in green “→”). This part of the network is beyond the Endeavour Energy connection point and is funded in full by proponents. While this is not quantified, investment here is typically in the order of 100’s of millions to billions.

Interconnecting the above elements are Shared Distribution and Sub-Transmission Assets (shown in grey “↔”) and New Connection Related Assets (shown in pink “↔”).

New connection assets (pink “↔”) are required between the customer connection points and the existing Endeavour Energy network. Within NSW this part of the network construction is delivered within a contestable market framework and is majority funded by proponents / developers. Assets installed by developers that stand to benefit adjacent or subsequent connections, are contributed to by Endeavour Energy as ‘connection headworks’. The proportionality of funding is detailed within the **Endeavour Energy Connection Policy**.

In the middle of the network are the Shared Distribution and Sub-Transmission Assets. These assets are required to provide interconnection to the broader network, and local connection availability at a suitable voltage. These assets are funded in full by Endeavour Energy and are recovered through regulated revenue from the wider customer base. It is this part of the network to which the **Growth Servicing Strategy principles apply**.

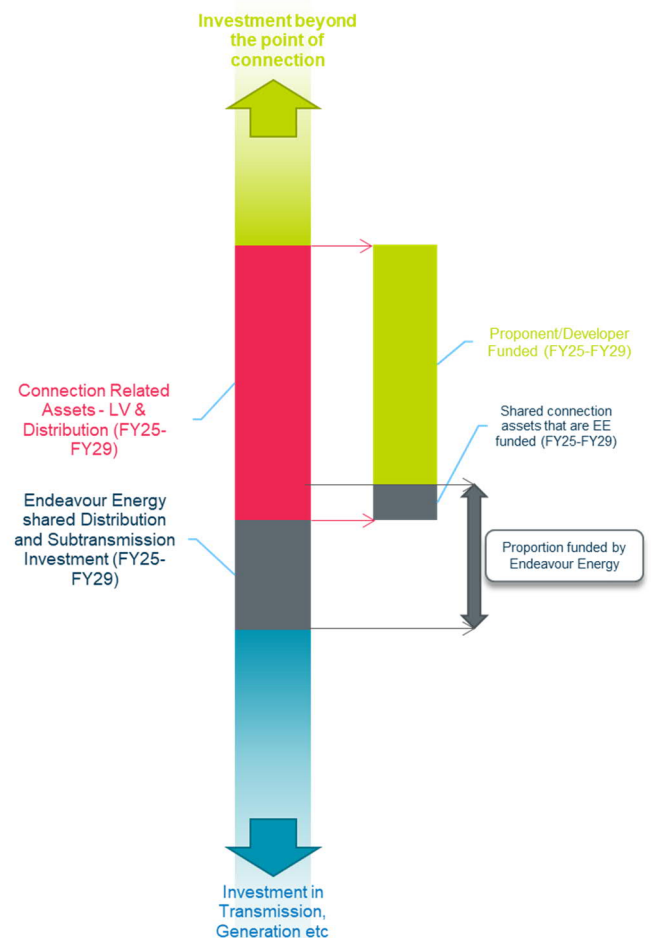


Figure: Indicative 5 year investment across the EE and supporting transmission network



### 3.4 Segmenting the growth areas into Greenfield and Brownfield

To support the demands of a growing network, this strategy recognises that different parts of Endeavour Energy's network face different opportunities and needs, therefore the growth can be categorised into one of either two types:

- Greenfield
- Brownfield

**Table 4** below outlines the attributes of decision-making framework that is utilised to determine whether the investment is greenfield or brownfield.

<i>What is the Trigger for investment?</i>	
<p><b>Connections driven</b></p> <ul style="list-style-type: none"> <li>○ There is substantial growth in new connections (quantity and/or magnitude) as new precincts are developed. This includes the development of new commercial centres, "employment lands" and the provision of supporting social infrastructure and housing all of which adds to growth impacts and demand on network infrastructure.</li> <li>○ Development in areas that have not been built on before. This often includes rural/non-urban areas that are located on the edge of towns or cities</li> </ul>	<p><b>Either Redevelopment or Demand driven</b></p> <ul style="list-style-type: none"> <li>○ Growth in connections in older areas is due to redevelopment, increased housing density and land re-use due to re-zoning (urbanisation of older industrial and commercial lands)</li> <li>○ Demand growth in existing established areas is being driven by general economic activity and changes in customer end-use patterns and appliance uptake. This is termed 'organic growth'. The post modelling adjustment (PMA) process modifies the rate of organic growth as adjustments for the uptake of PVs and other energy efficient appliances may reveal no organic growth</li> </ul>
<i>What is the type of growth?</i>	
<p><b>New Growth (Step Change in new load)</b> There is a substantial growth in the area primarily due to release of new land and / or high industrial loads such as data centres being established that increases the network requirements</p>	<p><b>Densification</b> Urbanisation in existing areas or growth forecast in new areas in future years.</p>
<i>What is the ability to Utilise adjacent network (DAPR) to service the growth?</i>	
<p><b>Average to Weak</b> (Light Orange to Dark Orange on DAPR)</p>	<p><b>Average to Strong</b> (Light Orange to Sky Blue on DAPR)</p>
<i>What is the Identified Need?</i>	
<p><b>Reliability Corrective Action</b> NER 5.10.2 defines reliability corrective action as a network business' investment in its network to meet 'the service standards linked to the technical requirements of schedule 5.1 or in applicable regulatory instruments and which may consist of network options or non-network options.</p>	<p><b>Sum of Consumer and Producer Surplus</b> The sum of consumer and producer surplus maximises the NPV of the market benefit, where the market benefit is the total net benefits of the project to all consumers and producers in the market.  NER 5.17.1 specifies classes of market benefits</p>
<i>Which input is the need most sensitive to?</i>	
<p>Magnitude of load requirement and/or rate of new connections</p>	<p>Maximum Demand (MD) Forecast of existing and known new connections</p>

**Table 4 - Attributes of decision-making framework for Greenfield/Brownfield investment**

Table 5 below outlines the characteristics of greenfield and brownfield investments by mapping the attributes from Table 4 above.

Attribute	Greenfield	Brownfield
Trigger	Connection Magnitude or Volume Driven	<ul style="list-style-type: none"> <li>• Demand Driven, or</li> <li>• Connections Volume Driven</li> </ul>
Size of Growth	New Growth (Step Change in new load)	<ul style="list-style-type: none"> <li>• Densification, or</li> <li>• New Growth</li> </ul>
Ability to utilise adjacent network (DAPR Connections Map)	Weak to Average	<ul style="list-style-type: none"> <li>• Weak to Average, or</li> <li>• Average to Good</li> </ul>
Identified Need	Reliability Corrective Action	<ul style="list-style-type: none"> <li>• Sum of Consumer and Producer Surplus, or</li> <li>• Reliability Corrective Action</li> </ul>
Sensitivity	Rate of New Connections	<ul style="list-style-type: none"> <li>• Maximum Demand (MD) Forecast of existing and known new connections, or</li> <li>• Rate of New Connections</li> </ul>
<b>Response</b>	<b>Just in Advance</b> investment to establish headwork network infrastructure to facilitate growth	<ul style="list-style-type: none"> <li>• For <i>reliability corrective action</i> Base Case Credible Option installed just in time, or</li> <li>• For others BAU Base Case is No Proactive Intervention</li> </ul>

**Table 5 - Greenfield and Brownfield Characteristics**

## DAPR Connections Map

The Distribution Annual Planning Report (DAPR) is used to identify the available capacity in the Endeavour Energy's network. Endeavour Energy publishes a connections opportunity map as part of its DAPR (<https://dapr.endeavourenergy.com.au/connections/>), which shows locational opportunities where large-scale development can be cost effectively connected to the Endeavour Energy network. Figure 3 shows the DAPR map.

