Appendix 1.16:

Network Development Plan

Regulatory proposal for the ACT electricity distribution network 2024–29

NETWORK DEVELOPMENT PLAN

This Network Development Plan provides strategic view of the development of Evoenergy's electricity network and explains the methodology employed in the preparation of the plan.

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FREQUENTLY USED ACRONYMS AND ABBREVIATIONS

AEMO	-	Australian Energy Market Operator
DER	-	Distributed Energy Resources
EV	-	electric vehicle(s)
ISP	-	Integrated System Plan
NZM	-	net zero model
NDP	-	Evoenergy's Network Development Plan
NZ45	-	net zero emissions 2045 target
PV	-	photovoltaic installation
SAMP	-	Evoenergy's Strategic Asset Management Plan
ZEV	-	zero emissions vehicle(s)

1. INTRODUCTION

1.1 Purpose

This Network Development Plan (NDP) is an outcome of the strategic planning conducted in line with Evoenergy's asset management system. The purpose of the NDP is to provide the long-term view of the drivers impacting the electricity network and the ensuing electricity supply requirements. The NDP sets out the long-term context together with strategy which underpins our work programme.

1.2 Scope

This NDP focuses on the long-term requirements of the electricity supply in the ACT. The plan identifies the key existing and emerging trends in consumption, technology, and policy initiatives. The NDP assesses consequential network constraints, risks, and opportunities in relation to the network primary assets. NDP explains how we considered these factors in the development of the electricity network transmission and distribution assets.

The NDP's focus is firstly on the constraints impacting the network and secondly, on the corresponding solutions. NDP identifies our proposed medium-term projects and potential long-term projects.

NDP assessments of network augmentation are integrated with asset replacement, reliability, and power quality. Thus, the needs of the primary assets have been considered in a broad operational context.

1.3 Timeframe

The NDP endeavours to provide a medium-term view and a long-term view of Evoenergy's network development.

Whenever possible a 20 year time frame or longer is applied. However, this may vary depending on the information available for each planning area including:

- Long-term master plans for each ACT district
- Primarily qualitative analysis
- Outlines known future development and trends and expected areas of constraints, risks, and opportunities
- References key government artefacts & other relevant information e.g. ACT Planning Strategy
- Outlines key known drivers of augmentation
- Annual Planning Report

Figure 1 below indicates typical timeframes for the key network planning artefacts:

- Annual Planning Report: 5 years for distribution and 10 years for transmission
- Business cases: 5 years for distribution and 10 years for transmission

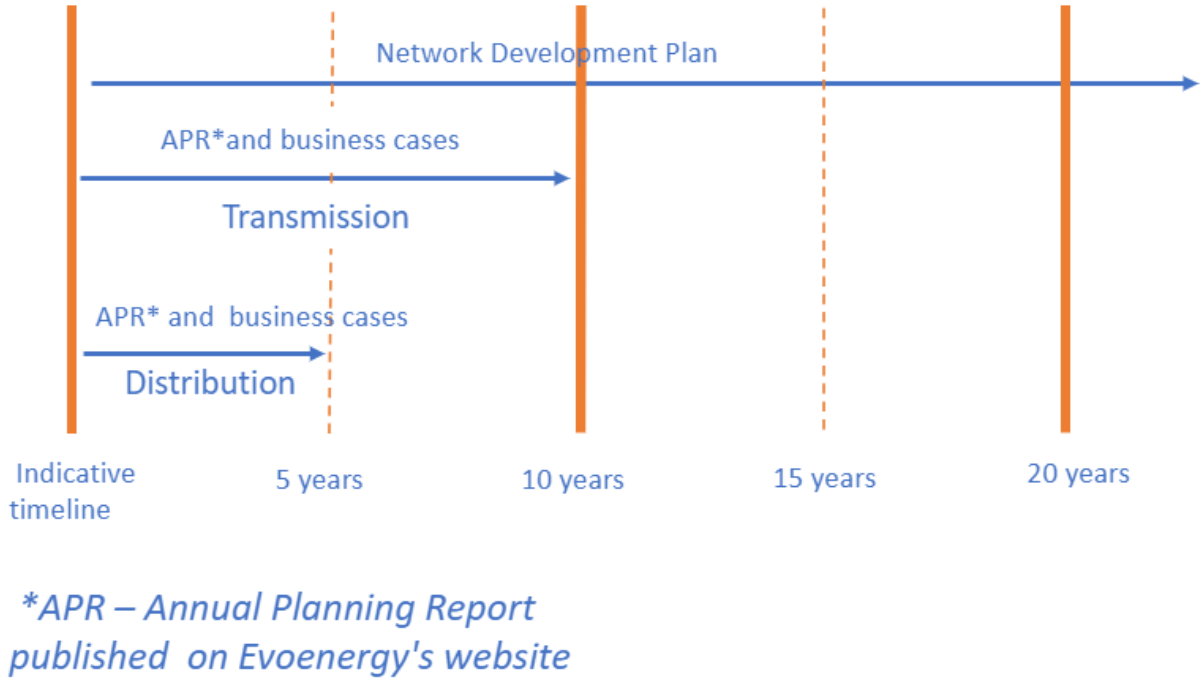


FIGURE 1. TYPICAL PLANNING TIMEFRAMES

1.4 Framework

The Network Development Plan (NDP) is part of Evoenergy's Asset Management System. It has been prepared together with the methodology and processes set out the following artefacts:

- Asset Management Objectives
- Strategic Asset Management Plan
- Distribution Network Augmentation Standard
- Annual Planning Report

Figure 2 depicts and overview of the main components of our asset management framework including the Network Development Plan.

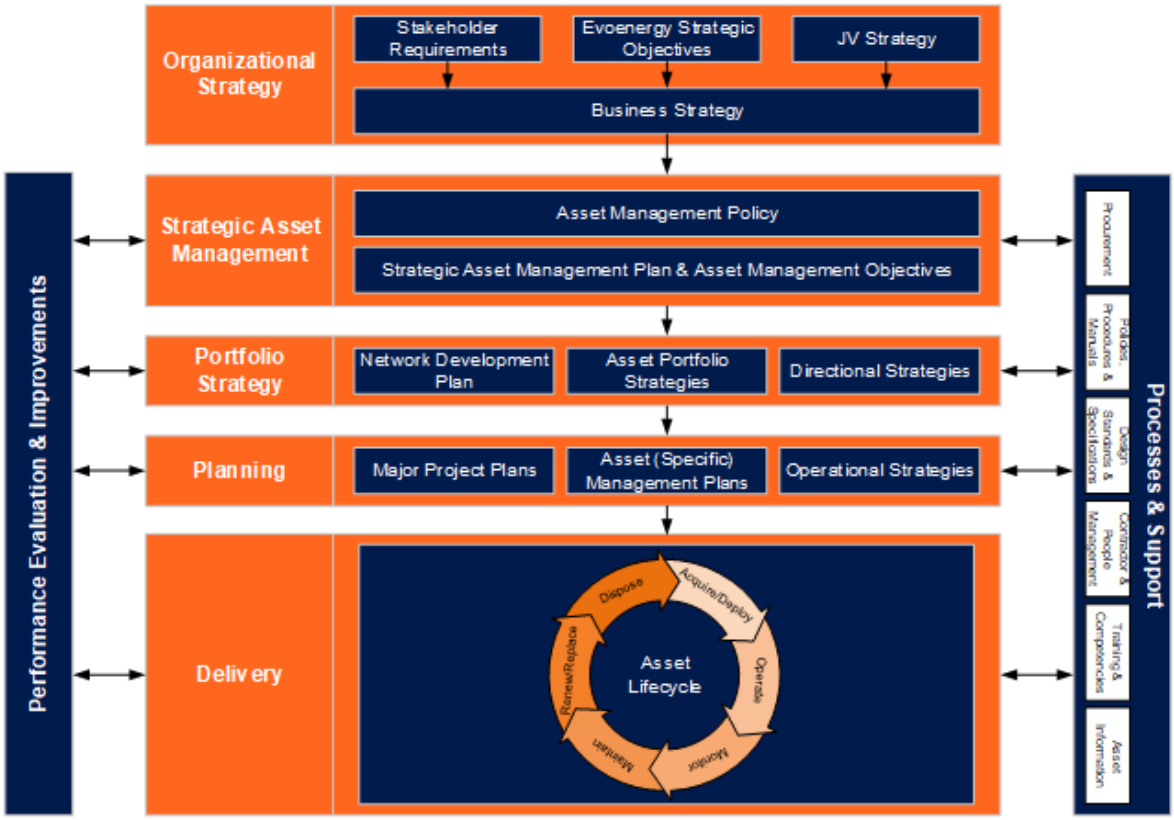


FIGURE 2. ASSET MANAGEMENT FRAMEWORK

1.5 Operating environment

Evoenergy operates the electricity transmission and distribution network in the ACT with a small number of consumers located in NSW. As of December 2022, our network consists of over 180 km of transmission lines, 16 zone substations and switching stations, almost 4800 distribution substations, over 2100 km of overhead distribution lines, and over 2500 km of underground distribution lines. A range of operating parameters including configuration, structure and quantity of electrical network assets are discussed in detail the Annual Planning Report (APR) published on the Evoenergy's website.

Figure 3 shows the existing geographic configuration of transmission lines and substations within the Australian capital Territory.

Figure 4 shows the schematic of the existing and proposed future network components.

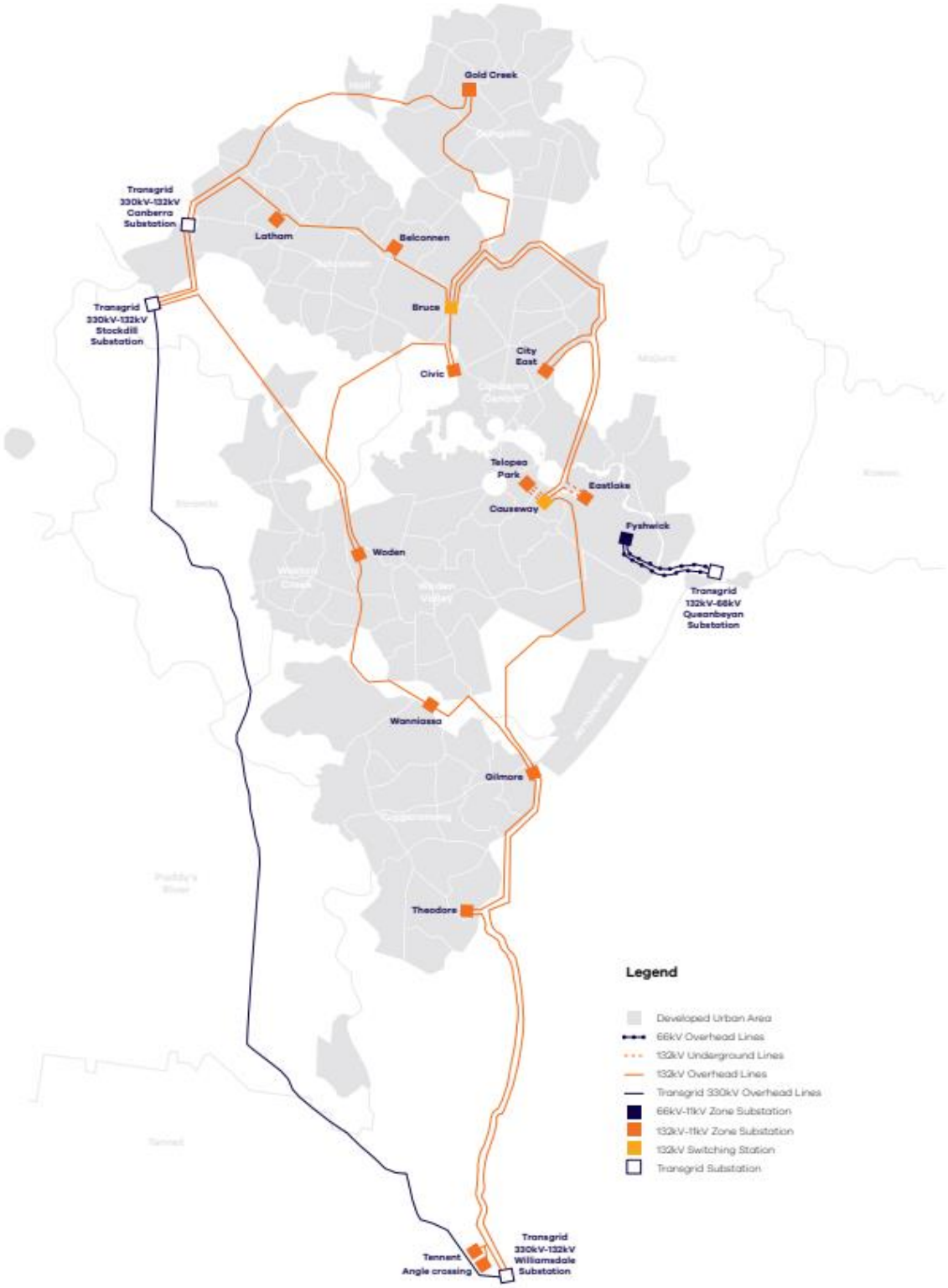


FIGURE 3. EXISTING EVOENERGY'S TRANSMISSION NETWORK (DECEMBER 2022) – GEOGRAPHIC REPRESENTATION

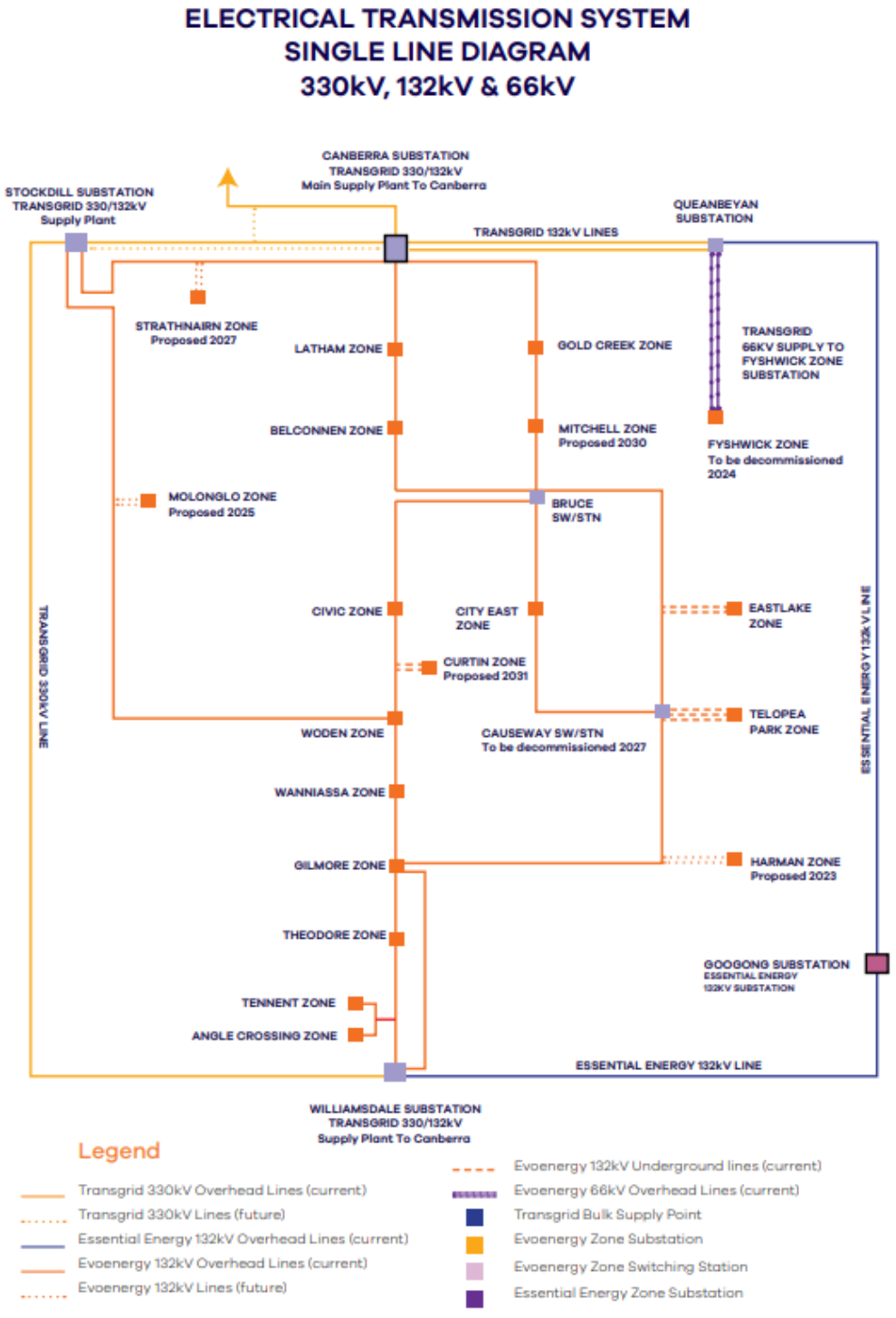


FIGURE 4. ELECTRICAL TRANSMISSION SYSTEM INCLUDING FUTURE ZONE SUBSTATIONS.

The schematic depicts representation of the existing Evoenergy transmission network, interconnecting Transgrid and Essential Energy lines, and existing and proposed zone substations. Notably, under some network contingencies involving Transgrid's line outages, Evoenergy's network provides support to the regional transmission network.

2. DRIVERS

We have identified three primary factors which are driving significant implications for the Evoenergy electricity network in the short, medium, and long term. These include:

- The transition to net-zero
- Urban intensification
- The ongoing roll-out of Distributed Energy Resources.

Each of these drivers, both individually and together, are and will drive changes in respect of the scale, function, and criticality of the Evoenergy electricity network. The following sections provide more context and detail on these drivers and the implications to the Evoenergy electricity network.

2.1 The transition to net-zero

2.1.1 Background

Climate change and climate change policies are expected to have significant impact on Evoenergy's electricity network., ACT, in collaboration with NSW Government, undertook modelling of climate changes in the near term (up to 2039) and long term (2060-2079). The diagram below shows a snapshot of climate change parameters derived from that modelling[1]. The results of the modelling informed the ACT Government climate change strategies and consequential energy policies.

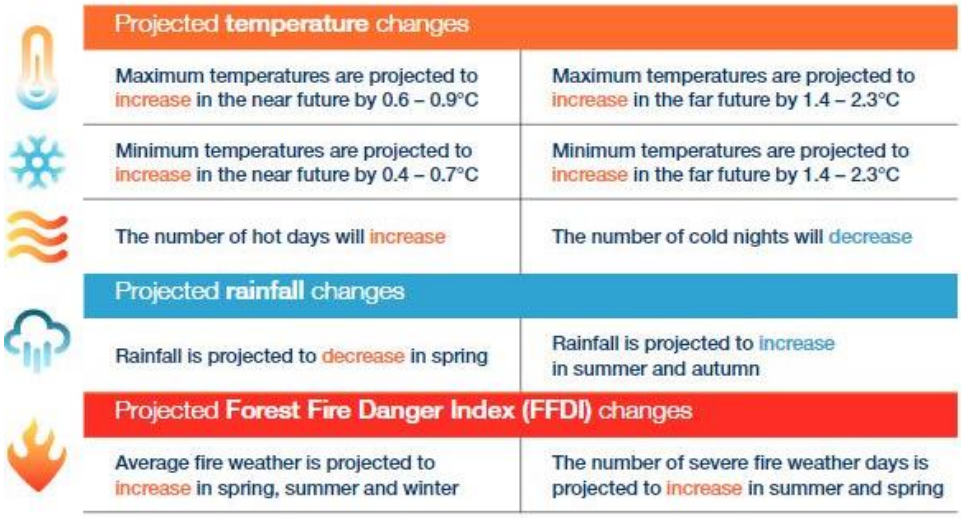


FIGURE 5. ACT GOVERNMENT – CLIMATE CHANGE MODELLING

In 2019, the ACT has achieved 100% renewable energy target with the intention to maintain it into the future as energy consumption grows.

Both Commonwealth and Territory governments have set out climate change polices and net zero targets.

The consequential effect of net zero on the electricity network is discussed in the sections below.

2.1.2 Net zero target

The ACT net zero target refers to the target date for achieving carbon neutral position in the Australian Capital Territory. The target is set for 2045 in the ACT while the national target is set for 2050.

[1] ACT Climate Change Snapshot, 2020

The legislated ACT Government emission targets set out the following reduction milestones comparing with 1990 CO_2 emissions level.

- Year 2020: reduction of 40%
- Year 2025: reduction of 50% to 60%
- Year 2030: reduction of 65% to 75%
- Year 2040: reduction of 90% to 95%
- Year 2045: zero emissions

The above reduction milestones are aligned with the ACT Climate Change Strategy which is being implemented through a range of initiatives in urban planning, energy, and transport to reduce or eliminate greenhouse emissions.

2.1.3 Implications for the Evoenergy electricity network

ACT Government initiatives which are designed to reduce emissions over-time translate to varied impacts on electricity network. Some factors tend to mitigate peak demand growth while others enhance the peak demand and capacity constraints. Figure 6 below lists key climate policy initiatives and their corresponding impact on the network.

Material increases in peak demand create constraints within distribution and transmission levels, including localised network constraints at zone substations and distribution feeders.