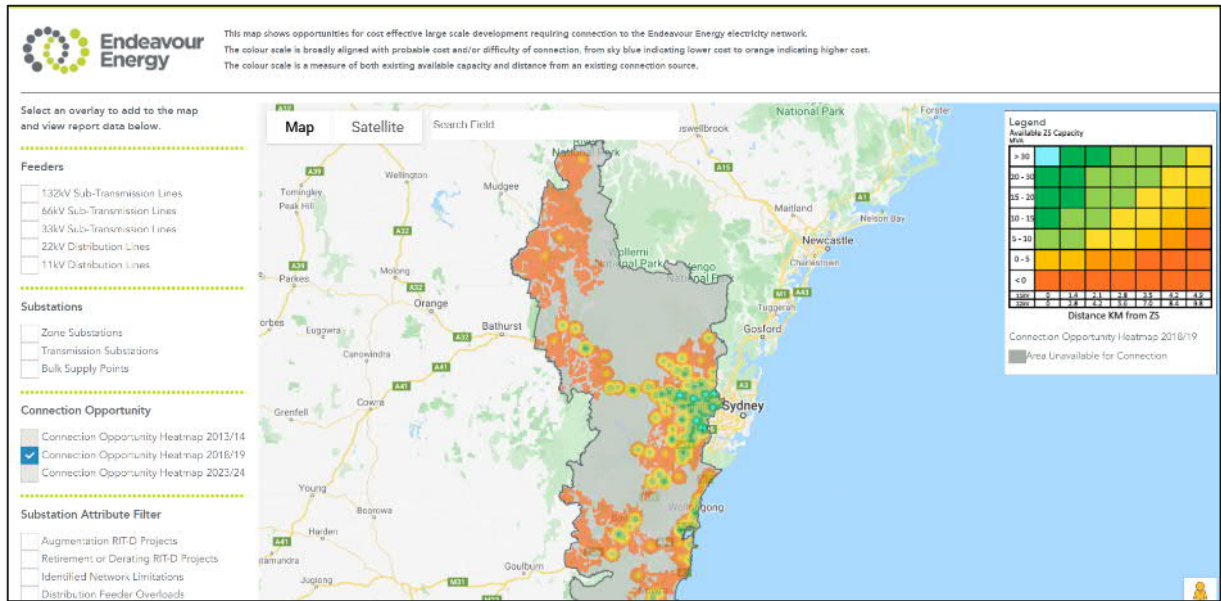


Figure 3 - DAPR - Connections Opportunity

**Note:** Green areas in DAPR does not mean greenfield areas. Figure 4 shows example of the greenfield and brownfield areas on the DAPR map.

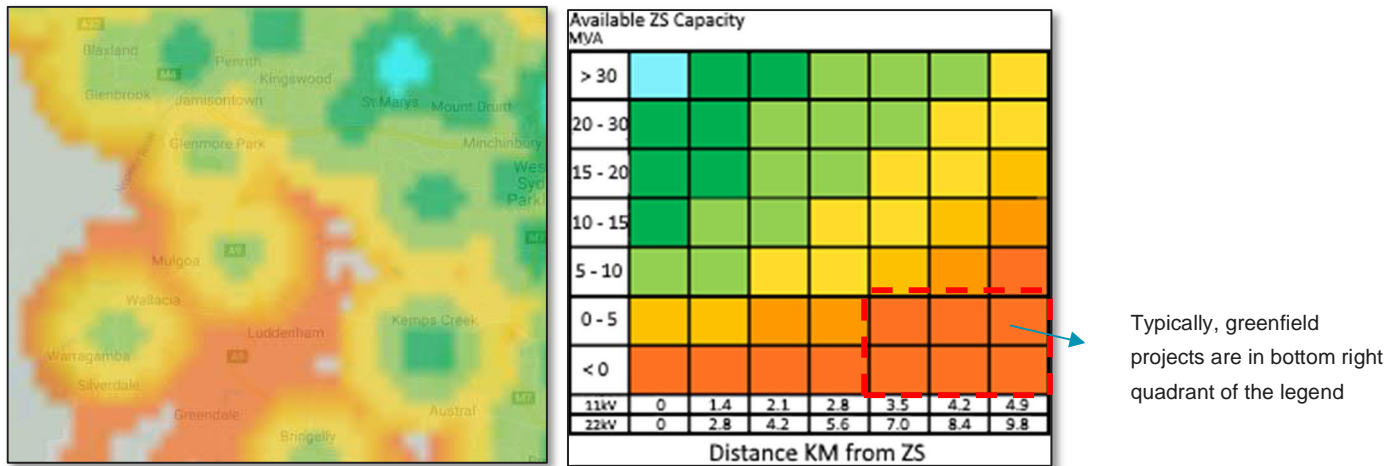


Figure 4 – DAPR Legend

### 3.5 Timing of Infrastructure to support growth

The timing of the investment to meet the identified need is critical to facilitate growth. Section 1 outlines the four-step approach, which includes a step that determines the timing of the investment. This section provides strategic context for the timing approach.

For greenfield projects there is always a requirement to establish a backbone and / or minimum infrastructure to facilitate growth. This investment will be completed using *Just in Advance* principles.

For all other investments, a *Just in Time* principle is to be applied.

#### Just in Advance principle

Endeavour Energy will adopt a just in advance principle to design and deliver the infrastructure to meet the growth needs in those growth areas that have been identified for greenfield development. Just in advance is the process of delivery of the minimum electrical infrastructure in readiness to facilitate growth. Just in advance is not about a 'set and forget' approach, which poses the risk of stranded assets. Instead, it is a process that ensures that assets with a high likelihood of utilisation are built ahead of time to propel development. The Just in Advance principle achieves this by following:



Figure 5 - Just in Advance Approach

Strategically, the just in advance approach is critical for greenfield development as electricity infrastructure is one of the key enablers of growth. For example, the total capital cost of all infrastructure is estimated to be around \$100bn over 20 years in the Western Parkland City. Energy, digital and waste make up 3.7% of this investment<sup>7</sup>. A delay in electricity infrastructure could have catastrophic consequences and to control this risk, a just in advance strategy that supports the prudent and efficient investment is the recommended control.

Following are some key lessons to further support the just in advance principle:

- **Drawing on lessons on rate of development:** Endeavour Energy has faced challenges in meeting demand in significant growth areas such as Oran Park, Marsden Park, Edmondson Park, Jordan Springs, and South Leppington. In all these projects, the key lesson learned was the mismatch between the developer rate of development and the rate of electricity infrastructure design and construction rate resulting in potential delays in connection. For example, the application time from developers have typically had 12 months of lead time from the time of application to requiring supply, whereas planning and delivery of infrastructure can typically take between three to four years including the RIT-D process.
- **Preventing delays in development of the wider capital infrastructure due to unavailability of electricity assets:** A key measure of success for Endeavour Energy, customers, stakeholders, and the community in which Endeavour Energy operates is provision of infrastructure in a timeframe that supports growth. Delays in development for Western Sydney have resulted from a lack of utility infrastructure. An example of this was delays in development of housing in the suburb of Austral due to a lack of water infrastructure<sup>8</sup>. To support development, Endeavour Energy need to find a balance between infrastructure delivered too late to meet demand and the

<sup>7</sup> Making the Western Parkland City: Draft PIC report [https://gsc-public-1.s3-ap-southeast-2.amazonaws.com/s3fs-public/draft\\_pic\\_gold\\_-\\_a\\_city\\_supported\\_by\\_infrastructure\\_24\\_nov.pdf](https://gsc-public-1.s3-ap-southeast-2.amazonaws.com/s3fs-public/draft_pic_gold_-_a_city_supported_by_infrastructure_24_nov.pdf)

<sup>8</sup> Daily Telegraph, July 2021, *Leppington, Austral housing precinct: Sydney Water Service delays 5800 homes to 2026*

risk of stranded assets, resulting from demand not materialising. Endeavour Energy continues to support initiatives for multi-utility coordination and investment.