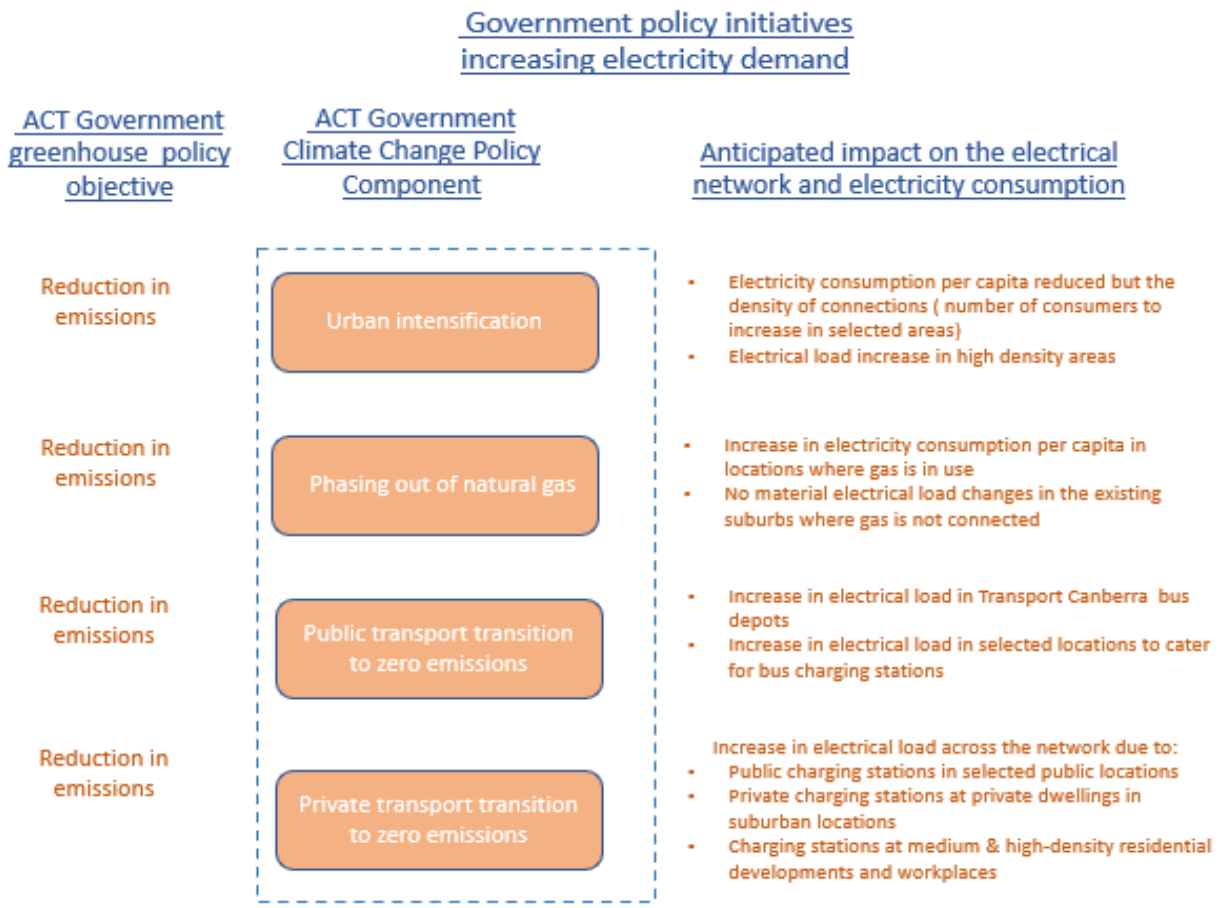


FIGURE 6. EXOGENOUS FACTORS CONTRIBUTING TO THE GROWTH IN ELECTRICAL DEMAND

While providing many benefits, the proposed electrification pathway reduces energy diversity and increases the criticality of the electricity network. These risks are higher at times of low rooftop PV output. Lower

outputs are likely to occur in winter during a series of cloudy days. There may be periods of high demand due to chilly weather, low roof top PV output and limited energy stored in batteries which may push the electricity network well beyond P10 maximum demand. Evoenergy considered increased operational risk and uncertainty in the preparation of this NDP.

Figure 7 below summarises key ACT Government climate change initiatives mitigating peak demand in electricity network. The components have been assessed by Evoenergy as factors mitigating growth in peak demand, energy consumption volumes or both.

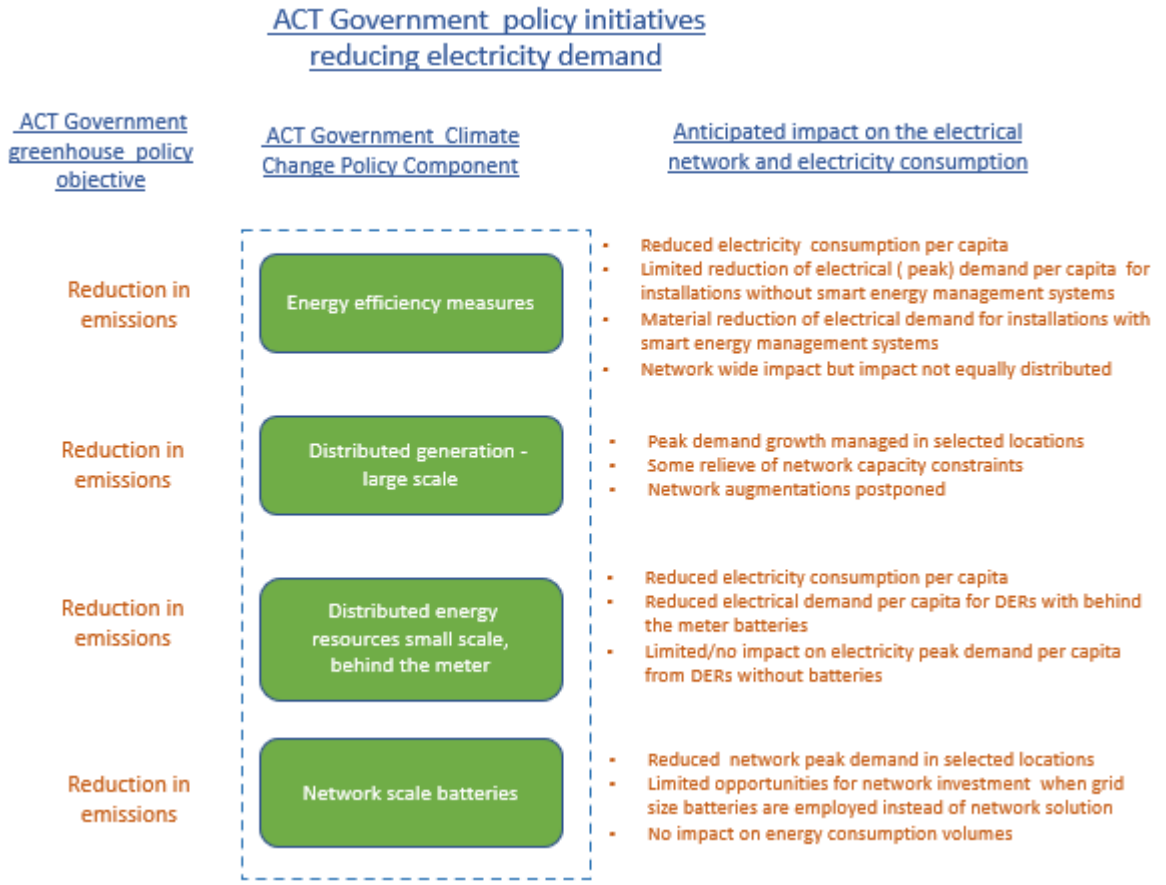


FIGURE 7. EXOGENOUS FACTORS MITIGATING GROWTH IN ELECTRICITY PEAK DEMAND

2.1.4 ACT Transport Strategy

Transport is the largest contributor to the ACT's greenhouse gas emissions and an important component on the way to net zero emission target. Progressive reduction of the transport emission is essential to a successful transition. Both ACT and Commonwealth governments announced support for the transition of transport sector to zero emissions. ACT policy includes emission reduction initiatives relating to:

- Public transport
- Private transport

Public Transport Strategy

Zero-emission Transition Plan for Transport Canberra sets out the zero-emission path for the public transport in Canberra. The plan is consistent with the ACT Transport Strategy[2]. The strategy including use of private

[2] ACT Government – ACT Transport Strategy 2020

vehicles, walkable spaces, and public transport. The public transport strategy includes progressive transition of the public bus fleet to zero emission vehicles and progressive extension of the electrical light rail system.

The map in Figure 8 below provides an overview of future public transport network in the ACT. The strategy is congruent with the urban intensification strategy of the ACT Government. The strategy proposes intensification of urban development along the major transport routes including electric bus routes and light rail corridors.

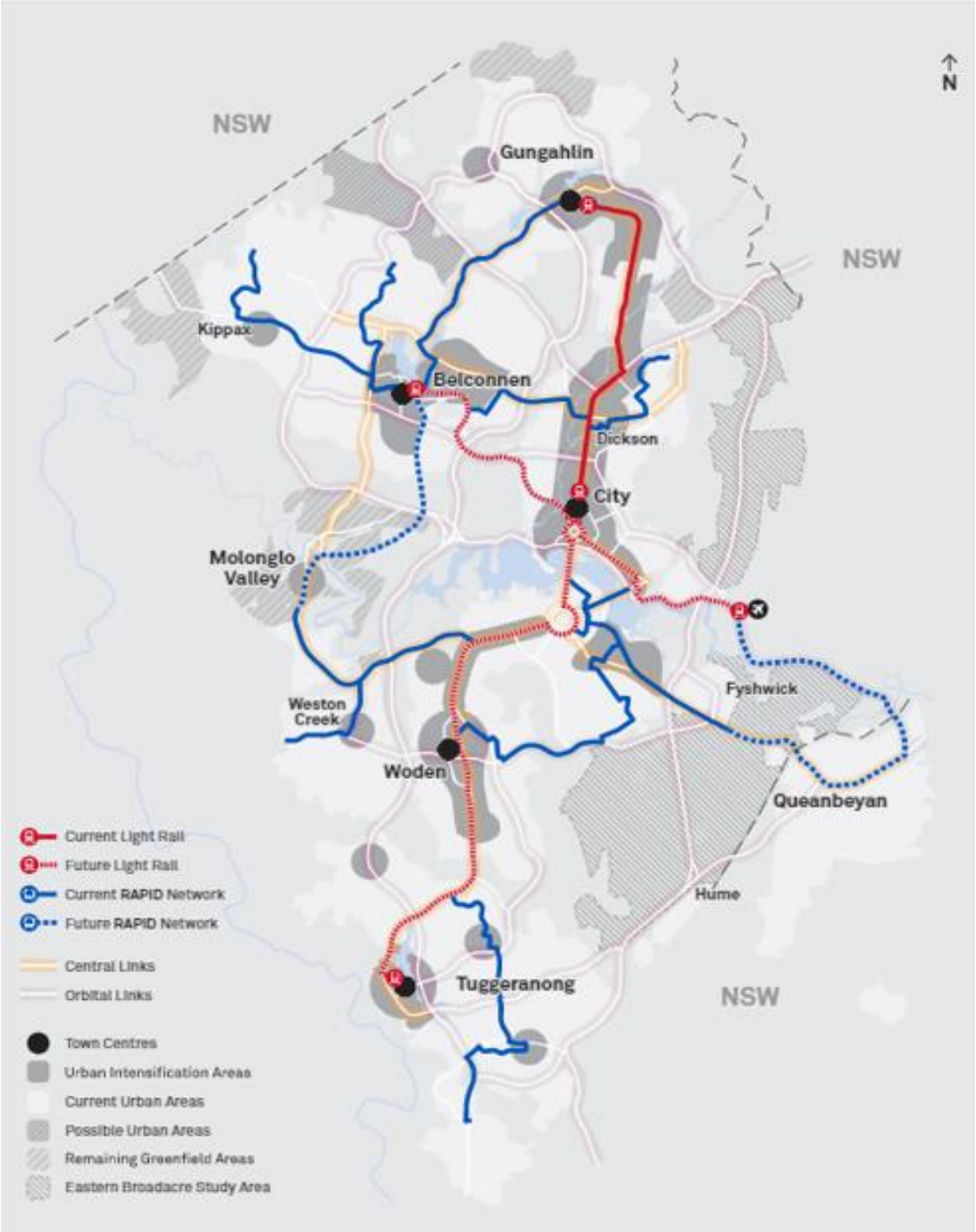


FIGURE 8. ACT'S PUBLIC TRANSPORT STRATEGY – MAJOR TRANSPORT LINKS

Public transport's transition to zero emissions includes:

- Electrifications of the bus fleet[3]
- Extension of the light rail network power by electricity

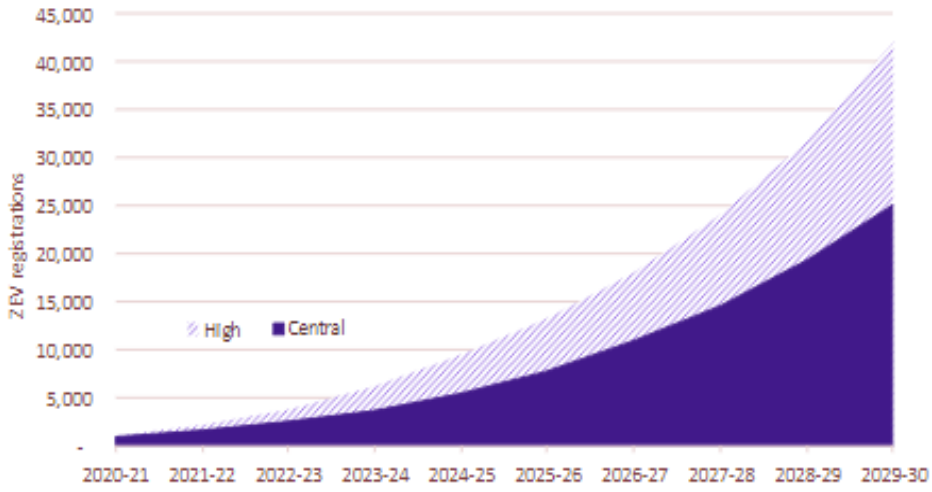
Electrification of the bus depots to cater for electric bus charging will result in significant point loads in several locations including Woden, Tuggeranong, and Mitchell. Currently there are around 450 public buses in the ACT. The current ACT Government timeline for bus electrification forecasts around 90 electric buses by 2024, increasing to around 45% of the fleet by 2030 and 100% by 2040.[4]

The extension of light rail network is expected to have moderate direct impact in terms of peak electricity demand but is facilitating intensifications of urban development along the main transport route.

Private transport strategy - Zero Emission Vehicles (ZEVs)

In 2022, ACT government has published Zero Emissions Vehicle Strategy 2022-2030 strategy. The strategy sets an ambitious 2030 target for 80-90% new cars sales in the ACT to be ZEV. The strategy sets out the path towards that target. The policy includes financial, regulatory and infrastructure components supporting the transition of the private sector. The objective is to increase up-take of electric vehicles through supporting affordability and roll out of charging infrastructure[5].

The study by Deloitte Access Economics commissioned by ACT Government projected an increase in the electric vehicles in the ACT as shown in Figure 9.



Line chart showing forecast EV registrations in the ACT to 2030 across two scenarios: a central case and a high uptake scenario. Source: Deloitte Access Economics, 2021.

FIGURE 9. ACT EV REGISTRATIONS TO 2030, CENTRAL CASE AND HIGH (OPTIMISTIC) OUTLOOK.

According to ACT Government initial strategy at least 25,000 passenger Electric Vehicles (EVs) would be registered in the ACT by 2030. However, if the conditions for the higher up-take are met[6] the number of passenger EVs is projected to be over 40,000. In addition, the projections include around 10 000 non-passenger EVs including light commercial vehicles. ACT Government aim is to support the high case scenario of 50,000+ zero emission vehicles which include around 40 000 passenger vehicles by 2030. This high EV up-take path, which is often referred to as an "optimistic" scenario provides the basis for the ACT Government's Zero Emission Vehicle Strategy 2022-30.

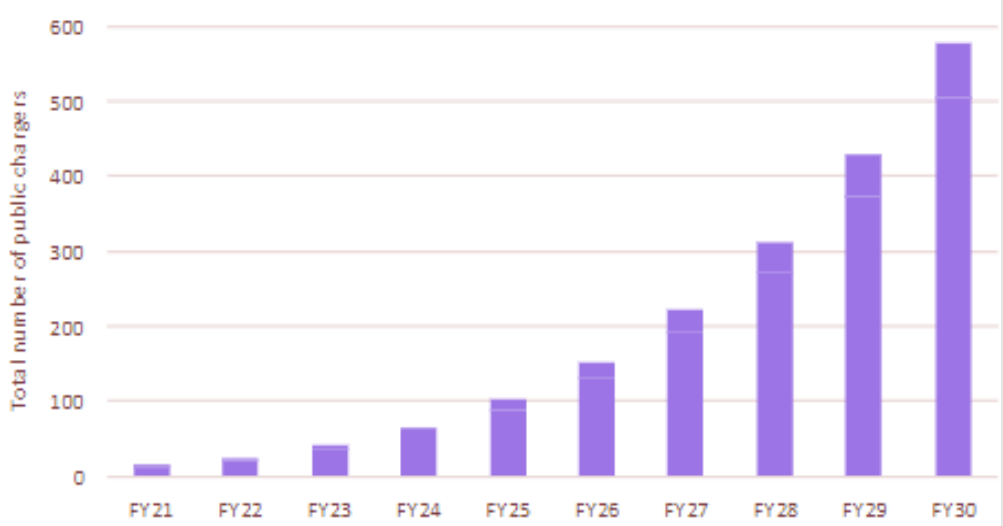
[3] The electric vehicle technology is the most advanced, technically, and economically viable zero emissions technology at the time of writing this plan
[4] Economic and technical modelling – Base case– GHD report to ACT Government (April 2022)
[5] The policy measures include sunset on the combustion vehicles registrations by 2035 and interest free loan towards the purchase of the ZEV capped at $15 000.
[6] Assumptions relating to the price of EVs, technology and energy costs are included in Deloitte's report.

Evoenergy's assessment is that the ACT Government Zero Emission Vehicles strategy is likely to have significant impact on the electricity network in the next 8 years and beyond due to the requirement for the charging infrastructure. This impact, which is confirmed by the modelling and peak demand forecasts, is discussed further in this NDP.

The charging infrastructure is expected to include:

- Private chargers (in single residential dwellings)
- Private chargers in medium and high-density developments
- Public chargers in various locations

The need for public chargers is projected to increase rapidly in line with the growing up-take of electric vehicles. The ACT Government study predicts that requirements for 600 to 1,000 public chargers by the year 2030. The lower bound of the projected growth in public chargers is shown in the diagram below.



Bar graph showing forecast demand for public EV chargers in the ACT, demonstrating increasing need for public chargers in the ACT. Source: Deloitte Access Economics, 2021.

FIGURE 10. ACT - EV PUBLIC CHARGING DEMAND TO 2030 (CENTRAL OUTLOOK).

Installation of chargers is expected to be incorporated into the design of medium density and high-density developments. The ACT Government advised the interested parties including developers of this requirement. Specific obligations are to be included in the relevant building regulations and development conditions.

Figure 11 shows expected geographic distribution of EVs across Canberra which is based on the - "optimistic" EV[7] up-take path. The projected EV registrations are not equally distributed due to socio-economic and urban design factors which increase the network impact in specific locations. Some network locations are expected to be impacted more by the EV and charger connections. Locations with higher EV up-take are more likely to experience capacity constraints. The distribution network must support the progressive roll out of the chargers across the ACT, which will require a resolution of localised network constraints.

[7] ACT Government Zero Emissions Vehicle Strategy 2022-2030.

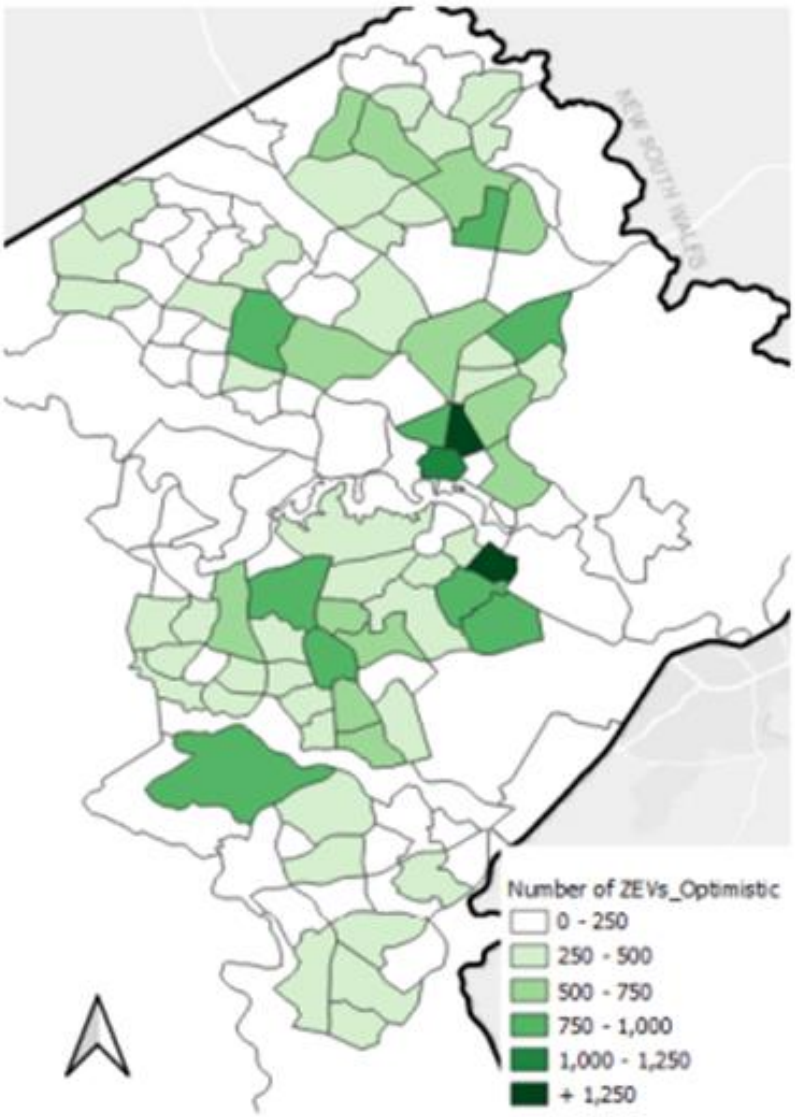


FIGURE 11. INDICATIVE DISTRIBUTION - EV REGISTRATIONS BY 2030 UNDER HIGH (OPTIMISTIC) SCENARIO[8].

Furthermore, charging technology is evolving rapidly and the capacity of fast charging stations has increased in recent years. When employing new charging technology, it is common for chargers to have a minimum capacity of 100 kWs and often up to 400 kWs. Those evolving technical parameters introduce additional uncertainty around future network impact.

2.1.5 Gas substitution

A key component of the ACT government climate policy on the road to Net Zero 2045 target is the progressive elimination of gas as an energy source. Currently, gas plays an important role within the household and commercial energy mix. It is the government's policy to promote gradual transition away from gas towards renewable electricity as the energy source supplying the community.

The transition away from gas has been a subject of major studies commissioned by the ACT government in which various scenarios have been assessed. Gas conversion is also one of the key parameters included in

[8] Around 40 000 passenger EV by 2030 and an additional 10 000 light commercial and other electric vehicles.

the Net Zero Model commissioned by Evoenergy (discussed further in this NDP). The projected impact of gas conversion extends to businesses, households, and energy networks. Electrification is projected to have a significant impact on peak demand in our network at the system and the local level. The ACT Government is yet to confirm intended pace of the gas conversion. That pace is likely to be defined by future changes in policy settings. This unknown introduces additional planning uncertainty in forecasting future network requirements.

2.2 Urban intensification

Urban intensification is an official policy of the ACT Government designed to achieve more compact urban development and reduce development in the new greenfield areas. The ACT government published a long-term ACT Planning Strategy (2018).

The ACT Planning Strategy sets out more intensive development of Canberra in many locations which are expected to result in a higher density of electrical load in selected locations. To achieve a smaller development footprint, 70 per cent of new homes are to be built within the existing urban envelope and 30 per cent are to be developed in the greenfield areas. The ACT government has identified eight areas where 90 per cent of urban infill is likely to occur. Figure 8 provides and overview of locations where the density of urban development is set to increase and therefore, a density of electrical load is expected to rise.

Urban intensification is forecasted to result in localised capacity constraints in the network. In particular, the demand is projected to increase within the high-density zone, along the major access roads, transport routes and light rail corridors.

2.3 Distributed Energy Resources

Distribution Energy Resources (DER) such as photovoltaics can be considered a relatively new but already well established technology. Evoenergy is forecasting continuing high growth in DER and behind the meter storage both in the small-scale and commercial size installations. These forecasts are consistent with the ACT Government and AEMO's forecast published in the Integrated System Plan. As described below, DER integration is a key prerequisite of Evoenergy's transformation to a Distribution System Operator.

Figure 12 shows the expected impact on the electrical energy consumption resulting from the continuing growth of distributed photovoltaic and behind the meter battery resources. This forecast has been aligned with the high scenario contained in the AEMO's ISP[9] and the ACT Government incentives for the DER[10] in the ACT System.

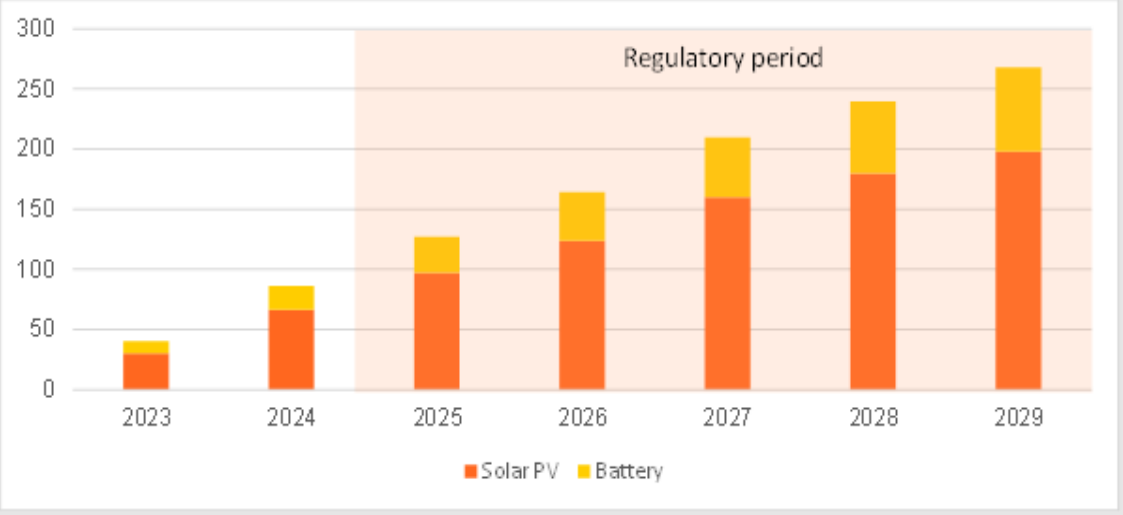


FIGURE 12. DER GROWTH AND BEHIND THE METER BATTERY (BMB) – PROJECTED ENERGY (GWHS)

[9] AEMO Integrated System Plan 2022.
[10] ACT Government incentives include $825/kW subsidy towards the battery storage

Notably, while the batteries moderate growth in energy volume drawn from the network and consumption per capita - the corresponding impact on the peak demand is relatively small. It is expected that in the medium term, the batteries will not substantially offset growth in the peak demand. However, this assessment may change if the uptake of batteries accelerates.

2.3.1 Integration of the Distributed Energy Resources

The growth in Distributed Energy Resources (DER), combined with the transition to net-zero and urban intensification, will require a fundamental change in Evoenergy's mode of operation. Evoenergy's electricity network will need to continue to evolve from a network which provides one-directional flow to a management where two-way energy flows with multiple energy sources. Evoenergy considers that progressive introduction of advanced operational methods will be essential to an efficient utilisation of network resources and transition to the role of the Distributed System Operator.

The ongoing transition necessitates a coordinated set of initiatives which are designed to increase Evoenergy's operational capabilities in response to a new operating environment including:

- Increasing visibility of the network parameters to network operators
- Facilitating dynamic system operation including DER export limits, two-way flows, voltage regulation and battery charging
- Enabling flexible access to the network as a function of network load, capacity, and other operational parameters.
- Developing dynamic network pricing to maximise network utilisation within operational envelopes
- Provision of new network services to enable customers and to maximise value derived from network assets

To achieve these goals, we will need to enhance and develop operational capabilities such as:

- Network monitoring at the (selected) distribution substations and customer connection points
- Integration of DER into the grid to facilitate battery and PVs operation within the required envelope.
- Interfacing of the Advanced Distribution Management System (ADMS) with the DER platform to facilitate some of the capabilities listed above

While this NDP is concentrating on the requirements of the primary network assets it recognises that enhancement of operational capabilities is required to facilitate efficient operations in a new environment.

3. METHODOLOGY

3.1 Key planning steps

Figure 13 outlines the steps which we have followed to develop this NDP. These steps include bottom-up and top-down assessments:

- Net zero modelling which informed us of the "whole of network" net zero impact under various scenarios and applied to validate proposed investment path
- Peak demand forecast at the network and zone substation levels which allowed us to analyse network transmission and zone substation constrains
- Area planning studies which analyse localised constrains within the distribution system

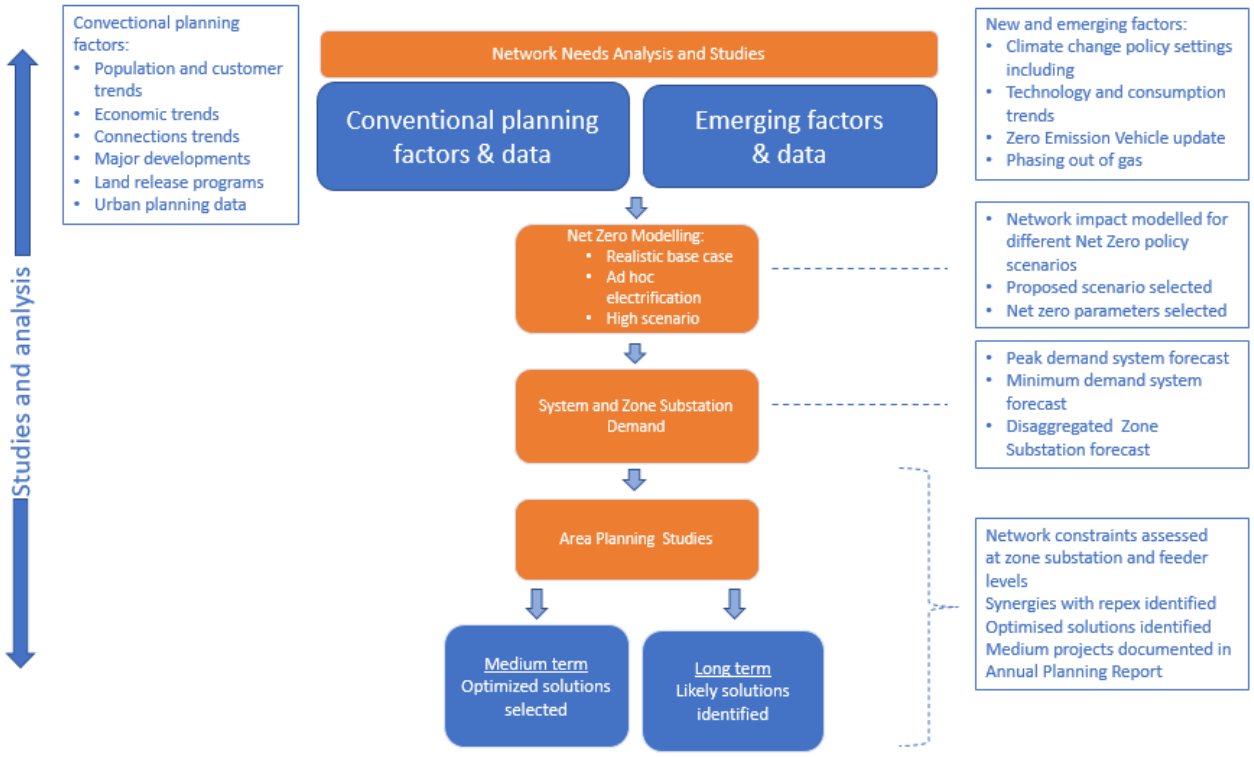


FIGURE 13. NETWORK DEVELOPMENT PLAN – PROCESS OVERVIEW

Top-down assessment

Net Zero Model provides a directional view of future network requirements across several scenarios. It informs of the impact under various assumptions and policy settings within the modelling time frame.

Net zero modelling also constitutes a “whole of network” top-down view of the network requirements. The projected parameters such as network peak demand and the corresponding capital requirements are understanding network impact under each scenario in the medium-term and the long-term. In our planning process, these parameters have been used to cross check and verify the outcomes of bottom-up planning outcomes. Thus, net zero modelling informed the subsequent detailed network planning.

Modelling of scenarios is discussed in more detail in section 4.

Bottom-up assessment

The bottom-up assessment includes detailed assessment of new and emerging transmission, zone substations and distribution constraints. The methodology is consistent with the Evoenergy’s Expenditure forecasting methodology.

The bottom-up analysis is granular and is focused on localised constraints. Peak demand forecast is used as the main reference to identify existing and emerging hot spots at the zone substation and transmission levels. The assessment of constraints is also conducted for individual distribution feeders.

Whenever required analysis accounts for non-uniform load and capacity distribution in the network including unequal distribution of electric vehicles or major point loads. Some network constraints have been analysed under various net zero assumptions corresponding to the modelled scenarios.

3.2 Dealing with uncertainty

A rapidly changing energy environment creates risks and opportunities. Intrinsically, strategic planning requires assumptions about levels of business certainty.

As discussed above, we are operating and planning in the environment of substantial uncertainty. Accordingly, this NDP sets out a network development path which embraces future uncertainty of dynamic

industry and changing energy landscape. The adopted approach and proposed network development path introduce flexibility to our strategic planning allowing us to navigate future uncertainties and pivot where required.

Our strategic approach has two key characteristics:

- It is adaptive
- Due to uncertainties, we have set out to identify a network development path of least regrets

3.3 Adaptive planning

Adaptive approach introduces flexibility and allows us to adjust plans when required. In our strategic planning we follow a cycle which includes the key steps depicted in Figure 14.

Strategic planning requires us to monitor and adapt the plans in line with changing business environment and circumstances. It includes scenario planning and adapting the plans to real-life observable data. The corresponding models and programs are adjusted and calibrated to reflect observed trends in energy consumption, peak demand, technology, and a range of other factors. In effect the proposed programs are adjusted by comparing real life observations with the simulated projected scenarios.

This approach allows us to monitor how we are tracking against various scenarios as well as update and refine the scenarios as new information comes to light.

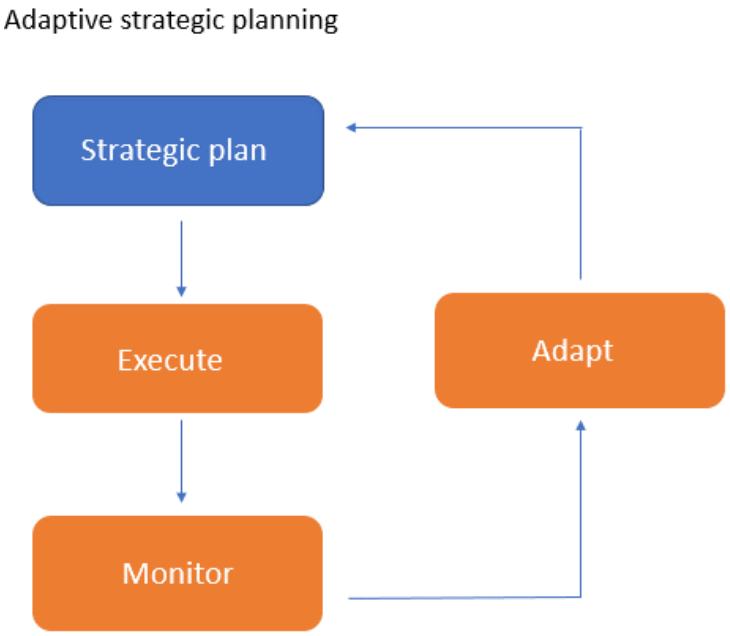


FIGURE 14. STRATEGIC PLANNING – ADAPTATION TO OBSERVED REAL-LIFE DATA.

4. SCENARIOS

4.1 Net zero modelling

Modelling of net zero scenarios is the first step in the development of this NDP. Given the materiality of the drivers in respect of scale, function, and criticality we have conducted sophisticated, informed, and comprehensive scenario analysis to guide our planning approach.

To do this we commissioned a consulting consortium, comprising Marsden Jacob Associates, Entura and Frazer-Nash Consultancy, to develop a dynamic model of the ACT's energy system: the Net-Zero Model

(NZM).[11] The NZM identifies the potential impacts on customers, Evoenergy and the ACT under a range of scenarios and pathways to achieve net-zero by 2045.

The NZM spans the period up to 2045, including each 5-year regulatory period, and produces energy, price, peak demand and capex outcomes for each scenario. The NZM provides a "whole of network", top-down view of the network requirements informing granular network planning process and allowing for a consideration of network impact under various net zero scenarios.

4.2 Scenario development

Initial scenario

Initially the model considered three scenarios:[12]

- Full Electrification – the full electrification of the ACT and decommissioning of the gas network.
- Electrification + Green Gas – the continued electrification of greenfield suburbs while preserving the gas network for future green gas.
- Base Case – the move towards zero net emissions is undertaken on an economic basis with no policy intervention.

The key findings were that:

- Significant augmentation of the electricity network was required in all scenarios. This was mainly driven by increases in peak winter demand driven higher by gas churn, population growth and the assumption of convenience charging for Battery Electric Vehicles (evening charging). These factors offset energy efficiency and higher take-up of behind the meter battery (recharge during the day and discharge in the evening).
- Investment in connection assets and the low voltage network is required due to growth in both customer numbers and peak demand increases.
- Investment in transformers, medium and high voltage network, substations and sub-transmission is required due to increases in peak demand in the ACT.

ACT Government Base Case

In April 2022, the ACT Government released independent modelling, produced by GHD and ACIL Allen, which also outlined a base case based on existing policy settings.

Consequently, Evoenergy and the consulting consortium prepared a new scenario 'Realistic Base Case' with revised assumptions informed by those applied by the ACT Government.

In this scenario peak demand in winter increases by 15.7% by 2023/34 with additional capex required to handle load growth (co-incident demand increase of 101 MW) together with the growth in customer connections (26,407 new customers from 2020/21 to 2033/34).

Full electrification pathway

In August 2022, the ACT Government decided to pursue a full electrification pathway with the announcement of two policies:

- To phase out the use of natural gas.
- Move to zero-emission vehicles (ZEV) through a SEV sales target of 80-90% by 2030 and to cease the registration of new light ZEV by 2035.

A 'realistic electrification scenario' based on the policies announced by the ACT Government was produced. This scenario assumed an optimistic ZEV up-take and assumes the development of incentives and cost reflective tariffs to ensure that most charging occurs outside of peak periods.

[11] Further details on the model is set out in Marsden Jacob Associations 2022, Evoenergy Net Zero Modelling Journey.

[12] The model also considered variations of the first scenario scenarios depending on whether the transition was adhoc, planned of a hybrid.

In this scenario winter peak demand increases from 659 MW in 2020-21 to 824 MW by 2033/34 due to the use of electricity for space heating and EV charging in the evening period. By 2033/34 peak demand during the day almost matches evening peak demand due to the assumption that EV charging occurs more often in daytime periods.

The realistic electrification scenario is not consistent with the achievement of net-zero by 2045. This is unsurprising as this scenario only reflects policies announced and does not include policies which will be included in the ACT Government's yet to be released Integrated Energy Plan.

Scenario summary

As a result of the initial and subsequent analysis, there are three key scenarios set out in Table 1 below.

TABLE 1. SCENARIO SUMMARY

Scenario A - Realistic Base Case	Scenario B – Realistic Electrification	Scenario C – Full Electrification scenario
No policy intervention. Net-zero by 2045 is not achieved.	Only reflects announced policies to August 2022. Net-zero by 2045 is not achieved.	Net-zero by 2045 is achieved with all policies currently in place.
• ACT Population growth consistent with ACT Treasury projections • Customer growth of over 26,000 within the next two regulatory periods until 2034 • Conservative scenario for the EV up-take as projected by ACT Government i.e. passenger 25000 EVs in the ACT to be EV by 2030. • Minimal gas conversion to electricity by 2034 resulting in the gas energy reduction of around 12%. • Does not achieve net-zero by 2045.	• ACT Population Growth consistent with the ACT Treasury projections • Customer number increase of over 26,000 by 2034/35 • ZEVs up-take consistent with ACT Government "optimistic" projections of light passenger vehicles 40,000 ZEVs and 51,000 total ZEV by 2030. • ZEV sales target (light vehicles) for the ACT to be 80-90% by 2030[13] • Ceasing registration of non-ZEVs by 2035 in accordance with ACT Government settings • Gas conversion on ad hoc basis while gas network remains operational until 2045[14] • Does not achieve net-zero by 2045.	• Reflects accelerated up-take of ZEVs and gas churn to ensure reaching net zero emissions by 2045. • Assumes phasing out of gas by 2045 and the necessary policy interventions. • Requires changes in climate change policy settings and an introduction of accelerated emission reduction initiatives in the Evoenergy's future comparing with Scenario A and Scenario B.

The cumulative capex requirements for each scenario is shown in Table 2 while peak demand is shown in Figure 15, Figure 16 and Figure 17 for the Realistic Base Case, Realistic Electrification and Full Electrification scenarios respectively.

[13] ACT Government, ACT's Zero Emission Vehicle Strategy 2022-30
[14] ACT Government, Powering Canberra, Our Pathway to Electrification, ACT Government Position Paper, August 2022.