### **Case Study: South Erskine Park Zone Substation**

**Key Outcome:** The investment of South Erskine Park Zone Substation was deferred for a long time caused by mismatch between the rate of growth in industrial load and the zone substation construction duration.

**Trigger:** It was estimated that 90MVA of load was required based on the significant industrial growth outlined by the developer. The land was made available by the developer but due to the uncertainty in estimating the capacity of industrial load, the substation was delayed with a view to be ready just in time.

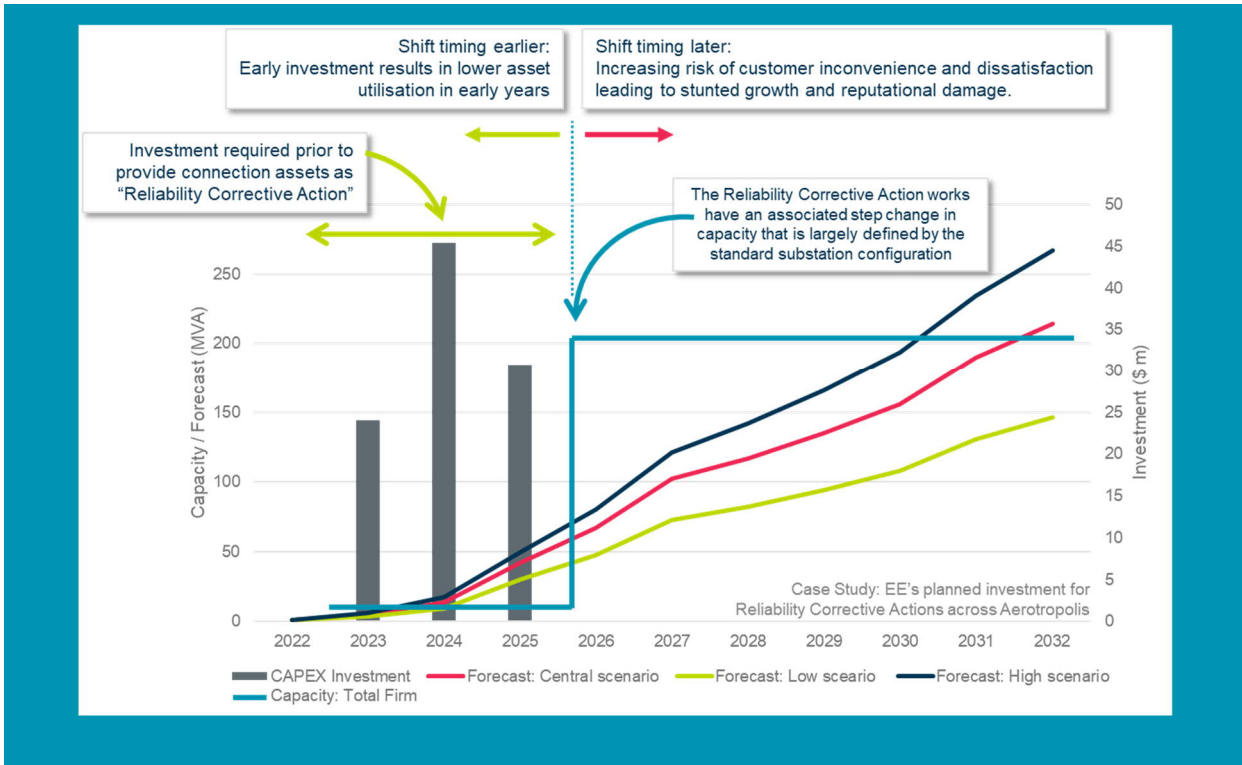
**Sustainable Growth:** Endeavour Energy worked in collaboration with the developer to outline various stages of the development. The first couple of stages were supplied by utilising load from the nearest zone substation capacity. However, the rate of growth of the future stages was faster than anticipated by Endeavour Energy. The zone substation was commissioned in 2022.



**Lessons Learned:** For commercial /industrial development it is difficult to calculate the load requirement with level of certainty. In addition, the rate of growth of industrial sites by developers is significantly faster than residential thus making it difficult to accurately predict the just-in-time requirements. For these types of projects, it is prudent to commence the investment as soon as practicable.

### **Case Study: “Just in advance” Greenfield Precinct Timing within the Aerotropolis**

For greenfield growth areas the timing of investment is the main variable of control. Across the Aerotropolis, some early growth is supported from the very limited existing 11kV network the ultimate investment in 22kV connecting assets is required to support the vast commercial and industrial precincts. The planned investments are Just in Advance.



**Just in Time principle for growth in Brownfield development**

The just in time principle is the standard approach where the principle used is ‘as late as reasonably possible’. As the timing of the growth is largely dependent on the sensitivity of the increase in maximum demand, a low, medium, and high sensitivity analysis is conducted to inform the timing of the infrastructure. The approach is outlined in detail in the CFI template. A just in time principle could still mean 2-to-3-year development phase that includes the RIT-D process. The approach is supported by the presence of existing infrastructure or infrastructure recently established under the ‘Just in Advance’ principle.

**3.6 Providing optionality and the transition of growth**

While the classification of our Growth response is segmented into Greenfield and Brownfield, in practice there is often a transition into and through these classification various stages. For example, Greenfield Growth construction phases can be supported by providing connection to any available network that is geographically suitable. While this connection may be undersized for even early term growth it allows construction to being and initial lots development. The establishment of infrastructure Just In Advance of the majority Growth is then required. As the precincts mature, the foundational infrastructure established Just In Advance is monitored and transitioned with later stage investments (for example subsequent transformers) to Brownfield responses that are Just In Time.

## Case Study: Catherine Park Growth Area

**Key Outcome:** The Growth response provides increasing utilisation on existing assets and the creation of transfer capacity links prior to the establishment of capacity by prudent investment in temporary substations and deferral of later phases

**Optionality** and transition of growth: The Catherine Park Growth area is a large residential and mixed-use precinct. The first stages of development are serviced with a limited connection from the existing network (a zone substation approximately 6km by cable route). During early stages of development, the existing sub transmission feeder was undergrounded (by the proponent for amenity) and terminated onto temporary structures within a future Zone Substation lot. Across 2023 a mobile 132/11kV single transformer substation will be deployed to increase capacity in this area – this investment is Just in Advance of the majority Greenfield Growth. The mobile substation defers the ultimate zone substation by approximately 7 years. The initial stage connections continue to provide optionality and transfer capacity.



## 4. Objectives

### 4.1 Line of sight to Endeavour Energy's corporate strategy

Twelve network Objectives have been developed to enable Endeavour Energy to deliver its Corporate and Sustainability Strategies and to meet customers, shareholders, and regulator expectations. Each of the objectives align with one of the five Strategic Initiatives within the Corporate Strategy. The specific objectives, measures and targets are listed in the Network Business Strategy document.

This Growth Servicing Strategy is one of the core enablers to ensure that growth of Endeavour Energy's network supports the delivery of Endeavour Energy's purpose, vision, and corporate strategies – in particular the objective of Network Availability and Capacity. Figure 6 below shows the line of sight between the Network Availability and Capacity objective and the Corporate Strategy.