TABLE 2. SCENARIOS – CUMULATIVE CAPITAL REQUIREMENTS AND ZERO EMISSION OUTCOME

Scenario	Capital requirements up to 2029 $billion (Next regulatory control period)	Capital requirements to 2045 $billion	Zero emission outcome
Scenario A - Realistic base case	$0.44	$2.26	no commitment
Scenario B – Realistic electrification	$0.61	$2.94	no commitment
Scenario C – Full electrification scenario	$0.74	$3.30	by 2045

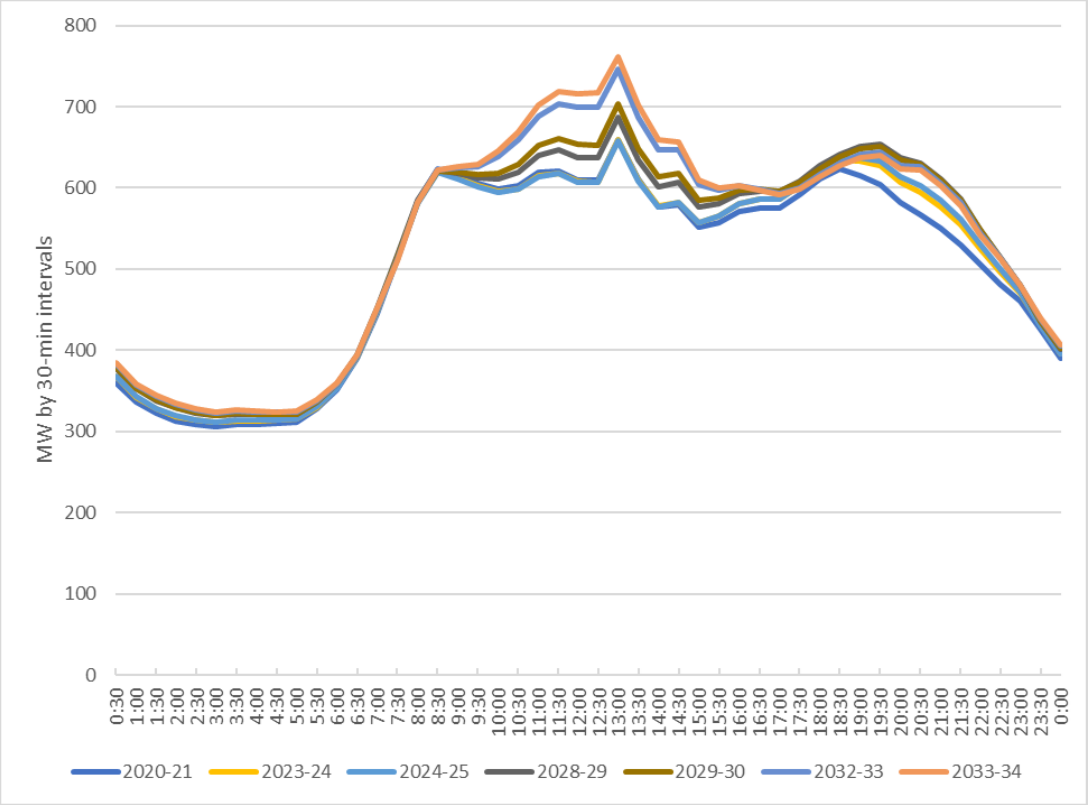


FIGURE 15. REALISTIC BASE CASE: WINTER PEAK DEMAND (MW) FOR ELECTRICITY (10% POE)

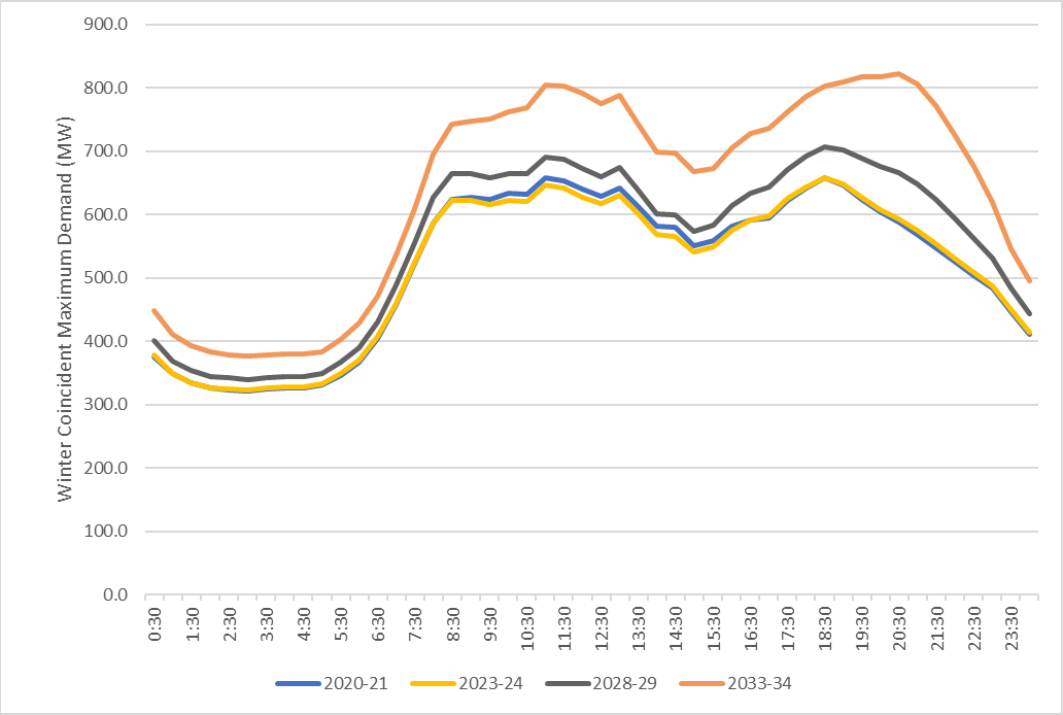


FIGURE 16. REALISTIC ELECTRIFICATION: CO-INCIDENT PEAK DEMAND FOR ELECTRICITY (10% POE) – WINTER WEEKDAYS

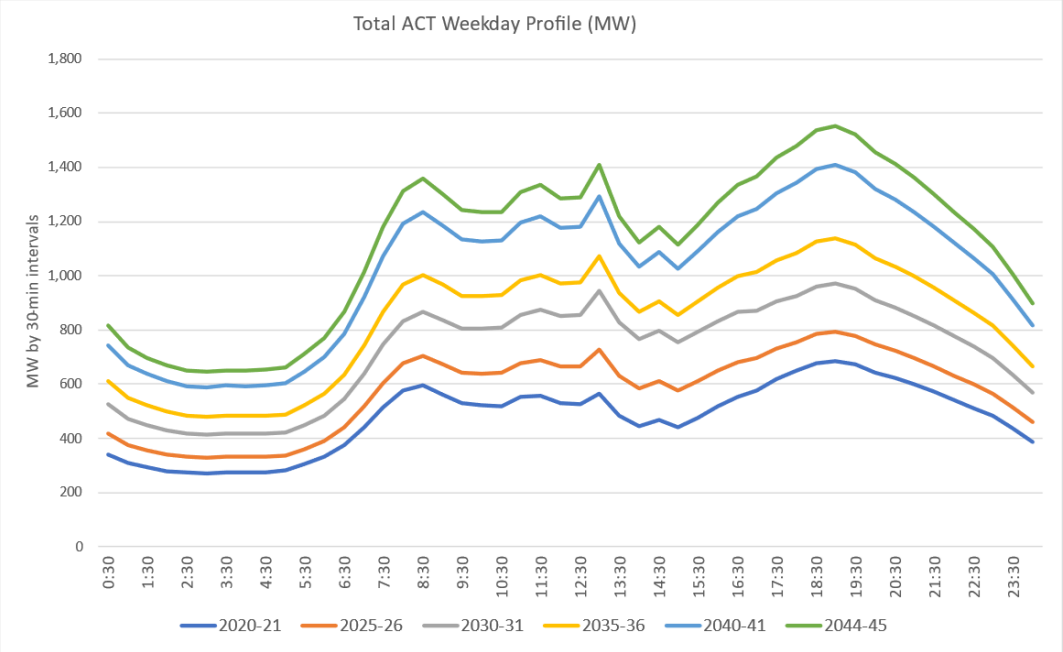


FIGURE 17. FULL ELECTRIFICATION: WINTER MAXIMUM DEMAND (10% POE LEVEL)

4.3 Consistency with AEMO's forecasting approach

The NZM is consistent with the AEMO's Integrated System Plan and energy source trends contained in the plan and relies on several common assumptions or inputs, such as energy efficiency projects, electric vehicle charging profiles.

As depicted in Figure 18, the key points from AEMO's assessment[15] confirm transformational changes of the energy landscape:

- Demand capacity is set to triple between 2023-2050
- PVs are expected to grow five-fold to 2050 from the current levels
- Significant growth in overall renewable generation from wind and solar (including utility solar and small scale). AEMO forecasts nine-fold increase in renewables to 2050 and threefold increase to 2030.
- Significant growth in energy storage from DER

Evoenergy's projections in relation to the ACT are aligned with the AEMO's national forecasts. However, due to a 5 year difference between the national Next Zero 2050 target and the ACT's 2045 target – Evoenergy's timeframe for the response is shorter than in other jurisdictions.

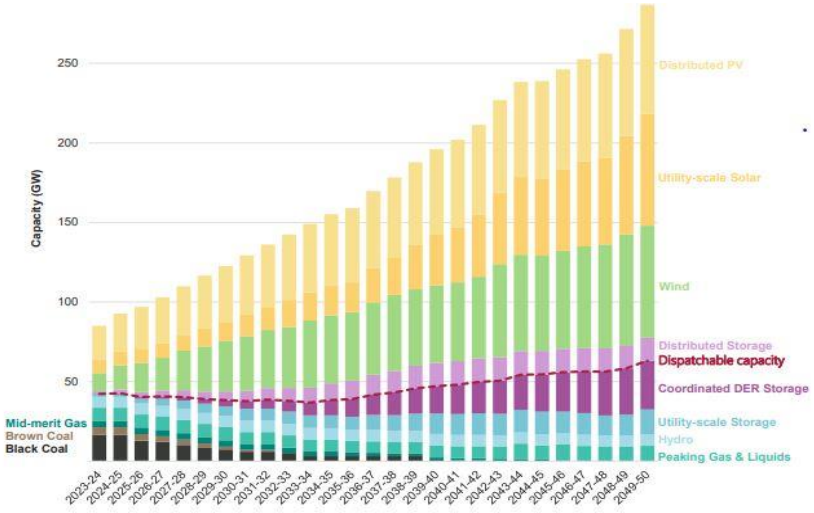


FIGURE 18. FORECAST OF ENERGY SOURCES – AEMO'S INTEGRATED SYSTEM PLAN 2021

4.4 Strategic implications

The scenario analysis and the NZM results in three key scenarios:

- Realistic Base Case (Scenario A) – no policy intervention and net-zero by 2045 is not achieved.
- Realistic Electrification (Scenario B) – only includes announced policies and net-zero by 2045 is not achieved.
- Full Electrification (Scenario C) – net-zero by 2045 is achieved with all policies in place.

Realistic Base case and Full electrification provide two bookends to a range of feasible futures which could arise.

Realistic electrification reflects current policy settings but not the ACT Government's commitment to net-zero by 2045. As a result, it does not include future yet to be announced policies which are likely to be included in the ACT Government's Integrated System Plan due for release in 2024.

Key drivers of network demand

A key outcome of the NZM are the key factors driving network investment, specifically:

- Pace of EV (and other ZEV technologies) up-take in the residential and commercial sectors
- Pace of conversion of gas to electricity as the main energy source for household and businesses

[15] Integrated System Plan, AEMO, 2021

Notably this is true, even though EV are assumed to shift from evening (convenience) to daytime charging. Despite that moderating effect, EV charging is projected to be one of the most important drivers of growth in localised demand and network constraints.

The secondary factors are expected to mitigate growth in peak electrical demand and facilitate deferment of some investment. These factors include:

- Integration of DER and behind-the-meter energy storage
- Application of network batteries
- Application of community batteries

However, at this stage, these secondary factors are not expected to significantly offset the need for large network investment driven by EVs and gas substitution. Moreover, the modelling found that existing slight downward trends in energy consumption per customer does not result in the proportional peak demand reductions. The projected peak demand growth at the system and local level is substantial due to growth in consumer numbers, EV load and (in the long-term) gas conversion.

Consideration of the demand side management and non-network solutions is mandatory for all investment proposals. Innovative solutions include application of network batteries. While Evoenergy considers non-network solutions on case-by-case basis, at his stage, the overall application of batteries is not wide-spread due to cost and technology considerations. Therefore, this technology still does not have a major impact on network investment.

Deferred investment creates future challenges and risks

The second insight from the scenario analysis is that shifting from the Realistic Base Case and Realistic Electrification scenarios to the Full Electrification scenario at a point in the future will back-load investment requirements to later periods.

Given the magnitude of the investment required, this creates risks around planning, deliverability and operations and may result in network constraints and sub-optimal rationing of network services. There are international examples of this, such as in West London where there is currently insufficient capacity for new connections in some areas until 2035.[16]

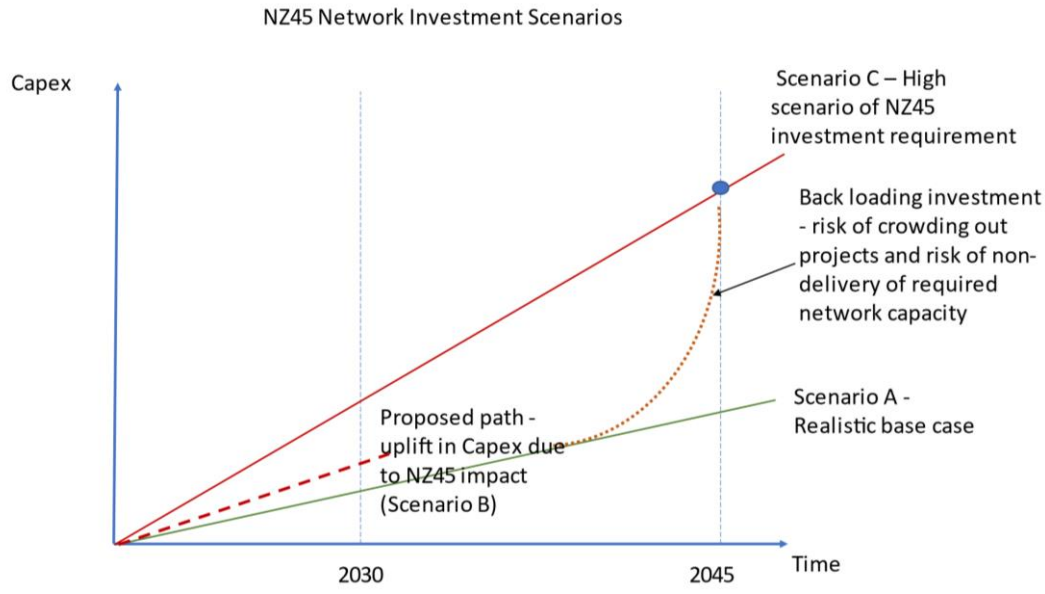


FIGURE 19. NETWORK INVESTMENT- NET ZERO SCENARIOS

Figure 19 illustrates conceptually (ignoring actual network constraints and the implications for the delivery of network services in the near term) how initially adopting the Realistic Electrification pathway (scenario B)

[16] For more details see here: https://www.london.gov.uk/media/4975/download?attachment

allows for flexibility and management of future operational and investment risks. While it is below the pathway to achieve zero emissions by 2045 but allows sufficient flexibility for escalation of expenditure if the need arises. In contrast adopting the Realistic Base Case pathway (Scenario A) would result in a much larger backloading of investment.

Key uncertainties

The last key insight is the range of outcomes driven by the range of assumptions applied. While we have used the most robust evidence available, the pathway to net-zero is unprecedented. Consumer behaviour and government policies have the potential to differ from forecast assumptions. For instance, the uptake of photovoltaic systems and electric vehicles has been much higher than historically forecast.

Given the communities commitment to net-zero it is possible that the transition to net-zero (specifically the shift away from gas and toward ZEV) occurs at a much faster rate than forecast. In contrast it is unlikely that the transition occurs at a slower rate given the ACT Government's dynamic and adaptive approach depending on community choices.[17] Essentially this means that government policy will act as a backstop by adjusting policies if the transition lags to ensure we achieve net-zero by 2045. Those consideration are key in Evoenergy's planning path where.

5. BOTTOM UP ASSESSMENT

5.1 Network Studies

Detailed planning process involves identification of network constraints based on the analysis of transmission and distribution systems. It involves "whole of network" and localised considerations. This is a granular process which is conducted for to analyse restrictions on various network components including transmission lines, zone substation and feeders. The process involves peak demand forecast. The underlying assumptions related to major demand drivers employed in the analysis are congruent with those applied in the modelling of net zero scenarios.

The main scenario used in the analysis incorporated the roll out of EV's consistent with the ACT Government's announced policies and assumptions of the net-zero model (the Realistic Base Case). However, the network impact of assumptions under scenarios was also tested.

Once a network constraint is identified a detailed assessment of alternative solutions (including non-network solutions) costs, and benefits is undertaken. This process often employs probabilistic methods to quantify risks and benefits. Figure 20 below depicts the key steps applied in the assessment of network constraints.

[17] ACT Government 2019, ACT Climate Change Strategy 2019-25, p.17

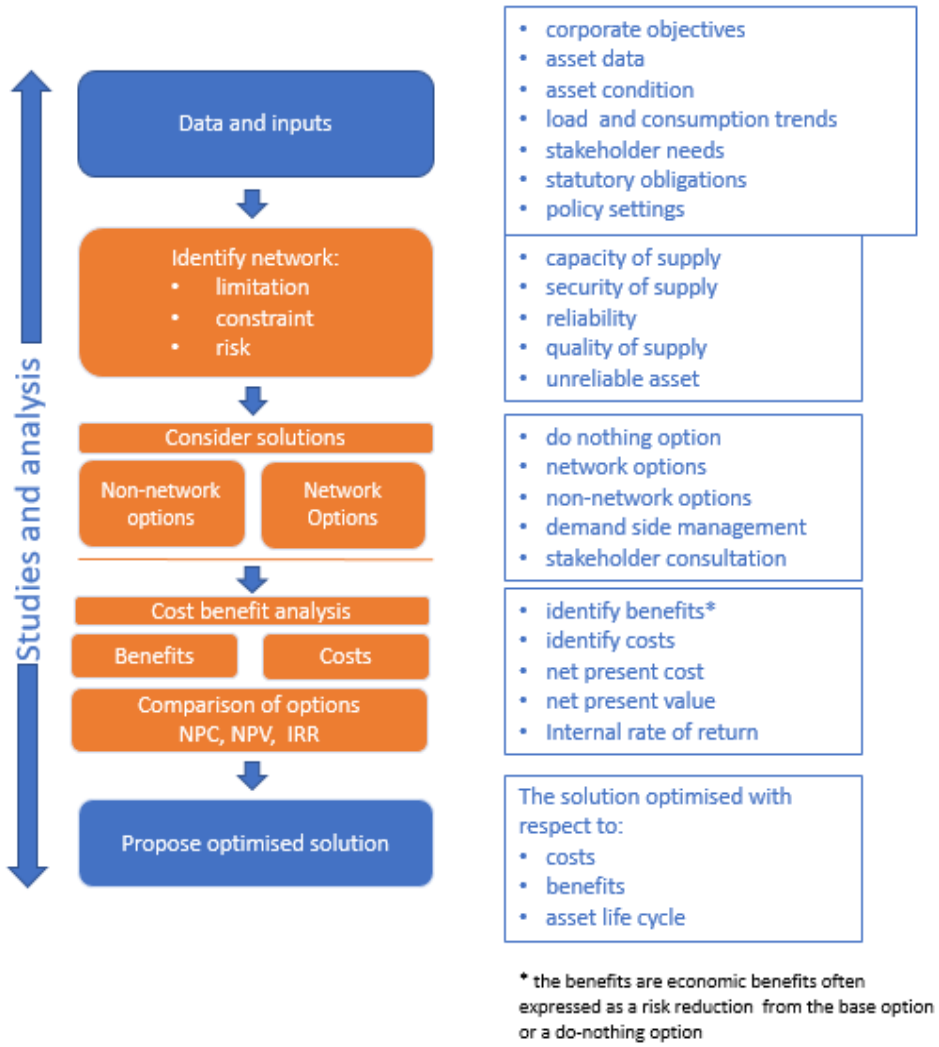


FIGURE 20. ASSESSMENT OF NETWORK CONSTRAINTS

5.2 Integrated Network Planning

The detailed planning for this NDP identifies network augmentation requirements which have been considered holistically, including synergies with other work programs and investment triggers such us:

- Customer connections
- Asset replacement
- Quality of supply
- Reliability and;
- Other capability enhancement projects (such as DER Integration program).

Figure 21 below provides an overview of the integrated planning approach employed in the preparation of this NDP.

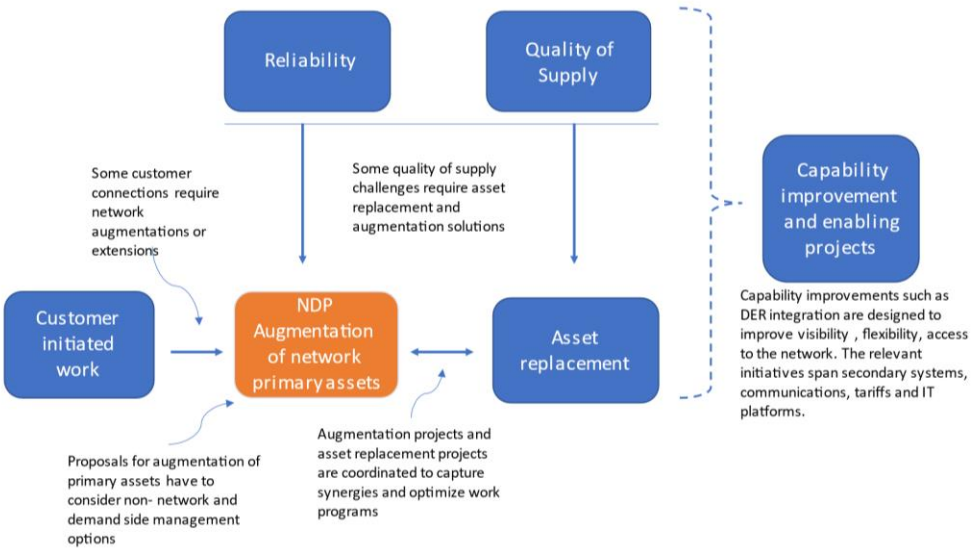


FIGURE 21. INTERACTION OF ASSET AUGMENTATION WITH INVESTMENT TRIGGERS

As indicated in Figure 21, augmentation may be driven not only by network capacity constraints and new connections, but also considerations relating to network reliability and quality of supply. For example, proposed augmentation for zone substations is coordinated with replacement of major equipment such as switchgear or power transformers. Thus, planning for expansion of existing or new zone substations is coordinated with the replacement of the existing zone substation assets.

The NDP also integrates retirement of major 66kV assets which includes Fyshwick Zone substation and interconnection 66kV sub-transmission lines. To capture synergies, within the distribution system investment, a need for augmentation of cables or substation is considered when existing assets are due for replacement.

In addition, the above diagram illustrates interaction of the NDP investment components such as:

- Demand side management solutions
- Non-network solutions
- Enabling programs including integration of Distributed Energy Resources (DER).

Quality of supply and reliability

Evoenergy's approach to quality of supply is set out in the Quality of Supply Strategy[18] and the approach to managing reliability is set out in the Reliability Strategy. Evoenergy's long term objective relating to supply quality is to maintain the performance with respect to power quality. In that context, one of the key long-term challenges is continuing growth in distributed energy resources and behind meter batteries impacting voltage regulation and hosting capacity in many locations in the network.

Evoenergy's strategic reliability objective is to maintain reliability performance. At the individual customer level, the quality and reliability are to be managed in accordance with the ACT's Consumer Protection Code.

Non-Network and Demand Management Solutions

Peak demand and corresponding constraints are the main drivers for the network design and augmentation. development. Each investment is proposed after consideration of the alternative solutions. The assessment includes alternative non-network and demand side management solutions as well as provision of network services by third parties e.g., network scale batteries and integration of behind the meter's batteries into energy supply chain.

[18] Evoenergy, Quality of Supply Strategy, 2022

Some demand side initiatives are network wide and long term. The examples of those broad initiatives include Evoenergy's demand tariffs and energy efficiency initiatives by commonwealth and territory governments.

6. OUTCOMES

6.1 Peak demand forecasts

Peak demand is an important parameter which determines a need for network investment. The peak demand forecast is a main reference employed in the network planning process to identify network constrains at the system and zone substation levels. We have prepared the peak demand forecast for the network and zone substations for the period ending in 2032/33. The methodology applied to derive forecast is described in Appendix B.

Figure 22 shows network peak demand for summer and winter.

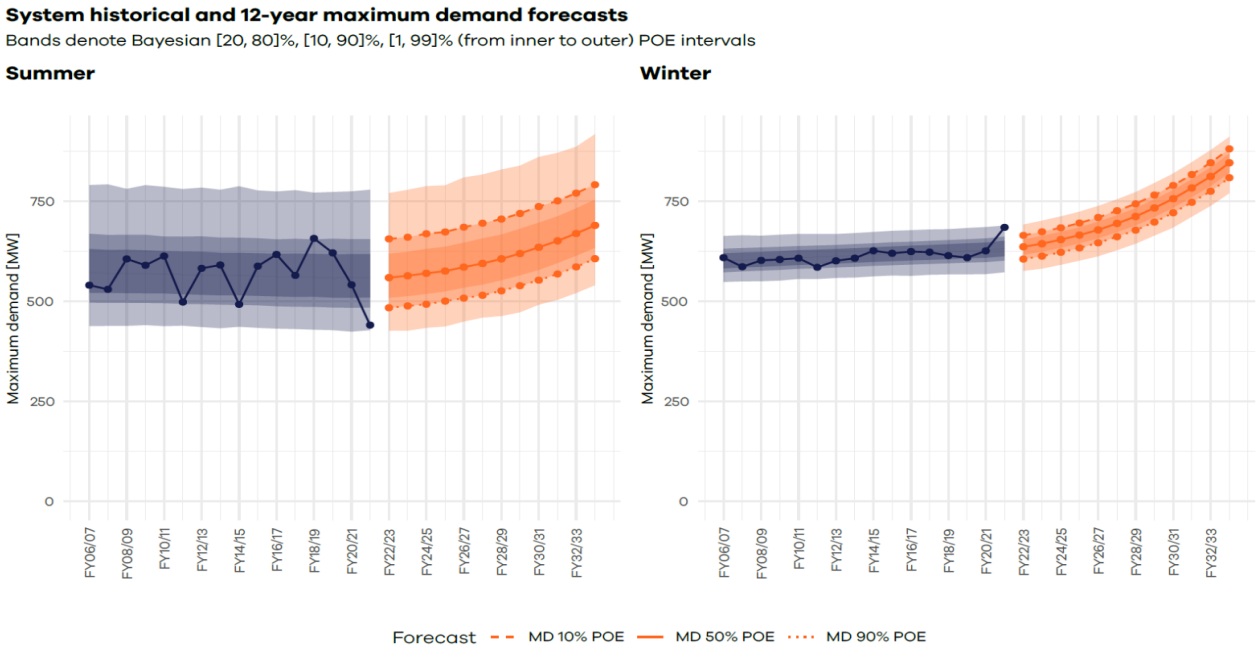


FIGURE 22. SYSTEM PEAK DEMAND FORECAST FOR SUMMER AND WINTER

Over the next 10 years summer peak demand is expected to grow 16% and winter peak demand is expected to grow by 23% over 10 years starting from 2023.[19]

Peak demand forecast is in line with the network peak demand derived from the net zero model. Both methods point to the projected peak demand figures within 10% of each other by 2033/34. The demand forecast also includes minimum demand forecast for the network.

The consideration of the results points to the following outcomes:

- No constraints have been identified at the transmission level

[19] See chapter 5 of the 2022 Annual Planning Report, available here: https://www.evoenergy.com.au/about-us/reports-and-publications/annual-planning-report and Appendix B which contains a description of the methodology which was applied in a development of the peak demand forecast for the network and zone substations.

- The forecast for individual zone substations was used to assess existing and emerging zone substation (summarised in Table 4).
- Voltage regulation constraints at zone substation (under low load conditions) requires further assessment

6.2 The path of least regrets

From the bottom-up assessment of existing and emerging network constraints we have built-up the network development path. We consider that this path aligns with the path of least regrets (Figure 19).

The path of least regrets allows us to optimise network investment while managing future risks. These risks relate predominantly to the pace of change resulting from the climate policy initiatives including electric vehicles, gas substitution and batteries, we consider that the path is congruent with the net zero scenario B (Table 2 refers). In practice, this means that the proposed planning path is based on current government policies (aligned with assumptions of the Realistic Electrification scenario) while being ready to pivot to an alternative approach once the ACT Government releases its Integrated Energy Plan in 2024.

The path of least regrets is prudent and efficient under a range of future net zero scenarios. It is cost effective as a medium-term investment path and allows for escalation or de-escalation of network investment in line with the observed data and developing scenarios.

The path of least regrets allows for future adaptation of network programs to the changing operational environment which includes a high degree of uncertainty. It also mitigates risks of substantial under-investment in the short/medium term which may jeopardise our ability to deliver services in the longer term.

The proposed investment path was derived through detailed assessment of network impact which has been informed by the results of the net zero modelling. The path comprises investment categories and projects discussed in the section and the Appendix A

6.3 Validation and context

Investment requirements over the medium term (up until 2029) derived from the bottom-up assessment have been crossed checked against the outcomes of the Net Zero Model.

This NDP focuses on investment in the primary network assets required to cater for the projected growth in demand. However, the proposed investments include growth and no-growth components.

Figure 23 shows how the bottom-up build-up of the of the proposed network augmentation capex was considered in combination with the Net Zero Modelling to arrive at the proposed capital expenditure. The comparison is indicative and confirms alignment between the bottom-up program and net zero modelling.

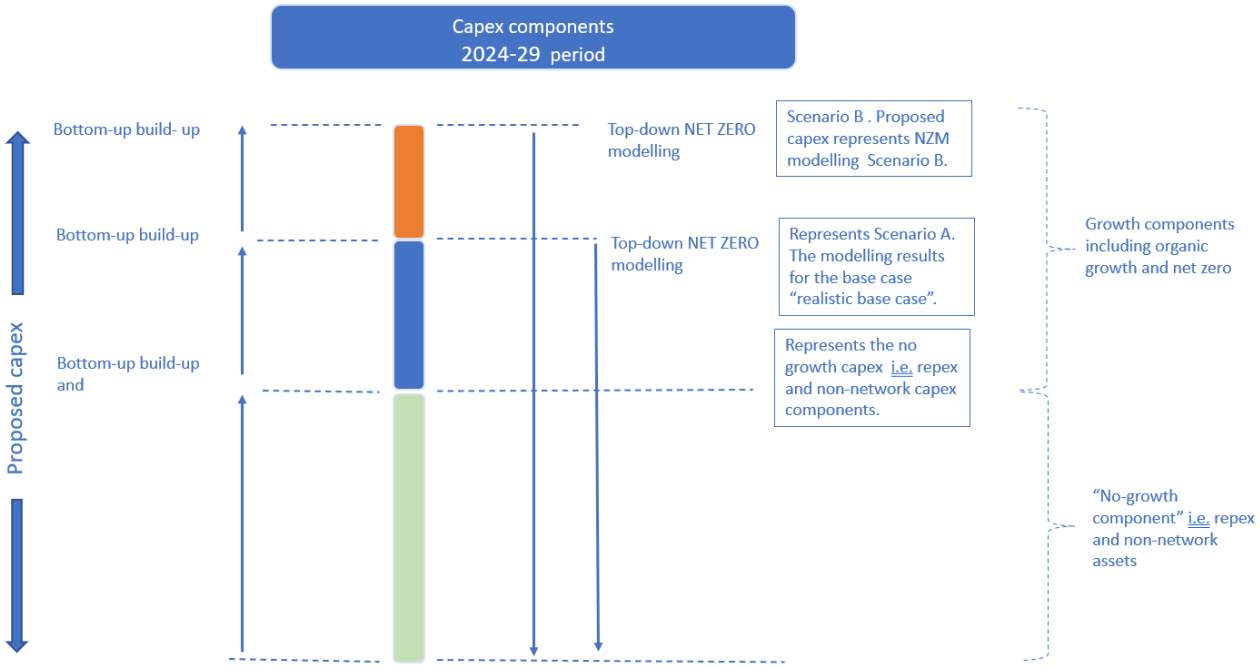


FIGURE 23. BUILD-UP OF CAPITAL EXPENDITURE WITH RESPECT TO THE NZM SCENARIOS

Notably, the proposed medium-term investment derived from the bottom-up assessment is below that derived from the net zero model for the corresponding scenario (Table 2, Scenario B refers). This observation provides additional assurance that the proposed investment path is efficient and reasonable.

6.4 Key investment categories

Detailed planning assessment of future electricity network requirements identified five key categories of network investment driven by a combination of intrinsic peak demand growth and net zero policy impact. These key categories are summarised in the table below.

TABLE 3. GROWTH RELATED NETWORK INVESTEMENT – KEY CATEGORIES

Augmentation component	Reason
Zone substations	New construction or augmentation due to capacity constraints. Selected upgrades due to voltage regulation constraints.
Distribution feeders	New construction of feeders and feeder ties due to capacity constraints. Selected upgrades due to voltage regulation constraints
Distribution substations	New substations and upgrades due to capacity constraints (coordinated with the substations replacement program)
Low voltage circuit upgrades	Upgrades due to capacity or voltage regulation constraints
Climate resilience upgrades	Need for equipment upgrades due to changes in operational conditions driven by climate change impact

Since no major transmission constraints have been identified at this stage, the above breakdown does not include augmentation expenditure for transmission lines. However, extension of the transmission lines will

be required to facilitate connection of the proposed zone substations. Evoenergy identified specific projects relating to zone substations and distribution feeders. In addition, the need for distribution substation augmentation and low voltage circuit augmentations are identified due to the likely impact of electric chargers and growing impact of gas conversion.

In relation to the listed categories, we endeavour to exploit synergies between asset replacement and augmentation. For example, when existing distribution substation is being replaced, an opportunity for capacity augmentation is being assessed at the same time.

The analysis identified that two dominant categories in terms of cost are:

- Zone substations
- Distribution feeders

The medium-term and long-term zone substation projects are summarised in Table 4 below.

TABLE 4. MAJOR NETWORK PROJECTS AT THE TRANSMISSION LEVEL AND INDICATIVE TIMING

Zone Substations	Key purpose	Timing		Timing	
		Start up to 2029	Finish up to 2029	Start after 2029	Finish after 2029
Gold Creek ZS – third transformer	To relieve capacity constraints in Gungahlin	✓	✓		
Gold Creek ZS – voltage regulation improvements	To address voltage regulation constraints at Gold Creek ZS	✓	✓		
Belconnen ZS – third transformer				✓	✓
New Strathnairn ZS	To relieve capacity constraints in West Belconnen. Supply to Ginninderry greenfield residential development	✓			✓
New Molonglo ZS	To supply existing and new developments in the Molonglo Valley	✓	✓		
New Mitchell ZS	To provide supply to Mitchell and North Canberra	✓			✓
East Lake ZS – third transformer	To relieve capacity constraints at Telopea Park ZS and commercial load growth in ACT eastern area.			✓	✓
Fyshwick ZS – decommissioning	To retire aged 66 kV network	✓	✓		
Gilmore ZS – third transformer and switchboard	To provide long term relief in Hume area	✓	✓		
New Harman ZS (customer funded)	To provide supply to major development in Harman area	✓	✓		
New Curtin ZS	To relieve capacity constraints in South Canberra	✓			✓
Causeway Switching Station and 132 kV lines – (customer funded) removal of the station and under-grounding of the132 kV lines	Required for expanding Kingston Foreshore Development.	✓	✓		
New CBD South Zone Substation	Required to support long term growth in CBD			✓	✓

Apart from the substation projects listed above, Appendix A includes long-term option to develop a substation in the vicinity of Canberra airport.

Appendix A further discusses medium-term and long-term planning outcomes for each of the nine Canberra districts. The transmission and distribution projects including zone substation and distribution feeders are summarised for each district.

APPENDIX A – DISTRICT PLANNING

ACT DEVELOPMENT STRATEGY

In 2018, ACT Government has published the planning strategy which was followed in 2022 by the draft District Strategies and Draft Territory Plan. The draft plans are subject to public consultation which is set to conclude in 2023. In the ACT, due to the land ownership by the Territory and the Commonwealth, the release of the leased land and the government role in planning is more prominent than in other jurisdictions. ACT Government strategy reflects the intention to intensify urban development within the existing footprint. The urban intensification is one of the key pillars of the broader ACT Government climate change policies. Urban development policies are coordinated with the climate, transport and energy policies which directly impact Evoenergy network. The map below highlights the urban intensification zones, Western Edge and other study areas which are set to impact electricity network in the years to come.

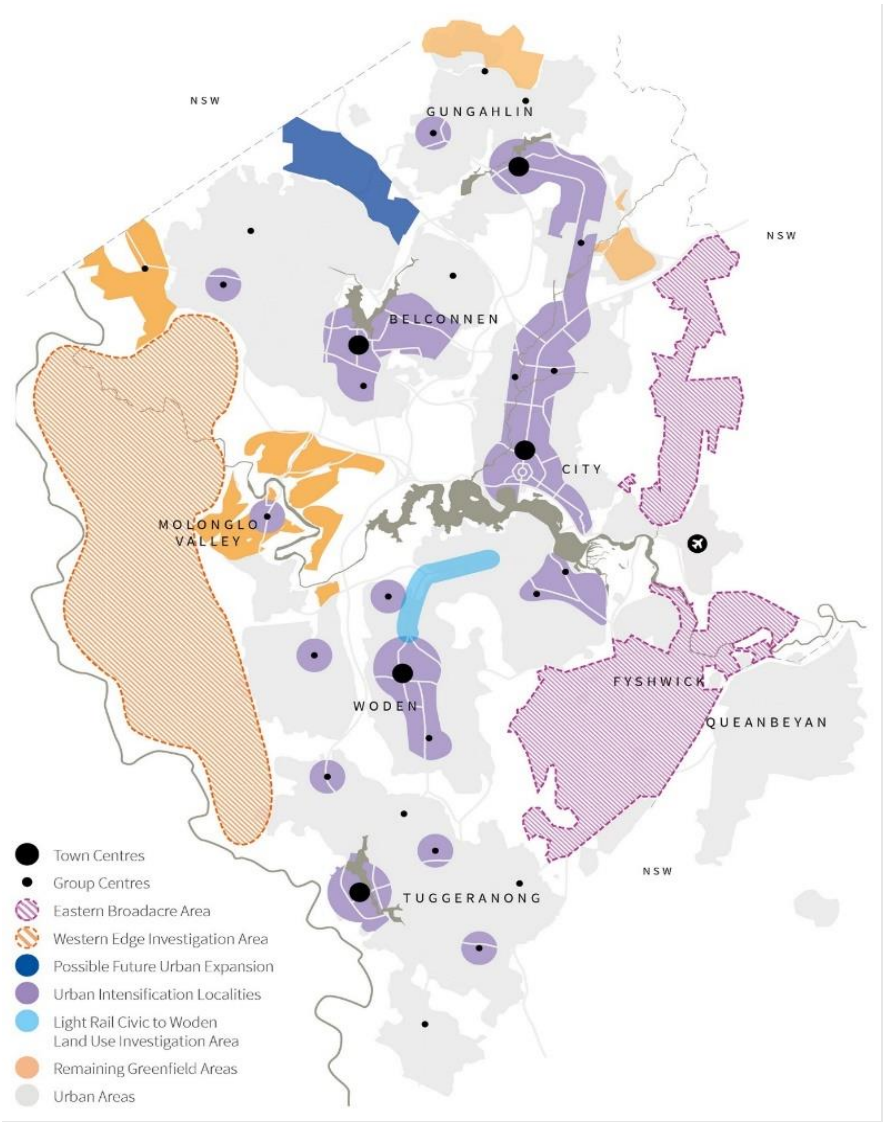
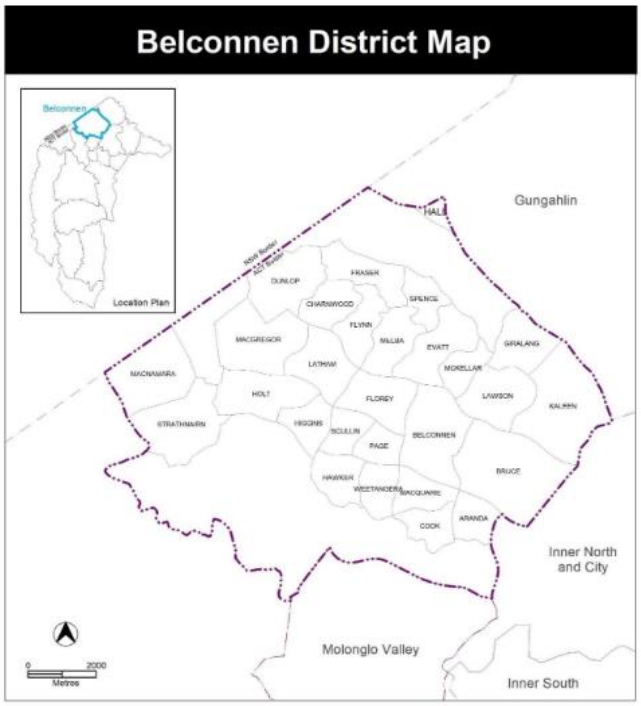


FIGURE 24: ACT GOVERNMENT – DEVELOPMENT STRATEGY FOR THE AUSTRALIAN CAPITAL TERRITORY

BELCONNEN DISTRICT



Development of Belconnen has commenced in late 1960s. Belconnen district consists of low-density residential housing with a large central town centre and several smaller community and commercial centres. In the last decade, planning regulations have changed to encourage greater density of development.

Belconnen is serviced by the two zone substations: Latham Zone Substation, which has 3 x 55 MVA power transformers and Belconnen Zone Substation, which has 2 x 55 MVA power transformers. Latham Zone Substation has some remaining capacity, however its distance from areas of growth provides cost and quality of supply challenges. Belconnen Zone Substation does not have any remaining capacity and if significant growth was required a third transformer would need to be installed.

While the Belconnen region is not growing as rapidly as some other areas of Canberra it is experiencing some growth including:

- The large greenfield development of Ginninderry, partially located in NSW forecast to have 11,500 dwellings and a population of 30,000 by 2055.
- The greenfield development in Lawson which can accommodate several thousand dwellings
- Ongoing growth and redevelopment at the University of Canberra
- Redevelopment and intensification around the Belconnen Town Centre including high density residential, commercial, and mixed-use developments
- Consideration of developments on the eastern and western side of Lake Ginninderra
- The Ginninderra greenfield development[2]
- Designated study areas for potential residential development designated by ACT Government in other locations including Bruce, Kaleen, Giralang, Aranda, Cook, Page, Latham, and Melba.
- Possible Light Rail extension from CBD
- Electrification of the bus depot to cater for public transport electric bus fleet.