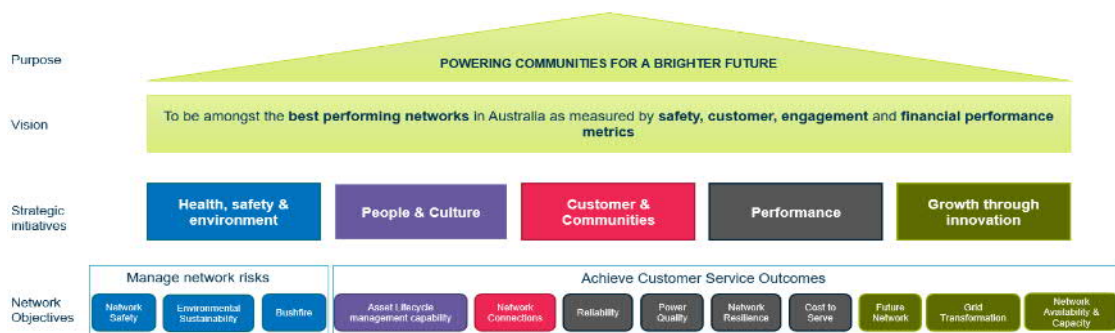


Figure 6 - Line of Sight to Network Objectives and Corporate Strategy

The relationship between this Strategy and the other artefacts within Endeavour Energy's asset management system is illustrated in Figure 7. A detailed description of Endeavour Energy's asset management system and its constituent parts is available in the Asset Management System Manual and the Asset Management System Guidelines.

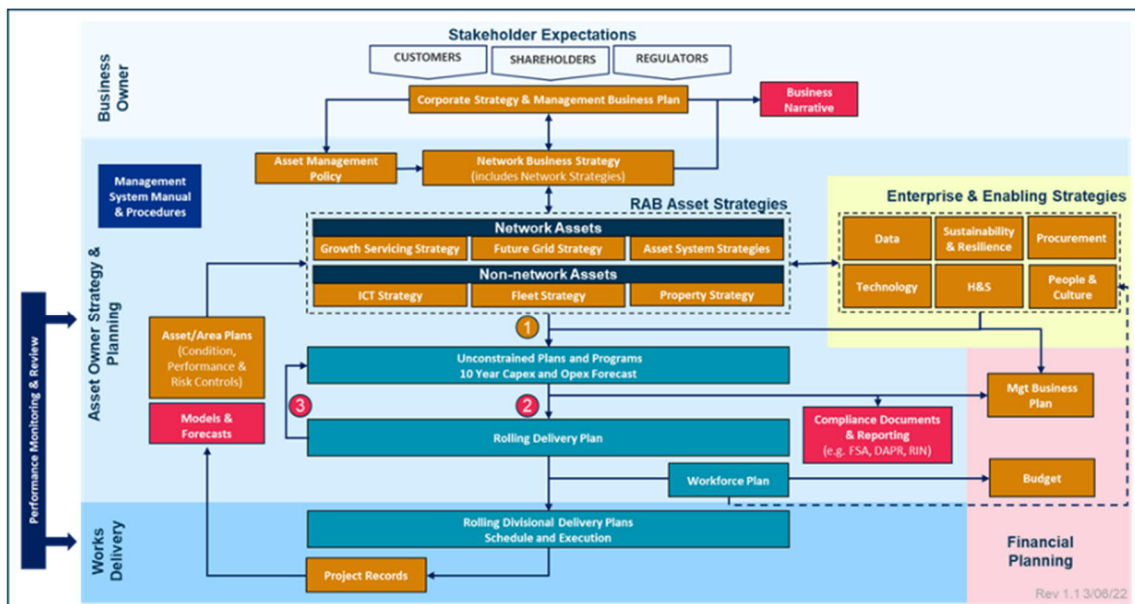


Figure 7 – Endeavour Energy Asset Management System artefact hierarchy



## 4.2 DPIE and NSW Electricity Roadmap objectives

The growth areas included in the strategy are aligned with the NSW Government’s plans for a Region of Six Cities<sup>9</sup>, the Greater Sydney<sup>10</sup> Metropolis of Three Cities and Regional NSW<sup>11</sup>. The investment in Endeavour Energy’s electricity infrastructure is aligned with these area plans. The DPIE plans include objectives that will influence the design and development of new electricity infrastructure within Endeavour Energy’s supply area. In addition, the DPIE plans will be critical to determine the timing of investment, in particular for greenfield development where electricity infrastructure will be required to facilitate new growth. A number of synergies between objectives of the growth strategy that support the relevant DPIE’s objectives are shown in **Table 6**.

Endeavour Energy Network Availability and Capacity Objectives	Growth Objectives Greater Sydney Vision	Growth Objectives Regional Vision (Illawarra-Shoalhaven)
Facilitate connection driven growth	Objective 1: Infrastructure supports the three cities Objective 2: Infrastructure aligns with forecast growth – growth infrastructure impact Objective 34: Energy and water flows are captured, used and re-used	Objective 2: Grow the region’s regional cities Objective 12: Build resilient places and communities Objective 25: Collaborate to leverage opportunities from Western Sydney’s growth
Facilitate demand driven growth	Objective 6: Services and infrastructure meet communities’ changing needs	Objective 12: Build resilient places and communities
Improve Network Utilisation and DER integration	Objective 4: Infrastructure use is optimised Objective 6: Services and infrastructure meet communities’ changing needs Objective 33: A low-carbon city contributes to net-zero emissions by 2050 and mitigates climate change Objective 34: Energy and water flows are captured, used and re-used	Objective 15: Plan for a Net Zero region by 2050 Objective 29: Utilise smart infrastructure to drive resilience, prosperity and vibrant places

**Table 6 – Synergies with DPIE Objectives**

**NSW Electricity Infrastructure Roadmap:** The Electricity Infrastructure Roadmap (Roadmap) is the NSW Government’s plan to transform its electricity system into one that is cheap, clean, and reliable. Although the roadmap is mainly focussed on large scale renewable energy generation and supporting transmission infrastructure, it includes actions with a view to deliver ‘whole-of-system’ benefits that will provide savings of around \$130 a year on the average NSW household electricity bill and \$430 a year on the average small business electricity bill between 2023 and 2040<sup>12</sup>. Endeavour Energy’s investments will align to the ‘whole-of-system’ vision roadmap through the prudence and efficiency testing (for example through new technology screening, and Non-Network Options reports discussed further in Section 5).

<sup>9</sup> From a metropolis of three cities to a city region of six cities, <https://greatercities.au/news/three-cities-to-six-cities>

<sup>10</sup> A metropolis of three cities, [https://gsc-public-1.s3.amazonaws.com/s3fs-public/draft\\_greater\\_sydney\\_region\\_plan\\_web.pdf](https://gsc-public-1.s3.amazonaws.com/s3fs-public/draft_greater_sydney_region_plan_web.pdf)

<sup>11</sup> Illawarra Shoalhaven Regional Plan 2041, <https://www.planning.nsw.gov.au/-/media/Files/DPE/Plans-and-policies/Plans-for-your-area/Regional-plans/Illawarra-Shoalhaven-Regional-Plan-05-21.pdf>

<sup>12</sup> NSW Electricity infrastructure roadmap, <https://www.energy.nsw.gov.au/government-and-regulation/electricity-infrastructure-roadmap/about-roadmap#-what-is-the-electricity-infrastructure-roadmap->

## 5. Response

### 5.1 Four step approach to respond to growth

To respond to the growth challenge, a four-step approach outlined in Figure 8 is used for both greenfield and brownfield growth stages of projects. The application of this approach ensures that the investment required to meet the objectives satisfy the prudence and efficiency test consistent with the NER. The four-step approach recognises the variation in qualifying need and determining timing for investments in greenfield and brownfield contexts and applies variation in these steps to ensure the appropriate investment response.