There is also a potential large-scale battery planned for the Belconnen area adjacent to the Stockdill Substation which is to be connected to the 132 kV Transgrid network. The battery will not have a direct impact on the demand in Evoenergy's network but is relevant to the voltage regulation in Evoenergy's network.

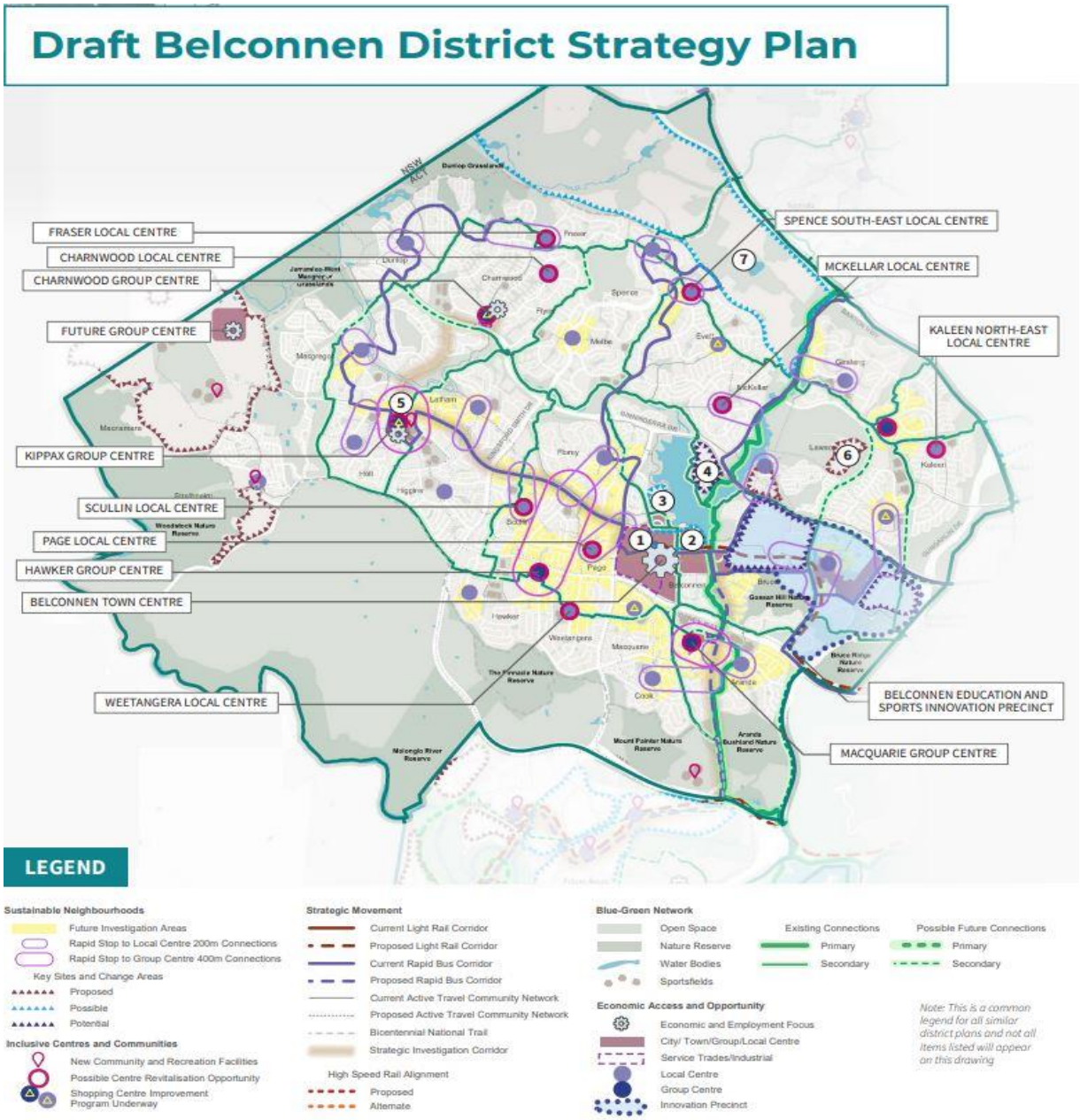


FIGURE 25. ACT GOVERNMENT - DRAFT BELCONNEN DEVELOPMENT STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

The primary long-term driver for increased electricity demand in Belconnen area is the Ginninderry greenfield development. Furthermore, urban intensification is a relevant factor in and around Town Centre. Impact of climate change initiatives are secondary but expected to increase in importance over time. Thus, in addition to the residential and commercial developments, the electrical load is expected to increase due to a set of policies and initiatives related to net zero 2045 target such as electric vehicle up-take, urban intensification, and gas conversion. Above average electric vehicle uptake is projected around Belconnen Town Centre, Bruce, and Kaleen.

The figure below provides a long-term staging of the Ginninderry development. This development is a key driver for the future Strathnairn ZS which is required to service this extensive long-term development. The existing substation at Latham can support only initial stages of the development. An initial planning for that

area includes demand side management solution and corresponding pilot studies involving use of batteries. These solutions may help to defer major investment in the network but are not projected to remove the need for capacity augmentation.

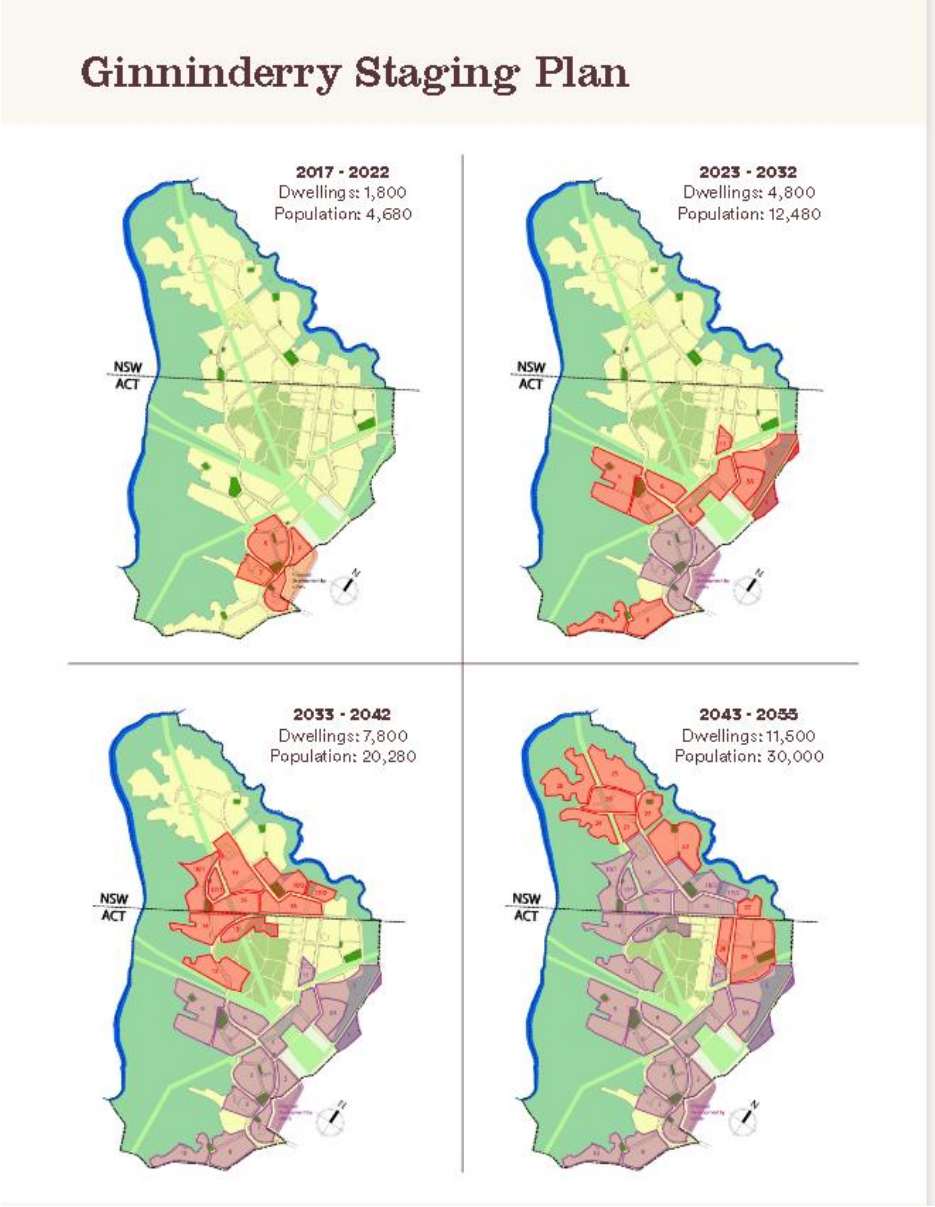


FIGURE 26. STAGING OF GINNINDERRY DEVELOPMENT

In addition to the Strathnairn Zone Substation, the Belconnen Zone Substation augmentation (3rd transformer) may be required (long-term) due to urban development intensification, EV up-take and gas conversion impact on electricity demand. Evoenergy monitors the pace of the development in the area and adjusts the network augmentation program to match the pace of development and the electricity demand.

The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case contain detail of the proposed medium-term projects.

TABLE 5. BELCONNEN DISTRICT - PROJECTED NETWORK CONSTRAINS AND SOLUTIONS – MEDIUM TERM AND LONG TERM

Future projects – proposed and potential	Medium term and long-term requirements		Comment
	Medium term Up to 2029	Long term After 2029	
Strathnairn Zone Substation (staged development)[20]	✓		Proposed
Two feeders from Strathnairn Zone to Ginninderry Substation	✓	✓	Proposed
Additional distribution feeders ex Strathnairn ZS to Ginninderry		✓	Subject to further studies
Belconnen Zone Substation – 3rd Transformer		✓	Subject to further studies
Distribution from Belconnen ZS (urban intensification)		✓	Subject to further studies
Distribution feeders to support NZ45 transition*		✓	Subject to further studies

* Further to the specific projects listed above, it is expected that in the long-term, additional feeder and distribution substation capacity may be required to cater for the upcoming connection enquiries, EV charging infrastructure, and gas conversion to facilitate transition to net zero 2045.

[20] Subject to RIT-D

GUNGAHLIN DISTRICT

Palmerston was the first suburb developed in Gungahlin. Since its establishment in 1991, Gungahlin has quickly grown through the construction of greenfield estates, town centre, medium density and high density residential, commercial and mixed-use developments. The density of development has increased over time in several suburbs, and along the light rail corridor.

The population of Gungahlin is estimated to be approximately 80,000 people (2021 census data to be released this year). With the passage of time, Evoenergy has seen steady growth in a residential and commercial load in that area.

While the greenfield suburbs of Gungahlin are close to being exhausted there are a few suburbs still under construction – primarily Taylor, Jacka and Kenny. There are also a few pockets around other suburbs expected to be filled in. Notably, a major residential development located west of Gold Creek village is being investigated. There is also significant urban intensification expected around the Gungahlin Town Centre with various medium and high density residential and mixed-used projects planned over the coming years.

The electrical distribution network in Gungahlin is primarily underground. There is also high penetration of rooftop solar photovoltaic systems due to a relatively high proportion of the single residential dwellings.

In addition to residential growth the commercial/industrial area of Mitchell is expected to experience growth. Several developments including data centres is expected to be constructed in Mitchell would result in capacity constrains within the existing network.

Furthermore, potential electrification of the bus depot in Mitchell is being considered by the ACT Government as part of the public transport strategy and electrification of the bus fleet.

Gold Creek Zone substation is the main zone substation supplying Gungahlin. Gold Creek Zone Substation which is currently operating with two transformers and some load at risk. Evoenergy currently (2022) has a proposal to augment the substation with the third transformer. The proposal is subject of the Regulatory Investment Test initiated by Evoenergy in 2022.

In addition, the projected peak demand growth for the broader Gungahlin area will require additional investment in the zone substation capacity. Major planned network infrastructure includes Mitchell Zone Substation which can facilitate support to the existing substations at Gold Creek, Civic and City East. The substation will provide additional supply capacity required for the urban intensification along the light rail corridor, continuing development of the Mitchell light industrial area, electric vehicle charging infrastructure and gas-to-electricity conversion.

FIGURE 27. ACT GOVERNMENT – DRAFT GUNGAHLIN DEVELOPMENT STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case contain detail of the proposed medium-term projects.

TABLE 6. GUNGAHLIN. MEDIUM-TERM AND LONG-TERM PROJECTS

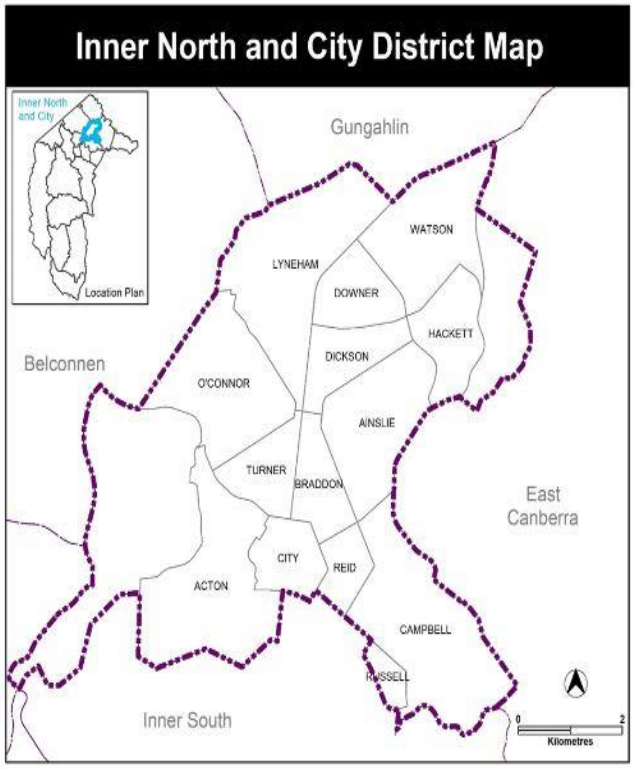
Future projects – proposed and potential	**Medium term and long-term requirements**		**Comment**
	Medium term Up to 2029	**Long term After 2029**	
3rd transformer Gold Creek[21] ZS	✓		Proposed[22]
Feeder from Gold Creek ZS to Gungahlin Mixed Development (Town Centre)	✓		Proposed
Feeder ties: Nona, Anthony Rolfe, and Hammer feeders	✓		Underway
New Mitchell Zone Substation	✓	✓	Proposed[23]
Voltage and power factor regulation – Gold Creek ZS		✓	Subject to further studies
Feeder from Gold Creek ZS to Franklin – net zero*	✓		Proposed
Distribution feeders to support NZ45 transition**		✓	Subject to further studies

***** Net zero feeders, predominantly driven EV charging infrastructure based on the ACT Government Zero Emission Vehicle Strategy 2022-30 which adopted “optimistic” EV take up scenario

** Further to the specific projects listed above, it is expected that in the long-term, additional feeder and distribution substation capacity may be required to cater for the upcoming connection enquiries, EV charging infrastructure, and gas conversion. Above average electric vehicles take is projected around Franklin, Gungahlin, Harrison, Ngunnawal, and Casey.

[21] Subject to RIT-D
[22] Subject to RIT-D
[23] Subject to RIT-D

NORTH CANBERRA AND CITY



The Inner North of Canberra is one of the older areas of Canberra. It is also an area with high density of development, in the city, Dickson, along major access roads and multiple other locations designated as high-density zones. Significant urban infill urban infill was experienced over the past decade, particularly in Braddon, Turner, O'Connor, and Dickson. The area is set for ongoing development intensification due to its proximity to the city and the first stage of the Canberra light rail project.

The intensification of the development is expected to continue along the major access routes and transport corridors. More intensive urban development is projected to increase the density of electrical load and to create network constraints.

The Inner North is primarily supplied by the City East Zone Substation (three 55 MVA transformers) and the Civic Zone Substation (three 3 x 55 MVA transformer). Both substations are projected to experience capacity limitations in the medium term. The distribution network outside city area is primarily overhead with some underground installations in areas which have been recently redeveloped.

The outcome of ACT Government Inner North and City planning strategy is a significant projected increase in population and employment in the area.

According to the base case scenario contained in the ACT Government draft strategy, the long term (25 year) projected increases are:

- around 12 000 additional residential dwellings
- around 22 000 in employment places

The above increases are likely to result in an additional residential and commercial load on Evoenergy electricity network. Some of the increase may be mitigated by the non-network solutions and demand side management measures. Nevertheless, the mitigation through non-network solution is not expected to fully offset the growth in demand.

The known major planned developments include:

- Redevelopment of Thoroughbred Park racecourse for residential and mixed-use projects[24]
- The Yowani Grounds - redevelopment of the Yowani Golf Course for residential and mixed-use projects[25]
- Multiple mixed-use projects in Dickson and Braddon

[24] https://thoroughbredpark.com.au/thoroughbred-park-proposed-territory-plan-variation/
[25] http://www.yowanigrounds.com.au/

It must be emphasised that projected increase in dwellings is limited to medium and high-density developments through a densification of the low-density areas. There is no projected increase in the detached residential dwellings in area. Therefore, opportunities for the rooftop distributed generation are likely to be limited. Some opportunities may be developed within medium-density and high-density developments, but they are not likely to substantially mitigate the peak demand growth.

In addition, the electrical load is projected to increase due to phasing out the use of natural gas and substitution of energy derived from gas in commercial and residential market segments.

Furthermore, the area is expected to require substantial number of public and private electric vehicle chargers which will also contribute to the growth in electricity demand. Inner North has been identified as one of the locations where the electric vehicle registration and charger numbers are projected to be the most intensive. conversion. The electric vehicle impact on the distribution network was assessed during the planning process.

A significant up-take of electric vehicles is expected in several inner north suburbs including Watson, Campbell, Turner, Ainslie, and Lyneham. The projected requirements for the charging infrastructure in the City and Braddon are some of the highest in Canberra.

Current zone substations at Civic and City East operate close to operational limits. Notably, the future Mitchell Zone Substation listed in the Gungahlin section is to provide capacity support to those substations. Civic Zone Substation is also set to be supported by the future Curtin Zone Substation listed in the Woden District section.

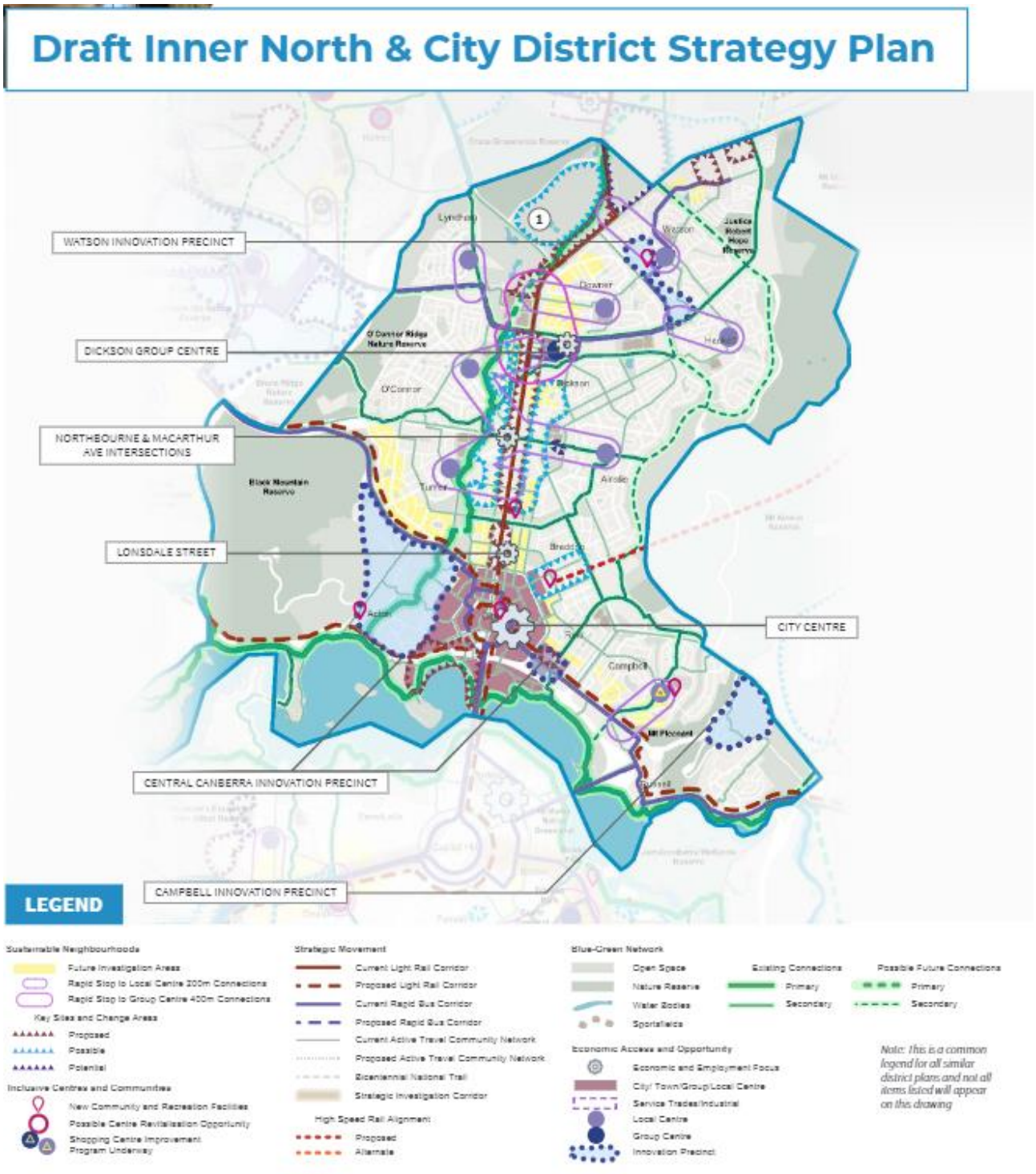


FIGURE 28. ACT GOVERNMENT – DRAFT INNER NORT AND CITY STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case contain detail of the proposed medium-term projects.