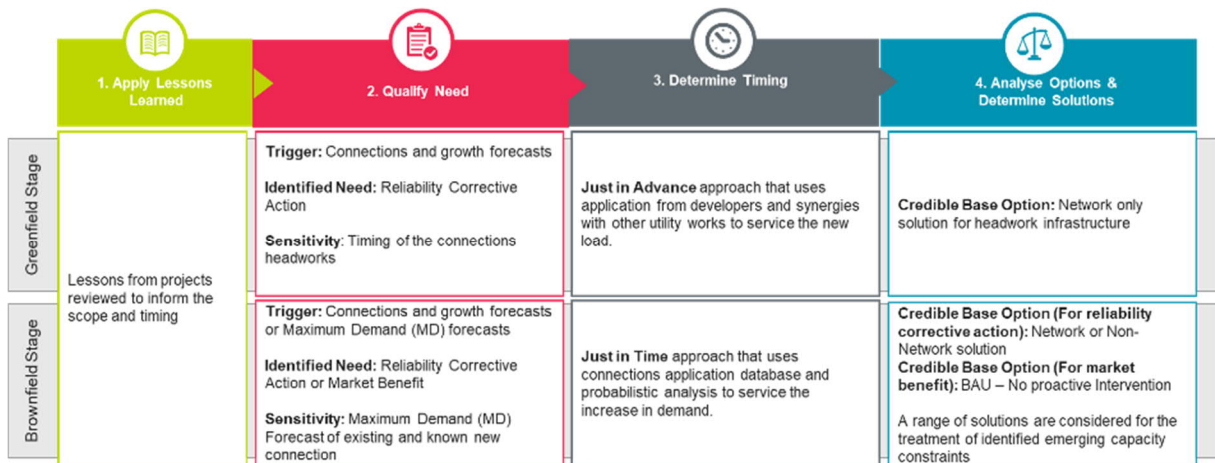


Figure 8 - Four Step Approach

It is also an important note that growth regions may be initially considered as greenfield for foundational infrastructure stages, but transition to a brownfield classification for later stage augments.

### 5.2 Servicing plans for widespread greenfield growth in Area Plans

The NSW DPIE has designated multiple Priority Growth Areas within the Endeavour Energy supply area, with the largest change in the North West, Central, South West, and Southern parts of the network. In each designated region there is a transformational change from agricultural / farming applications to dense urban environments (including future Central Business Districts). The regions are either distinctly absent of infrastructure, or any infrastructure that is existing is substantially undersized. Endeavour Energy uses Area Planning principals to plan the long-term needs of these priority growth areas. These plans overlay the variety of information sources to identify feasible long-term options, and appropriately place sub-transmission assets that support the growth. Area Plans play a key to aligning our individual investments to a broader plan.



Figure 9 – Example geographic from the Aerotropolis Area Plan

### 5.3 Step One – Apply Lessons Learned

In previous periods Endeavour Energy has underspent its Augmentation Expenditure (AUGEX) allowance. The primary reasons (in order of impact on the underspend) are listed in Table 7.

**Table 7 – Review of augmentation expenditure underspends**

Reason	Detail	Action
Delays from developers	Endeavour Energy deferred investment in several projects due to delays from the developers	Developer applications are analysed with a continual scan of the region that includes engagement with DPIE and other utilities to gain higher level of confidence.
Staging the provision of capacity	The delays from developers and the revision in the rate of growth (being slower than originally estimated) has resulted in deferment of investments.	Staging options (e.g., mobile substations or more extensions of 11kV) that include use of mobile substations is considered as part of the BAU options evaluation.
Non-Network Options	The outcomes of RIT-D process and other commercial arrangements substituted capital expenditure with operating expenditure (e.g., battery as a service).	Non-Network optioneering is now standard BAU with further investment in New Technology Master Plan (NTMP). All CFIs consider non-network options and selects the most commercial and technically credible option
Quantitative Risk Analysis	Endeavour Energy applies probabilistic risk assessment on servicing maximum demand.	Risk enabled approach by performing more sophisticated quantitative risk analysis
Capital efficiency – reduced unit rates	Through innovation funding several improvements have been made in design, delivery and standards resulting in lowering of unit rates.	Unit rates are progressively updated.

## 5.4 Step Two - Qualify Need

### 5.4.1 Connection Volume

The requirement of investment opportunity is validated through following sources:

- Connections forecast and New Growth – NSW Government body plans
- Customer Connection enquires (Customer Connection database).

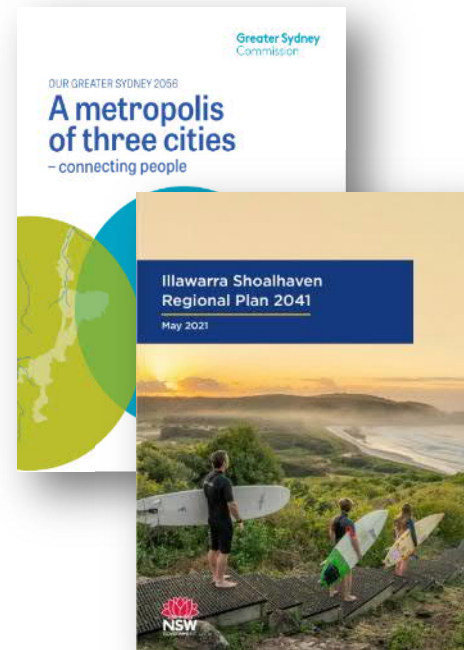
Endeavour Energy analyses both DPIE's forecasts and connections enquiries from developers to evaluate the need. For example, if the DPIE plan (which might be high level) says area A will have 10,000 residential properties by 2035 and the first developer for area A comes to Endeavour Energy with a connection application for 5000 properties in phase 1, then Endeavour Energy will use the developer's forecast to determine a project scope. Typically, utilising a staging approach when the growth forecast is over a large time horizon.

#### Connections Forecast and New Growth

DPIE publishes plans that are regularly updated with the latest forecasts of population growth, zoning, and release of land. The Greater Cities Commission plan (called Metropolis of three cities) and Illawarra-Shoalhaven plans<sup>13</sup> published on the DPIE's website are examples of such plans that Endeavour Energy uses to inform its case for investments.

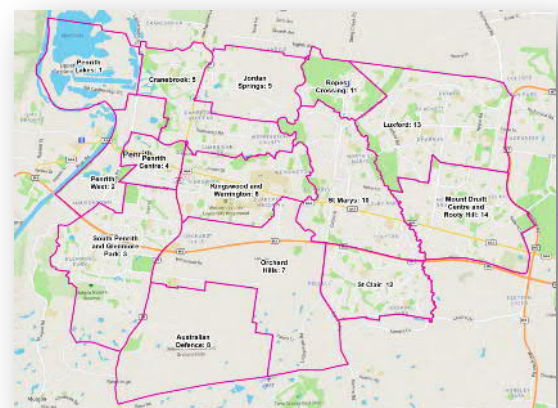
**Metropolis of Three Cities:** This plan informs district and local plans and the assessment of planning proposals. In addition, it is developed to assist infrastructure agencies to plan and deliver for growth and change and to align their infrastructure plans to place-based outcomes.

**Illawarra-Shoalhaven regional plan:** This plan informs local councils' land use planning, informs the work of infrastructure agencies to plan for growth and change, and informs the private sector and the wider community of the NSW Government's approach to creating a connected, sustainable, innovative, and vibrant Illawarra-Shoalhaven



#### Customer Connection Enquiries

Endeavour Energy receives and records connection enquiries and applications in centralised databases with unique tracking numbers assigned to each. This allows the tracking of developments across the whole network and in specific regions of focus. Areas of focus may include regions with strategic plans underpinning urban infill and densification developments. For example, the Greater Penrith to Eastern Creek Place Infrastructure Compact (Greater Cities Commission<sup>14</sup>) focuses on densification and urbanisation outcomes in an existing established corridor from Mount Druitt through to Penrith and from Orchard Hills to Jordan Springs. Tracking applications and enquiries in these regions informs the progress of developments in these regions and allows a forward demand profile to be constructed.



<sup>13</sup> <https://www.planning.nsw.gov.au/Plans-for-your-area>

<sup>14</sup> <https://greatercities.au/project/western-sydney-pic-program>

## 5.4.2 Demand Forecasts

The demand forecasts consist of following stages:

- Annual Demand forecasts
- Post Model Adjustments (bi-annual)

### Annual Demand Forecasts

Endeavour Energy is required to prepare long-term demand forecast for network planning purposes and submits the forecast to TransGrid, AEMO and the AER for their use and review. Endeavour Energy's demand forecasting techniques adopt the industry standard methodology in terms of processes and inputs. This involves analysing historical trends in electricity demand and correlating these trends against the drivers of electricity demand. All the forecasts are presented on a temperature corrected 10% and 50% Probability of Exceedance (PoE) basis. Historical and forecast peak demands 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). The forecasts provide both undiversified and diversified values where metering is available.