TABLE 7. INNER NORTH AND CITY. MEDIUM-TERM AND LONG-TERM PROJECTS.

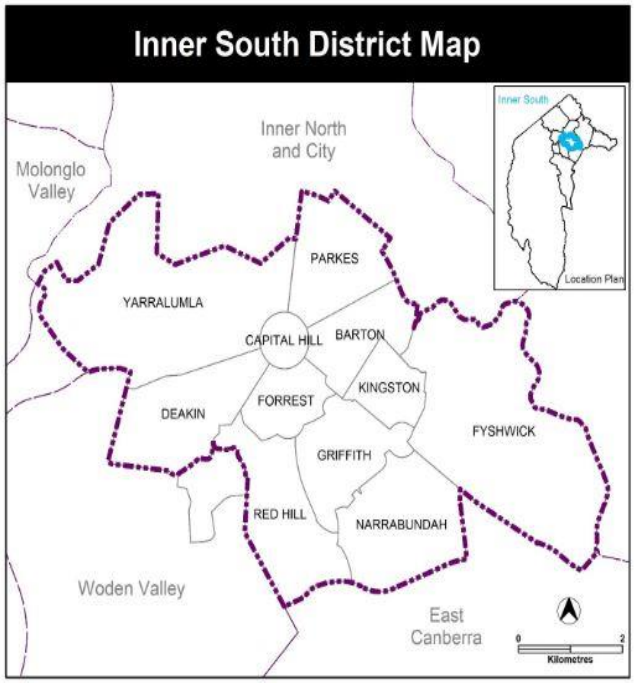
Future projects – proposed and potential	**Medium term and long-term requirements**		**Comment**
	Medium term Up to 2029	**Long term After 2029**	
Feeder from Civic ZS (CBD Section 63)	✓		Proposed
Feeder from Civic ZS (CBD Section 3 and Section 37)	✓		Proposed
Feeder from Civic ZS (CBD Section 96)	✓		Proposed
Feeder from City East ZS (CBD Convention Centre)		✓	Subject to further studies
New CBD South ZS		✓	Subject to further studies[26]
Feeder from Civic ZS to Lyneham (racecourse development)	✓		Proposed
Feeder City East ZS to Braddon* - net zero	✓		Proposed
Feeder from City East ZS to Watson* - net zero	✓		Proposed
Feeder from City East ZS to Campbell* - net zero	✓		Proposed
Feeder from City east ZS to Ainslie* - net zero	✓		Proposed
Feeder from City East ZS to CBD – net zero*	✓		Proposed
Two feeders from Civic ZS to CBD – net zero*	✓		Proposed
Distribution feeders to support NZ45 transition**		✓	Subject to further studies

***** Net zero feeders, predominantly driven by a need for EV charging infrastructure based on the ACT Government Zero Emission Vehicle Strategy 2022-30 which adopted “optimistic” EV up-take scenario.

**Further to the specific projects listed above, it is expected that additional feeder augmentations, distribution substation augmentations are likely to be required in the medium and long term to cater for the upcoming connection enquiries, continuation of the urban development intensification, electric vehicles charging infrastructure, and gas-to-electricity

[26] Subject to RIT-D

INNER SOUTH CANBERRA DISTRICT



The Inner South of Canberra is one of the oldest areas of Canberra. Due to its central location, it has undergone significant development intensification over the last decade.

The area also includes parliamentary triangle with several buildings of national importance including Parliament House, National Library, High Court, and National Gallery. Many developments over the last decade involved increased density. Barton, Griffith, and Kingston contain high density residential and commercial developments. Intensification of the development is set to continue around commercial centres (Manuka and Kingston), Kingston Foreshore and East Lake area. The district also includes diplomatic precinct in the suburb of Yarralumla with many locations subject to future re-development.

The Inner South is primarily supplied by the Telopea Park Zone Substation, a 3 x 50MVA power transformer zone substation. It is the oldest zone substation in Canberra, located adjacent to the old Kingston power station. It is a highly loaded substation with all 11kV circuit breakers utilised. It is also on a restricted site with no room for potential expansion. The East Lake Zone Substation supplying Fyshwick provides some capacity support to the Telopea Park Zone Substation.

The main transport corridor along Adelaide Avenue is earmarked for an extension of light rail to Woden. The plans include intensification of urban development along that route. The extension will require extensions of the existing distribution network to facilitate light rail operations. Moreover, major developments are planned for Kingston Arts Precinct [27] and urban renewal at East Lake[28]. Increased load in the area will put further pressure on the Woden Zone Substation and Telopea Park Zone Substation. The future capacity supported is to be provided by a more centrally located Curtin Zone Substation which would be able to take up some load currently supplied by Civic Zone Substation, Telopea Park Zone Substation and Woden Zone Substation.

The extension of Kingston Foreshore development towards East Lake will require removal of the existing Causeway Switching Station (which will become obsolete) and undergrounding of some sections of the 132 kV transmission lines. A mixed residential/commercial development located at the Dairy Road in Fyshwick will require new feeder from the existing East Lake Zone Substation. Inner South district also includes future development of old Canberra Brickworks. However, the estimated load can be supplied from the existing distribution network without a need for augmentation. Light industrial area of Fyshwick is supplied from East Lake Zone Substation and Fyshwick Zone Substation. However, Fyshwick Substation (operating at 66 kV while other zone substations operate at 132 kV) is earmarked for the imminent decommissioning due to reliability concerns and the plan to consolidate the transmission at 132 kV. The feeders interconnecting East Lake Zone Substation and the 11 kV switchboard.at Fyshwick Zone Substation are required to cater for the transfer of the load to East Lake Zone Substation and the removal of Fyshwick Zone Substation.

[27] https://suburbanland.act.gov.au/en/kingston-arts-precinct
[28] https://www.planning.act.gov.au/urban-renewal/other-projects/eastlake-urban-renewal

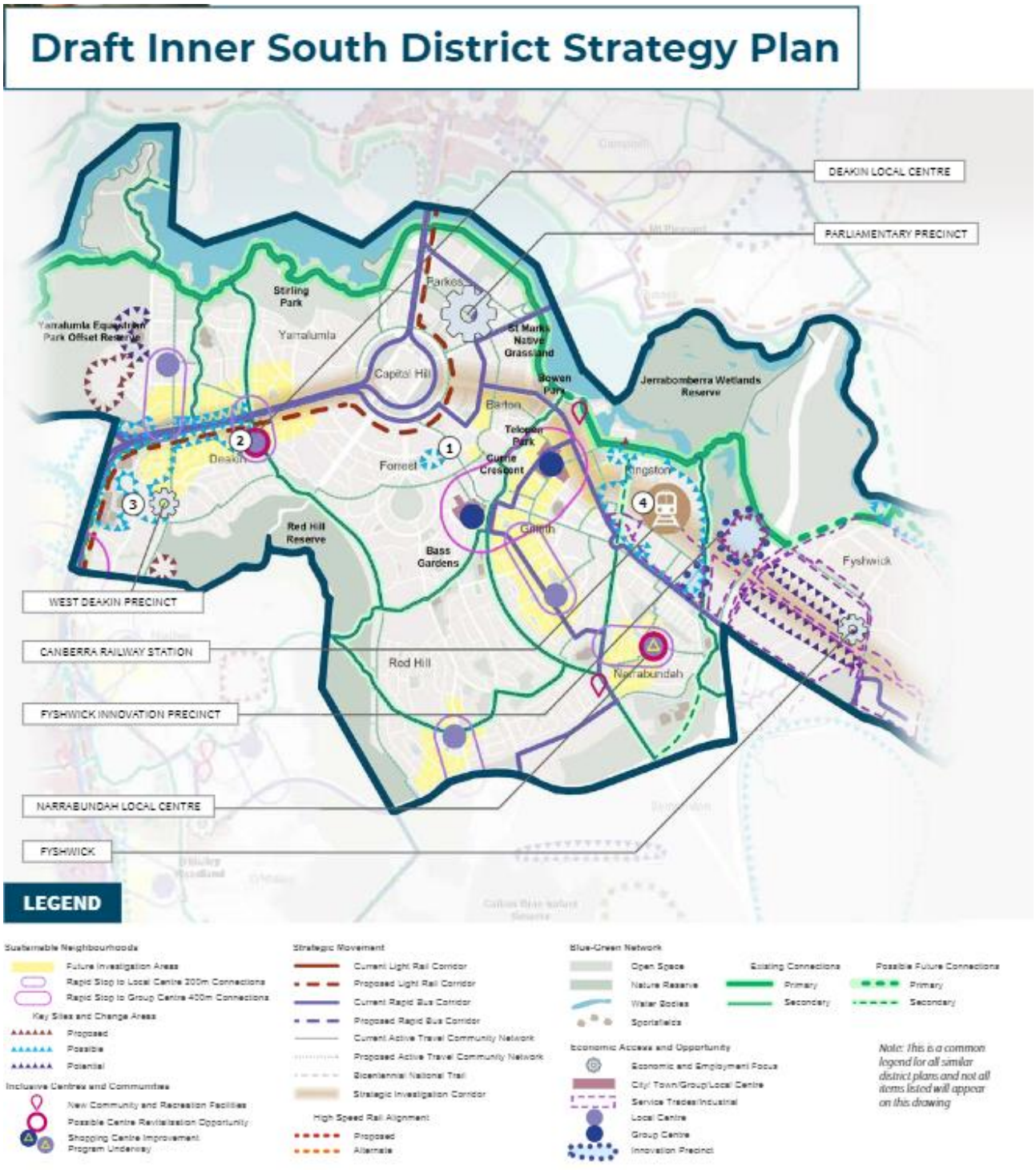


FIGURE 29. ACT GOVERNMENT – DRAFT INNER SOUTH DEVELOPMENT STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

Above average electric vehicle uptake is projected around Kingston, Griffith, Narrabundah, Barton, Forrest, and Red Hill. Since significant intensification of development is taking place in several Inner South locations. In the long term, electric vehicle chargers catering for high-density developments in the above suburbs are projected to have significant impact on the demand in the area.

The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case contain detail of the proposed medium-term projects.

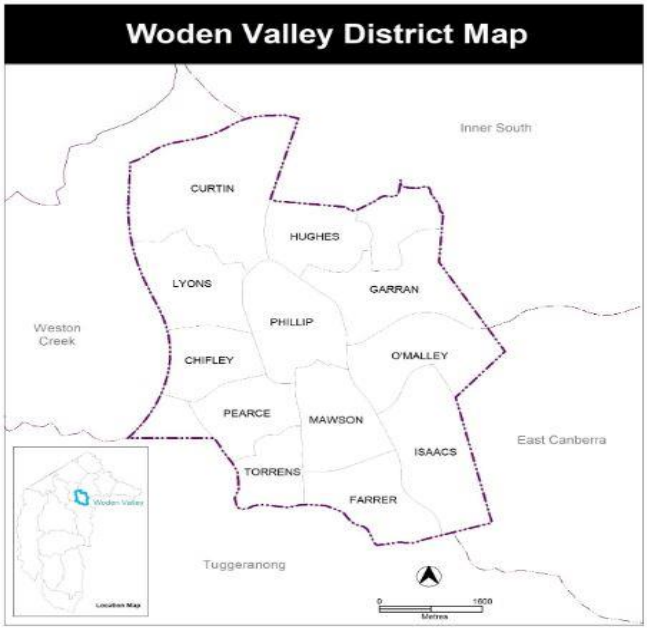
TABLE 8. INNER SOUTH. MEDIUM-TERM AND LONG-TERM PROJECTS

Future projects – proposed and potential	**Medium term and long-term requirements**		**Comment**
	Medium term Up to 2029	**Long term After 2029**	
Telopea Park ZS – transformer replacement	✓		Underway
Decommissioning of Causeway Switching Station[29] (customer funded)	✓		Proposed
3rd transformer at East Lake ZS	✓	✓	Subject to further studies
Three feeders from East Lake ZS to Fyshwick ZS	✓		Underway
Feeder from East Lake ZS (Kingston Foreshore)	✓		Proposed
Sundry network extensions to cater for light rail extension to Woden town centre (customer funded)	✓	✓	Subject to further studies
Two feeders from East Lake ZS (Dairy Road development)	✓		Proposed
Feeder extension to supply Queanbeyan Sewerage Treatment Plan (customer funded)	✓		Subject to further studies
Feeder to a large commercial load in Fyshwick	✓		Subject to further studies
Two feeders from Telopea Park ZS to State Circle development		✓	Subject to further studies
Distribution feeders to support NZ45 transition*		✓	Subject to further studies

[29] Customer funded project

*It is expected that additional feeder and distribution substation augmentations may be required in the medium and long term to cater for the upcoming connection enquiries, EV charging infrastructure, and gas conversion.

WODEN DISTRICT



Development of the Woden District has commenced in late 1960s. The district comprises convectional suburbs and commercial town centre. Over time the density of development around town centre and transport corridors has increased.

In recent years Woden town centre and surrounding areas have experienced elevated level of development activity and corresponding increases in electrical load. This trend is expected to continue. Woden is a centrally located region which is identified for significant urban intensification. The Canberra Light Rail network is expected to be extended from Commonwealth Park into the Woden Town Centre in Stage 2B of the Canberra light rail project.

In 2021, ACT Government engaged Snowy Mountains Engineering Corporation (SMEC) to undertake an urban intensification study of the Woden. The objective of the Study was to investigate the infrastructure opportunities and constraints. The study considered urban renewal and intensification in the Woden Valley district with a focus on the urban corridor from Mawson group centre, through the Woden town centre, to North Curtin and West Deakin. The SMEC study projected continuing increase in urban development, significant increase in population and employment. The study considered several scenarios reflecting various levels of development.

Under medium scenario the load is projected to increase by 11 MVA due to intensification of development and Woden and 19 MVA by 2041. Under the high growth scenario, the corresponding increases in load are 23 MVA by 2031 and 45 MVA by 2045.

The medium and high growth scenario (considered in the SMEC study) is driven by the intensification around the light rail and other identified urban infill developments. Apart from the general proliferation of the high-density developments, Woden demand is expected to grow due to identified major point loads including:

- Electrification of the Woden bus depot
- Redevelopment of the Canberra Institute of Technology (CIT) site CIT Woden redevelopment
- Canberra Hospital expansion and redevelopment
- Redevelopment of Callam Offices
- Future diplomatic subdivision in Curtin

Currently, Woden is supplied from the Woden Zone Substation which operates close to operational limits. The substation receives some support from the Wanniassa Zone Substation and Telopea Park Zone Substation. However, apart from the developments in the Woden district, Woden Zone Substation is supplying residential and mixed ongoing developments in the Molonglo Valley located to the East and North-East of Woden. Overall, available zone substation capacity and distribution capacity are currently (2022) significantly constrained.

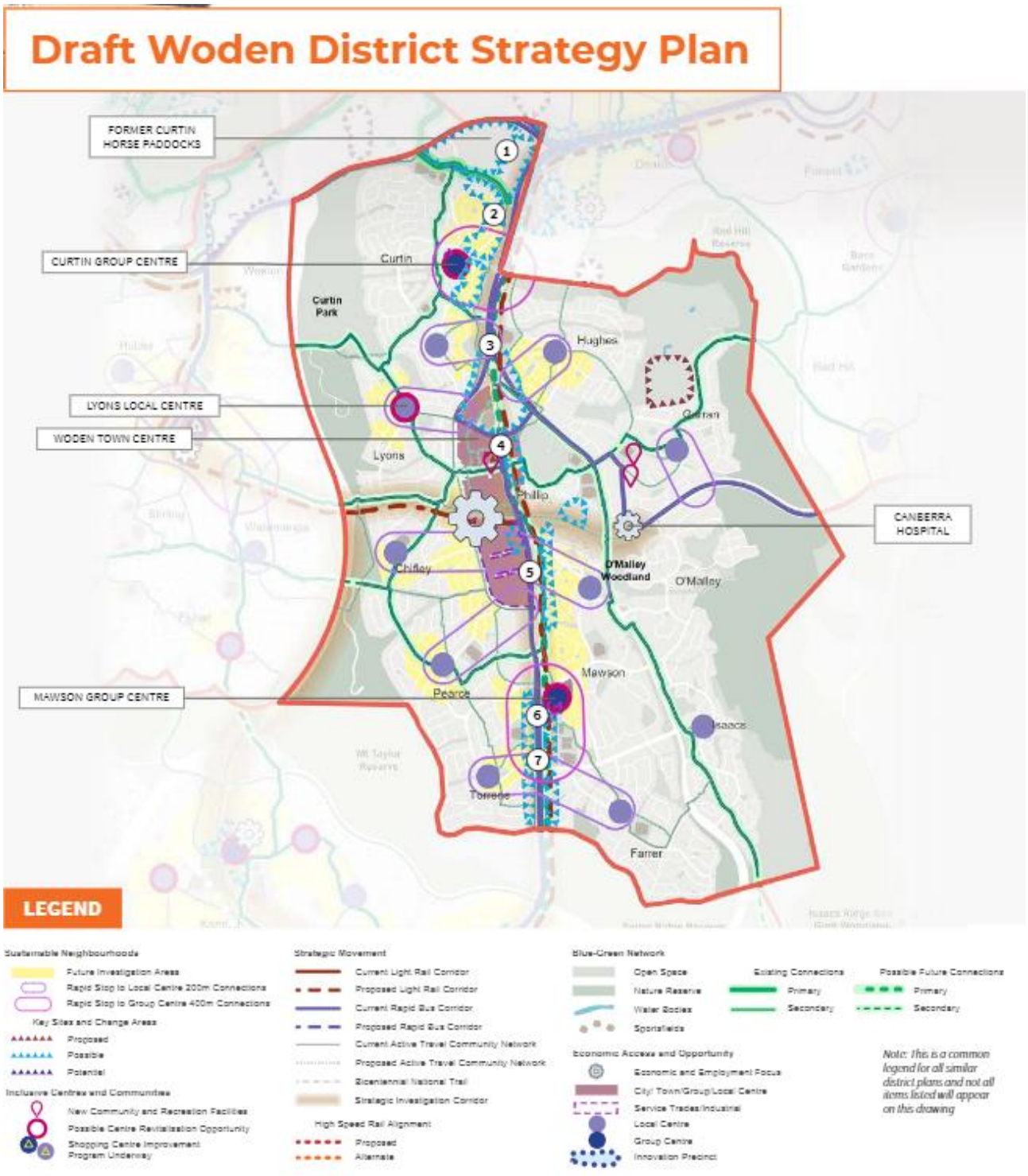


FIGURE 30. ACT GOVERNMENT – DRAFT WODEN DEVELOPMENT STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

Furthermore, the projected distribution of electric vehicles registration and chargers translates to above average projected increases in demand in Phillip, Mawson, Curtin, Garran, and O'Malley. The demand will be also increased by the progressive gas conversion in locations currently using energy derived from gas which includes most suburbs located in the Woden district.

The estimated growth in electrical demand supports the need to a new zone substation,11kV feeders and distribution substations to supply the forecast demand in the area in the medium-term and long-term.

The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case contain detail of the proposed medium-term projects.

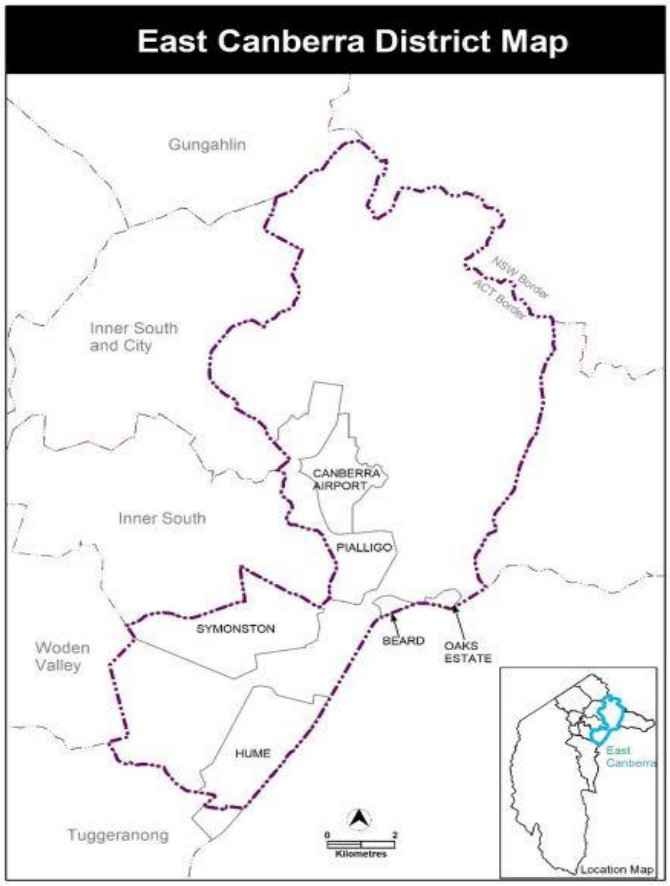
TABLE 9. WODEN. MEDIUM-TERM AND LONG-TERM PROJECT SUMMARY.