*Note on Greenfield Projects:* It is noteworthy that for greenfield projects, there is no historical trends in electricity demands.

There are two outputs from the demand forecasts:

- **Annual Transmission Network Planning Review (TNPR):** The TNPR identifies capacity constraints on Endeavour Energy's 132kV, 66kV and 33kV sub transmission network. The annual Endeavour Energy Summer and Winter Demand Forecast reports provide the basis for the transmission analysis. Specifically, the intent of the TNPR is to identify system constraints that will occur under "System Normal" and "Single Contingency" situations within the ten-year forecast period, and the year in which the constraints are likely to occur.
- **Distribution Annual Planning Review (DAPR):** This Distribution Annual Planning Report (DAPR) has been prepared to comply with National Electricity Rules (NER) clause 5.13.2. It reflects the outcomes of the annual planning review of Endeavour Energy's network. The DAPR mapping portal is available on <https://dapr.endeavourenergy.com.au>. The aim of 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 particularly for investments where the AER Regulatory Investment Test for Distribution (RIT-D) applies.

Finally, the demand forecast, TNPR and DAPR provides planners with insights into the existing capacity and forecast capacity to inform the connection optioneering that looks to maximising the utilisation of existing assets.

### Post Modelling Adjustments (PMA)

Post-model adjustments to the demand forecast considers changes in electrical demand resulting from several energy reduction policies, programs, technologies and other drivers. While this approach produces statistically sound forecasting models, Endeavour Energy is mindful that to improve the accuracy of demand forecasts, an up-to-date understanding of the changing trends and future new drivers of consumption and technologies is required. A bi-annual PMA report for Endeavour Energy is produced that includes a breakdown by policy/driver type, customer type, technology and season for both peak summer and winter demand and annual energy consumption. The PMA is aligned with AEMO's Electricity Demand Forecasting Methodology Information Paper<sup>15</sup>

**Demand Shapers:** Uptake of new technologies, increased appliance and end-use efficiency and 'demand shapers' such as rooftop solar PV installations and batteries has resulted in lower per-unit demand for new connections, both in established areas as well as new greenfield areas, but this is not necessarily offset by the growth in the number of connections.

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<sup>15</sup> AEMO Electricity Demand Forecasting Methodology Information Paper, Aug 2020

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- The above features are factored into the assessments of the impact that this growth is expected to have on the network.
- *Note on Greenfield Projects:* To ensure prudence in assumptions of load forecasts, the Maximum Demand (MD) for greenfield projects is informed by PMA demand models.

### 5.4.3 Qualifying Need and Investment program alignment

The significant proportion (approximately 70% by combined augmentation and connection expenditure value) of Endeavour Energy's growth is Greenfield driven, and as is described in earlier section the reliability corrective action for these connections is both timed and sized using the latest forecasts from Government and Council departments, as well as data submitted the land holders and developers directly. On collation of this data, while there is a procedural review of existing asset Demand Forecast information, the conclusion is often reached that a Reliability Corrective Action is the only feasible long-term option available to sustainably service the growth.

A much smaller proportion of our growth is related to existing assets (<30% by combined augmentation and connection expenditure value) and is relevant to the Demand Forecast pathway for need qualification.

Investment needs are also further considered in a context of any existing adjacent network equipment and its associated replacement programs (also referred to as REPEX). Opportunities for alignment or adjustment in the identified need are captured and considered in identifying the need.

## 5.5 Step Three - Determine Timing

### 5.5.1 Determining Timing for Greenfield Growth

In addition to information available from the NSW Government's plans, Endeavour Energy also uses the following sources to determine the ideal timing of the project:

- Application from Developers
- Collaboration with other utilities

Validation of these inputs is performed by scrutinising supporting activities including the lodgement or approval of either Development Applications or State Significant Development Applications. In the case of developments with lower network requirements and a slower ramp rate, the application to connect or the start of construction activities are similarly useful informers to the required timing.

The scale and type of underlying land holdings is considered and in particular the nature of the underlying land holdings. For land or precincts involving large individual holdings development can progress from rezoning to development to construction in relatively short timeframes. Communication with stakeholders is a key informant in this case. Where development is being undertaken on land with more fragmented ownership the development timeframe can be extended. This does allow a more reactive response but relies on received enquiry and application data to inform on the progress of developments and to construct a forward demand profile.

### 5.5.2 Applications from Developers

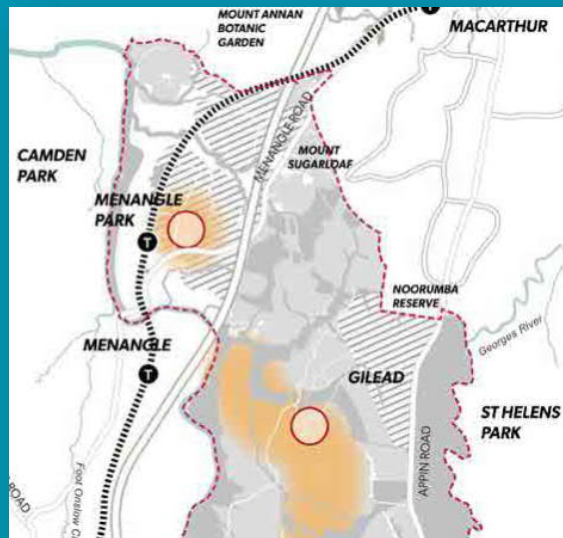
Endeavour Energy analyses applications from developers. Learnings are used to inform the scope as well as the timing of associated investments. The following case study is an example of lessons learned from Endeavour’s case study library:

#### Case Study: Mt. Gilead Zone Substation

**Key Outcome:** The investment of Mt. Gilead ZS was deferred due to delays in zoning application.

**Trigger:** In 2015, Lendlease proposed a residential development of approximately 1,700 lots at Gilead. The development was setup into two stages to service mainly residential load in greenfield development. There was not enough capacity in the area, which required construction of a new zone substation. The construction was estimated to commence in FY22 with \$20m of expenditure forecast to be invested in FY20-24 regulatory period.

**Sustainable Growth:** Endeavour Energy worked in collaboration with the developer to assess the timing of the load requirements. The load required for the first stage of development was serviced by installing a feeder from the adjacent Ambarvale ZS. The DPIE plans<sup>16</sup> suggested that by 2026 new zone substations need to be established in the Mount Gilead area to supply the area. Endeavour Energy did not use DPIE’s forecast and worked with Lendlease to determine the optimum timing for the project. Due to the risk of development impacting on Koala populations, the development of the second stage was a known risk and investment was put on hold until further clarification. Endeavour Energy is also working with developer on community battery solutions that could result in a 1–2-year deferral of the future zone substation.



**Benefits Realisation and Investment:** The capital expenditure of a new zone substation at Mt. Gilead has been deferred. .

### 5.5.3 Collaboration with other utilities

The Western Sydney Utilities Collaboration Group (UCG) was established in August 2019 to focus on innovative collaborative planning and delivery of utility infrastructure along identified corridors within Western Sydney. The UCG performs under an Agreement which supports the vision for the Parkland City and the Western City Parklands Authority Utilities Leadership Group (ULG).

The UCG members include Jemena, Transport for NSW, Sydney Water, NSW DPIE, Sydney Metro, TransGrid and Endeavour Energy.

The UCG meets monthly to focus on the Priority Program, escalations and includes out of session discussions to focus on specific corridors or project collaboration. The relevant purposes of UCG for the growth strategy are:

- Facilitate the planning and delivery of integrated utilities to service the Western Parkland City.

<sup>16</sup> <https://s3.ap-southeast-2.amazonaws.com/dpe-files-production/s3fs-public/dpp/297943/Greater%20Macarthur%202040%20Interim%20Plan.pdf>

- To optimise investment opportunities and ensure on-time delivery for industry and the community.

Endeavour Energy uses this forum to inform the timing of augmentation expenditure, in particular asset relocation or installing underground conduits to leverage off the synergies.

### 5.5.4 Determining Timing for Brownfield Growth

The timing of the brownfield projects is determined by:

- Volume of Connection Applications
- Rate of growth of maximum demand

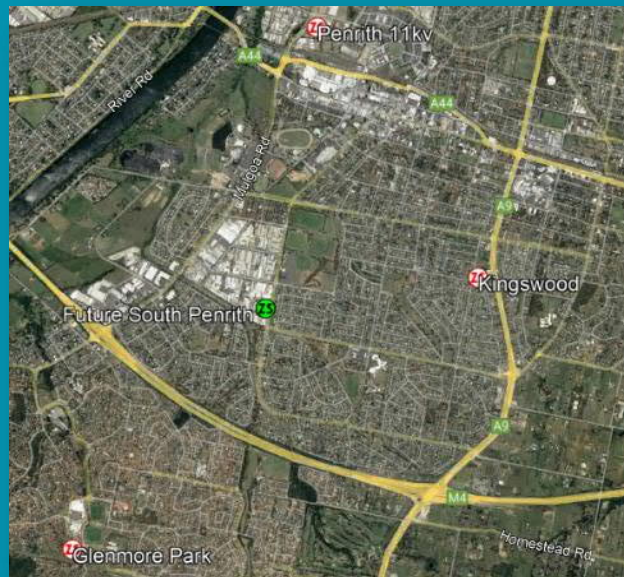
Endeavour Energy uses this information to form views on the likely investment required and the timing of such investment. Cases of brownfield growth are increasingly becoming candidates

**Case Study and Key Outcome:** The development of a zone substation was deferred by using large-scale batteries (20MVA / 40MWh).

**Trigger:** Endeavour Energy publishes a Distribution Annual Planning Review (DAPR), which includes demand growth forecasts, network performance, identified network constraints and major projects completed and future projects. A future South Penrith Zone Substation was flagged in the DAPR report as a potential new infrastructure to address the risk of involuntary load shed arising from increasing demand in the South Penrith area. The company Firm Power approached Endeavour Energy to discuss the opportunity to connect a large-scale battery to a strategic section of the Western Sydney medium voltage distribution network.

**Future Energy Choices:** This project demonstrates an innovative power-as-a-service model. This model will not only provide power system and energy services but will also provide network services by injecting power into the grid during times of critical peak demand. Endeavour Energy assisted Firm Power in their bid to gain ARENA funding, including a letter to Firm Power in May 2020 indicating in-principle support for the proposal as well as development of a Support Agreement Principles document.

**Benefits Realisation and Investment:** The capital expenditure of South Penrith Zone Substation has been deferred. This deferral value of the zone substation is approximately \$1m/year, which sets the upper bound of the support payment (operating cost). While the peak demand in the immediate area has dropped, surrounding areas of growth are now able to be supported using remotely operable cross zone substation feeder ties. This project mitigates the immediate load at risk and allows the optimisation of brownfield investment timing.





## 5.6 Step Four - Analyse Options and Determine Solution

Endeavour Energy undertakes ongoing reviews of the capacity of its network and its ability to supply the forecast demand for electricity supply. These reviews identify where the existing network can be utilised as much as possible to supply increasing numbers of new connections. Based on this approach a range of solutions are considered for the treatment of identified emerging capacity constraints, which are detailed below.

### 5.6.1 Utilisation of the existing network and minor network extensions

Utilisation of assets is one of the key metrics measured by AER. For both growth in brownfield and greenfield areas, the utilisation of existing assets must be explored as first priority. Following are some of the key points:

- The capacity of the existing infrastructure is optimised through operational changes and minor investments to defer the constraint for as long as it is practicable to provide initial capacity.
- Capacity from adjacent zone substations is utilised wherever possible through the provision of new distribution feeders or the extension of existing ones, assuming it is technically feasible to do so. Whilst this can come at a cost it is generally a low-cost start to the establishment of supplies in new developing areas.
- This generally only provides short-term capacity for greenfield areas but can result in medium term deferral in redeveloping areas.

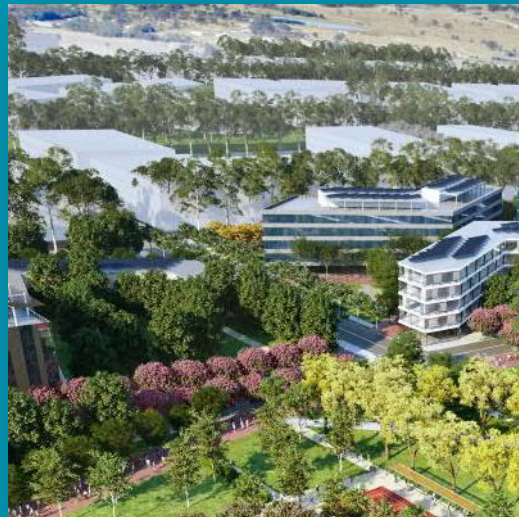
#### Case Study: Science Park Zone Substation

**Key Outcome:** The investment of Science Park Zone Substation was deferred by utilising assets from the existing Luddenham Zone Substation to power the initial stages of the development.

**Trigger:** It was estimated that 49MVA of load was required based on the significant growth outlined by the developer. Considering this level of demand, a new dedicated zone substation was deemed to be the commercially and technically viable credible solution.

**Sustainable Growth:** Endeavour Energy worked in collaboration with the developer to assess the timing of the load requirements. The development was setup in several stages, with demand for Stage 1 of this project estimated at 6.2MVA. This was supplied from Luddenham Zone Substation, which is the closest supply point to the Science Park development being located approximately 5 km to the west. As further stages of development were firmed up, two additional feeders were run from Luddenham Zone Substation which required modifications to decommission the Audio Frequency Injection Control (AFIC) equipment to make room for the connection points.

**Benefits Realisation and Investment:** The capital expenditure of a new zone substation at the Science Park was deferred. The utilisation of Luddenham Zone Substation increased from 30% to 70%.



## 5.6.2 Non-network solutions

The National Electricity Rules require that a DNSP investigate non-network options as an alternative to network capital investment to address network capacity or capability limitations, and that these be sought through open consultation processes with the community and non-network energy service providers. Non-network solutions are typically not Standard Control Services. Following are some of the key points in developing and assessing non-network solution options:

- o Endeavour Energy's Future Grid Strategy (which includes Demand Management and Non-Network approaches) guides the pursuit of non-network options instead of major augmentation.
- o **Utilising the New Technology Master Plan (NTMP):** Endeavour Energy has developed a proactive approach to the efficient use of non-network solutions to alleviate network constraints and respond to network needs, in the interest of the business and our customers. 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 options). The tool extends value beyond the DNSP view and informs on the wholistic value stack as it would apply to all market participants.
- o Demand Management initiatives are pursued on a case-by-case basis in accordance with the need to relief significant capacity constraints. Opportunities from the market for the provision of non-network options are sought in accordance with regulatory requirements.
- o Endeavour Energy is actively pursuing new technological developments such as battery storage, and other options to provide broad-based demand management solutions. For example, the 20MW Western Sydney Smart Battery (WSSB) located adjacent to Penrith Zone Substation.<sup>17</sup>

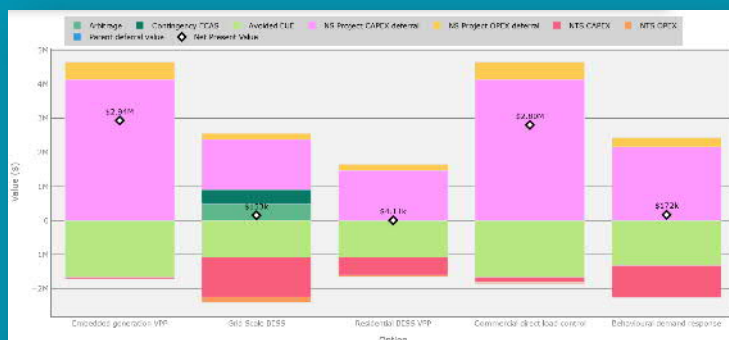
### Case Study: Identifying credible non-network options (NNO's) for load growth in West Dapto

**Key Outcome:** Credible non-network options are identified and are proposed as possible deferral options of a zone substation investment.

**Trigger:** Located in the West Lake Illawarra region, the West Dapto region will ultimately deliver more than 19,000 dwellings by 2051. Commercial, industrial, and central service precincts will complement the region's growth.

**Future Energy Choice and Sustainable Growth:** Endeavour Energy has already deployed a grid scale Battery Energy Storage System (BESS) on one of the constrained distribution feeders in the region. Charging at low load times and discharging during constrained hours, the BESS reduces network congestion during peak times. The identification of further non-network and new-technology options through the NTMP tool will seek to defer the major substation further.

**Benefits Realisation and Investment:** A Non-Network Options report is recommended to be issued, that will invite all options, but also recommend Demand Response and Grid Scale Storage options to defer investment.



(Image: NTMP outputs with indicative value of NNO's compared to credible Network Solutions)

<sup>17</sup> <https://www.firmpower.com.au/wssb>

### 5.6.3 Network augmentation (includes New Technology)

Network augmentation includes investment that is classified as Standard Control Services. Following are some of the key points in developing and assessing options for network augmentation:

- In higher growth areas or where the scale of the development warrants this, new zone substations and supporting sub transmission network infrastructure may be required once non-network options have been exhausted.
- **Utilising New Technology Master Plan (NTMP):** The NTMP tool will furnish Endeavour Energy with the knowledge and business capabilities that will allow for the effective identification of new technology options as network augmentation options.
- Where growth forecasts are lower, temporary substation installations (using mobile substations) may be deployed to appropriately stage the deployment of upstream supply infrastructure in alignment with the staging of the land development and its uptake.

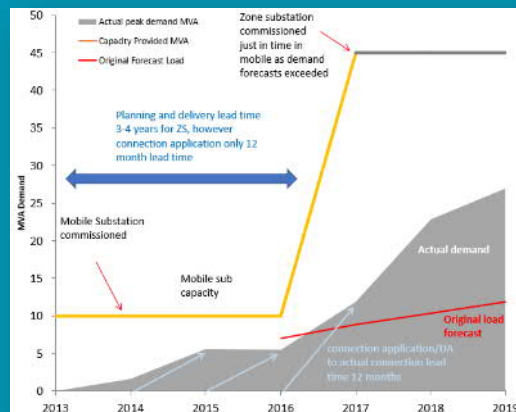
#### Case Study: Oran Park Zone Substation

**Key Outcome:** The investment of zone substation was deferred by utilising a mobile substation.

**Trigger:** Located in the Camden Local Government Area, Oran Park Town is a 380ha greenfield site that will eventually be home to 25,000 people in 10,000 new homes<sup>18</sup>.

**Safe, affordable, and reliable:** The development consists of mostly residential load. When the developer approached Endeavour Energy, there was not a high level of certainty on the timing of the development. Endeavour Energy had the ability to supply 10MVA of capacity by utilising a mobile substation, whilst the details of the timing of development were confirmed.

**Benefits Realisation and Investment:** The mobile substation provided 10MVA of capacity from 2013 to 2016. The rate of growth after 2016 was more than double the original load forecast with load in 2017 being greater than 10 MVA. The zone substation was commissioned just in time in 2017.



#### Supporting request for connection of large spot loads

Large spot connection requests are received for a wide range from applications including advanced automated logistics hubs, advanced manufacturing centres and data centres. These applications can be in the 10's or 100's of megawatts and are received with little prior notice.

Servicing connections of this magnitude requires diligent case by case planning and is cross informed by the long-term interest of surrounding customers. Solutions may require the provision of connecting infrastructure such as switching stations to provide reliable connection and capacity to adjacent precincts and the associated customers.

<sup>18</sup> <https://www.landcom.com.au/industry-news/industry-news/oran-park-town-from-paddock-to-masterplanned-town-in-southwest-sydney/>

## 5.6.4 Planning for the long term and phasing of network options

Where network augmentation is proposed, credible options are identified and tested in two primary ways:

- Firstly, the **selection of credible long-term options** in the context of the broad area plans, and
- A test of **phasing of the credible long-term option** for opportunity to defer stages of investment.

It is noted that where augmentation is required on the basis of reliability corrective action, both of the above steps apply a market benefits assessment approach in testing for the highest NPV option.

### Selection of Credible long term Network Options

The developed Area Plans (Section 5.2) play a key role in providing foresight to each individual investment within the long-term options for growth within the broader servicing methods for a region. Credible network options are identified by those that are aligned to the long-term region plans. The subset of long-term options is then tested with market benefits to identify the credible network option with the highest NPV.

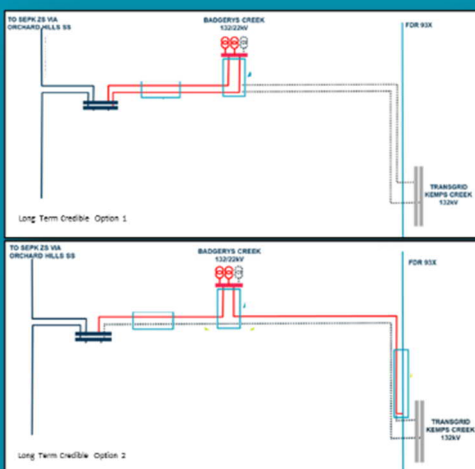
### Phasing of preferred long-term options

The identified network need may not always require the deployment of the complete long term network option. To deliver the highest value for customers, the long-term network option is then considered for phasing of the option. This may include, for example, the phasing of either a busbar configuration, the number of power transformers, or switchboard configurations. The phasing of a preferred option also promotes the feasibility of new-technology and non-network solutions to service the later stages of development following the provision of the initial connection availability.

#### Case Study: Selection of a long-term credible option for wider Aerotropolis and Badgerys Creek

##### Context

The Badgerys Creek development area within the Western Sydney Aerotropolis will see the development of mixed-use Enterprise precinct and the Sydney Water Advanced Water Recycling Centre. A zone substation is required for reliability corrective action. The foundational supply for the whole Aerotropolis region is by a transmission feeder ~24km along the western boundary from South Erskine Park in the North to Bringelly in the South. The long-term bulk supply will be from a future TransGrid site in Kemps Creek (timing TBC ~2030-2035)



##### Credible Long Term Network Options

Identified credible long term network options included variations on transmission feeder routes. Particularly options of continuing the supply from a west to east direction from the foundational supply, or the construction of an eastern link toward the future Bulk Supply Point.

##### Safe, affordable, and reliable

The long-term analysis identifies the establishment of an eastern link provides an optimal outcome across all precincts in the region due to the improved reliability by market benefits analysis.

## 6. Summary

This Growth Servicing Strategy has provided an overview of Endeavour Energy's response to growth across our network. It describes the strategic context of growth and the significant change occurring both across our regions and the wider energy industry. A considerable insight into our responses including several case studies is provided for examples of how we support growth.

Our plans are continually adjusted as new inputs are received and are further supplemented by annual or period reviews (such as the Distribution Annual Planning Report or *DAPR*, and updates to Area Plans and Cases for Investment). Our investments in growth are supported by our investment decision support tool (IDST), portfolio optimisation activities (both inter and intra-portfolio), and investment governance procedures.

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