Future projects – proposed and potential	**Medium-term and long-term requirements**		**Comment**
	Medium-term Up to 2029	**Long-term After 2029**	
Feeder from Woden ZS (diplomatic development in Curtin)	✓		Proposed
Feeder(s) from Woden ZS to the town centre	✓		Proposed
Woden ZS - switchboard extension (related to the Canberra Hospital development) (customer funded)	✓		Underway
Two feeders from Wanniassa ZS to Woden (bus depot electrification)	✓		Proposed
Various extensions for the light rail supply		✓	Subject to further studies
Feeder from Woden ZS to Garran and Red Hill - net zero*	✓		Proposed
Feeder from Wanniassa ZS to Phillip - net zero*	✓		Proposed
New Curtin ZS	✓	✓	Proposed
Transmission cable Woden ZS to new Curtin ZS	✓		Proposed
Distribution feeders to support NZ45 transition**		✓	Subject to further studies

***** Net zero feeders, predominantly driven by EV charging infrastructure based on the ACT Government Zero Emission Vehicle Strategy 2022-30 which adopted "optimistic" EV take up scenario.

** It is anticipated that in the long-term, capacity of the distribution system will have to be increased to cater for the net zero impact which includes increases in demand from electric vehicle charging and gas-to-electricity conversion.

EAST CANBERRA DISTRICT



East Canberra district encompasses a large low-density area located East to major development centres in Inner North, Inner South and Woden. Despite low density, this expansive area includes significant existing and planned electrical loads including Canberra Airport, Fairbairn, Oaks Estate, Symonston and Pialligo.

Pialligo, Canberra Airport and Beard

Over the last decade, the Canberra Airport was one of the of the main commercial development areas in Canberra. The Canberra Airport and nearby suburb of Pialligo are expected to experience significant growth over the coming years with several large projects expected including data centres and large commercial buildings. Growth in the Canberra Airport area was slowed by economic impacts from the 2020-2022 pandemic. However, with travel ramping up in 2022 it is anticipated that this growth will recommence.

Adjacent Fyshwick is a key light industrial area. While the wider Fyshwick area has not experienced much growth in recent years there have been some large data centres established which have required significant network capacity. Fyshwick is part of the Inner North district.

There are additional large data centres planned in the Beard area in the coming years and significant developments in Fairbairn.

The area is currently supplied by the Fyshwick Zone Substation, East Lake Zone Substation and Gilmore Zone Substation located at Hume. The Fyshwick Zone Substation is currently the only 66/11kV substation in Evoenergy's network. It also has end of life equipment associated with reliability constraints. Consequently, Evoenergy is planning to decommission Fyshwick Zone Substation and transfer the load over to the East Lake Zone Substation. The Fyshwick Zone Substation site will be maintained as a 11kV switching station to facilitate express feeders between the zone substations to avoid major feeder augmentation in the area. The proposed projects are listed in the section for Inner South district.

The East Lake Zone Substation is a 2 x 55MVA transformer zone substation with indoor gas insulated switchgear. It currently has the capacity to supply most of the confirmed developments in coming years apart from any large data centres. However, the longer-term plans include installation of the third transformer.

Highly loaded City East Zone Substation does not have capacity to provide relief through the load transfers. As at 2022, City East Zone Substation which does not have any spare 11kV circuit breakers for connection additional feeders. The long-term continuing development of the airport and adjacent areas including Beard and Fairbairn may put a long-term strain on the available capacity. The long-term plans consider a possibility of new Airport Zone Substation as one of the options. At this stage this is not a firm proposal, but an option which will be further studied. It is noted that this option would be associated with the significant transmission line works to connect the new zone substation to the transmission network.

Furthermore, Evoenergy currently has a customer initiated and funded project for the Harman Zone Substation which is currently underway. This substation and associated 132kV transmission line work will be constructed adjacent to the NSW border.

Hume

Hume is a commercial and light industrial suburb in the South-East of Canberra. The primary driver of growth in this area is commercial load with several large data centres established and under consideration. Data centres not only provide challenges with large load expected, they also often have significant redundancy requirements which require dedicated feeder circuit breakers and redundancy in zone substation capacity.

Hume area includes a 10 MW solar farm and the Mugga Waste Management Centre which has a 4 MW biogas generator. There is currently a plan to expand this generator to around 20 MW capacity.

Hume is supplied from the Gilmore Zone Substation. Gilmore Zone Substation operates with some spare capacity. Furthermore, reliability concerns at Gilmore Substation are increasing due to some end-of-life equipment still operating at Gilmore Zone Substation. Evoenergy is coordinating augmentation of capacity at Gilmore Zone Substation with other major asset replacement projects. To achieve savings a transformer removed from Telopea Park Zone Substation is to be placed at Gilmore Zone Substation with the objective to utilise its remaining asset life.

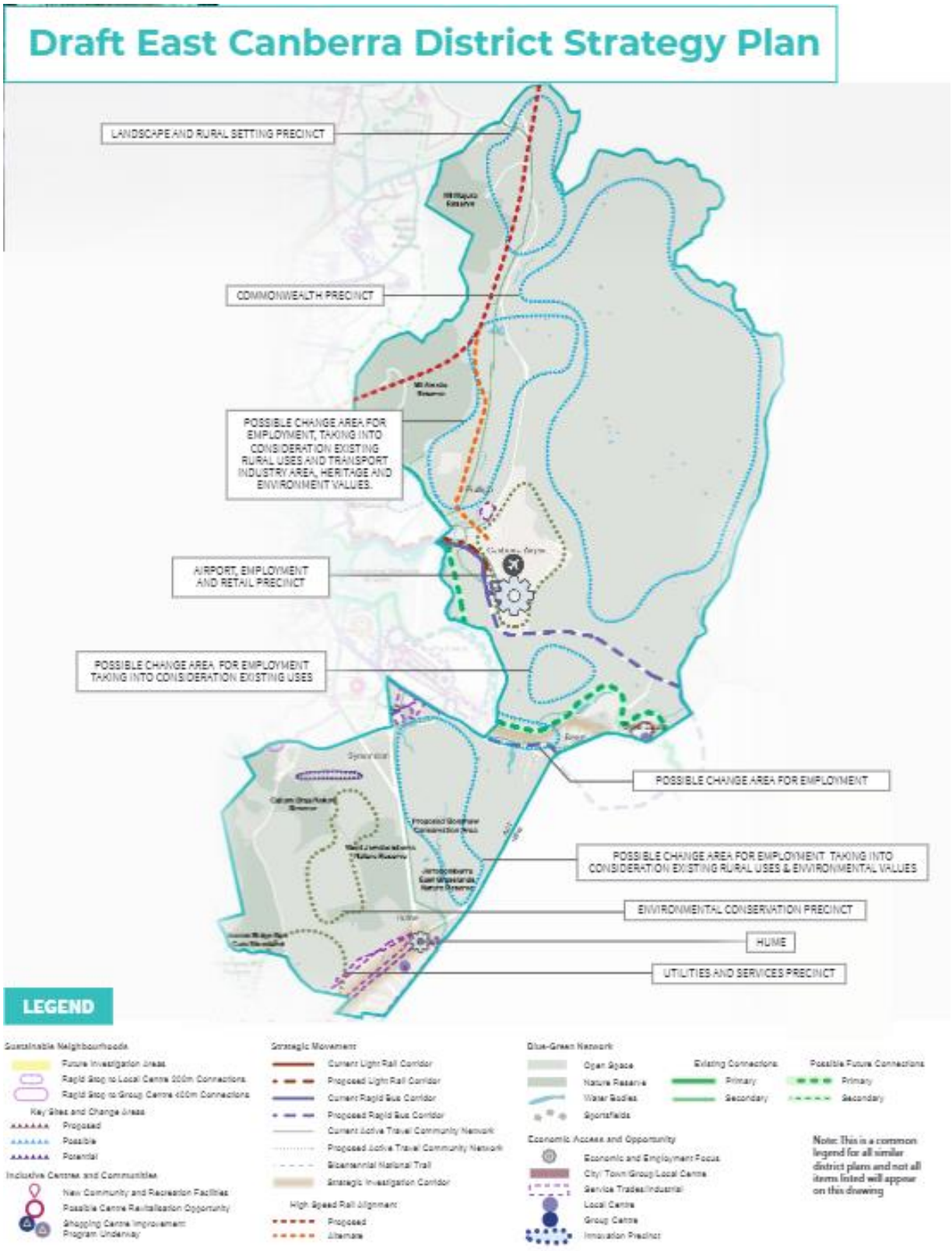


FIGURE 31. ACT GOVERNMENT – DRAFT EAST CANBERRA STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case (2023) contain details of the proposed medium-term projects.

TABLE 10. EAST CANBERRA. MEDIUM-TERM AND LONG-TERM PROJECTS

Future projects – proposed and potential	**Medium-term and long-term requirements**		**Comment**
	Medium-term Up to 2029	**Long-term After 2029**	
Feeder from Gilmore ZS to Hume West.	✓		Proposed
Gilmore ZS – installation of the 3rd transformer (transformer relocated from Telopea Park ZS)	✓		Underway
Gilmore ZS – installation of the 3rd switchboard	✓		Underway
Harman ZS – to supply government development (customer funded)	✓		Underway
Feeders to a potential large commercial load (customer funded)		✓	Subject to further studies
Feeder from East Lake ZS to airport precinct	✓		Underway
Feeder from East Lake ZS to Fairbairn	✓		Proposed
New Airport ZS		✓	Subject to further studies
Distribution feeders to support NZ45 transition*		✓	Subject to further studies

*In addition to the specific projects, it is anticipated that that augmentation of the distribution network is likely to be required to support the transition to net zero 2045 target and corresponding demand from electric vehicle chargers and gas-to-electricity conversions.

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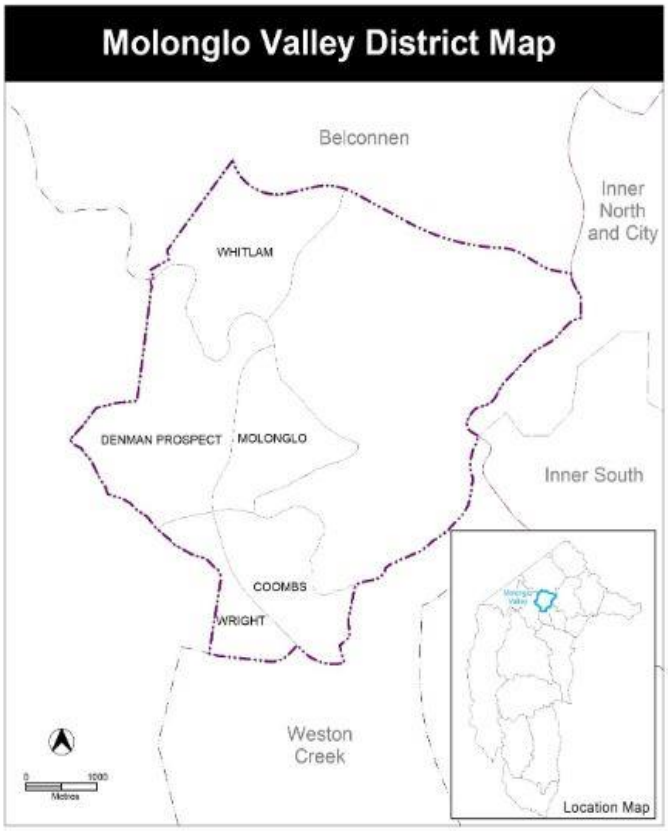
MOLONGLO VALLEY DISTRICT



The Molonglo Valley to the West of Canberra is currently the ACT's largest greenfield area. It began with the suburbs of Coombs and Wright which were gazetted in 2010 and followed by Denman Prospect in 2012. While suburbs at Coombs and Wright are mostly complete, there is some continuing development in these suburbs. Denman Prospect is partially complete and is currently rapidly expanding. The newest suburb of Whitlam is currently under construction with the first stages energised in 2021 and 2022. In addition, there are two large areas under consideration for the residential development and a large commercial centre. These suburbs 2 and 3 (located to the east and south-east of Whitlam) are marked with the light blue boundary on the map below.

The mixed residential/commercial development of Molonglo Valley is denser than comparable past developments. Despite some of the suburbs experiencing a high penetration of photovoltaics, the density of the electrical load is projected to be higher than in the older suburbs. Smaller blocks and higher proportion of medium density development contribute to that outcome.

Bulk of the Molonglo Valley development including Coombs, Wright, and Denman Prospect are currently supplied from the Woden Zone Substation. Feeders supplying these locations are very heavily loaded. Woden Zone Substation capacity is heavily constrained due to ongoing development within Woden District and adjacent areas. The first stages of Whitlam (suburb located to the north of Molonglo Valley) are supplied from the Civic Zone Substation. Due to the anticipated load growth and high feeder loading in the area, the Molonglo Valley was identified as an area of significant supply constraints. Evoenergy conducted a RIT-D for a new zone substation in the area – the Molonglo Zone Substation. As part of the RIT-D it was identified that a non-network option such as a battery could be used to defer the construction of the zone substation.

After going out to market for a non-network solution Evoenergy selected ITP Renewables to provide a 6.9MW/7.45MWh battery energy storage system (BESS) at the future zone substation site contracted to provide demand management services. The BESS is expected to be energised in August 2023 in preparation for the high summer loads in the area. The BESS is expected to be expanded to a second stage of the same size.

The first stage of the zone substation is expected to be energised prior to summer 2025. The first stage will be a single 55MVA power transformer with a second 55MVA power transformer to follow in 2028. Construction of the Molonglo Zone Substation requires a structured ongoing development of the distribution network originating from that substation.

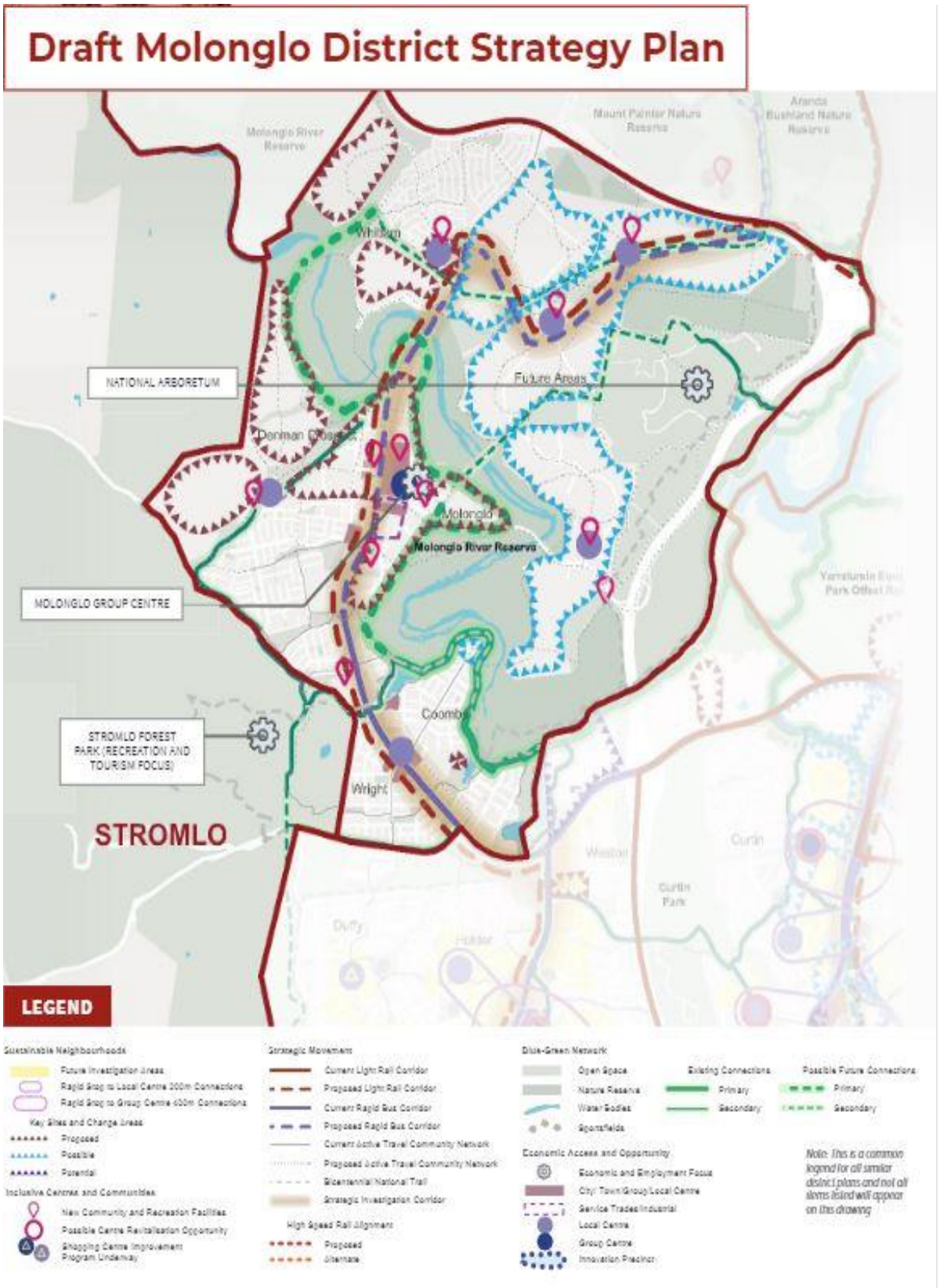


FIGURE 32. ACT GOVERNMENT – DRAFT MOLONGLO VALLEY STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case (2023) contain details of the proposed medium-term projects.

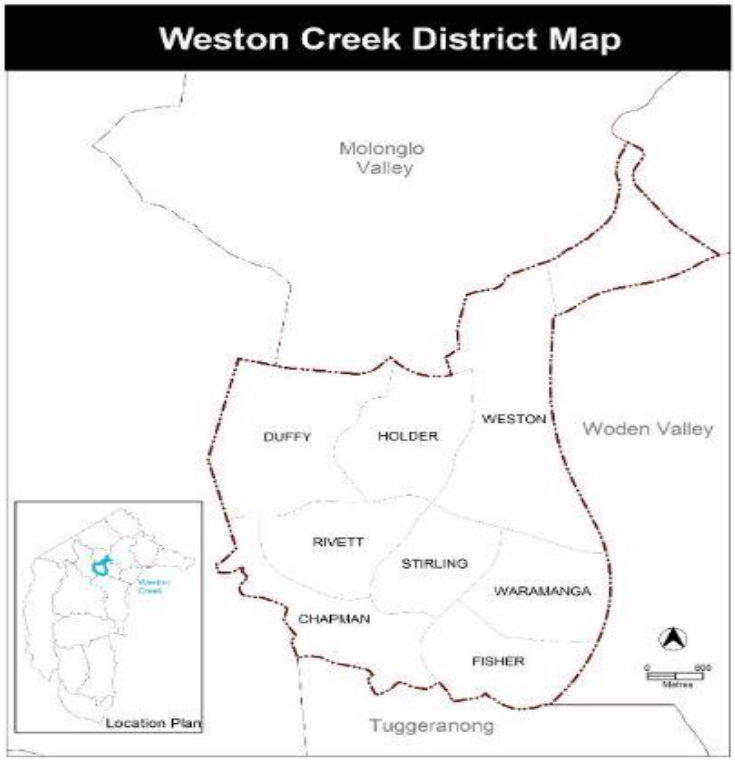
TABLE 11. MOLONGLO VALLEY AND WESTON CREEK. MEDIUM-TERM AND LONG-TERM PROJECTS

Future projects – proposed and potential	**Medium-term and long-term requirements**		**Comment**
	Medium-term Up to 2029	**Long-term After 2029**	
Feeder upgrade (existing) ex Civic ZS to Molonglo Valley	✓		Underway
Molonglo battery project	✓		Underway
Molonglo ZS Stage 1– First transformer	✓		Proposed
Molonglo ZS Stage 2 – Second transformer	✓		Proposed
Three feeders from Molonglo ZS	✓		Proposed
Distribution feeders from Molonglo ZS to cater for future estate subdivisions		✓	Subject to further studies
Distribution feeders to support NZ45 transition*		✓	Subject to further studies

*In addition to the specific projects, it is anticipated that that augmentation of the distribution network is likely to be required to support the transition to net zero 2045 target and corresponding demand from electric vehicle chargers and gas-to-electricity conversions.

It is anticipated that continuing expansion of (which may include Suburb 2 and Suburb 3 currently under consideration by ACT government) and demand increases due to electric vehicle charging and gas-to-electricity conversion will require additional distribution capacity in the long-term. However, at this stage, no sufficient details are available to assess scale and timing of the network impact.

WESTON CREEK DISTRICT



Weston Creek District consists mostly of residential low-density developments in a suburban setting. The commercial load in the district includes several local commercial centres and one medium size group centre. The draft map below provides more details on the planned developments strategy for the Weston District. There are several designated studies areas but in the medium term, opportunities for intensification of urban development appear to be limited and localised. Nevertheless, above average electric vehicle up-take is projected for several suburbs including Holder, Duffy, Rivett, and Weston. Most of the Weston District is supplied by the existing Woden Zone Substation with parts being supplied from Wanniassa Zone Substation. While Woden Zone Substation operates very close to capacity limits, Wanniassa Zone Substation operates within the operational limits with some spare capacity available. The planned construction of the Molonglo Zone Substation and Curtin Zone Substation is projected to provide sufficient capacity at the zone substation level to cater for future demand growth in the area. It is projected that the distribution system capacity in Weston is sufficient in the medium-term. However, in the long term, it is likely to require augmentation to facilitate transition to net zero.

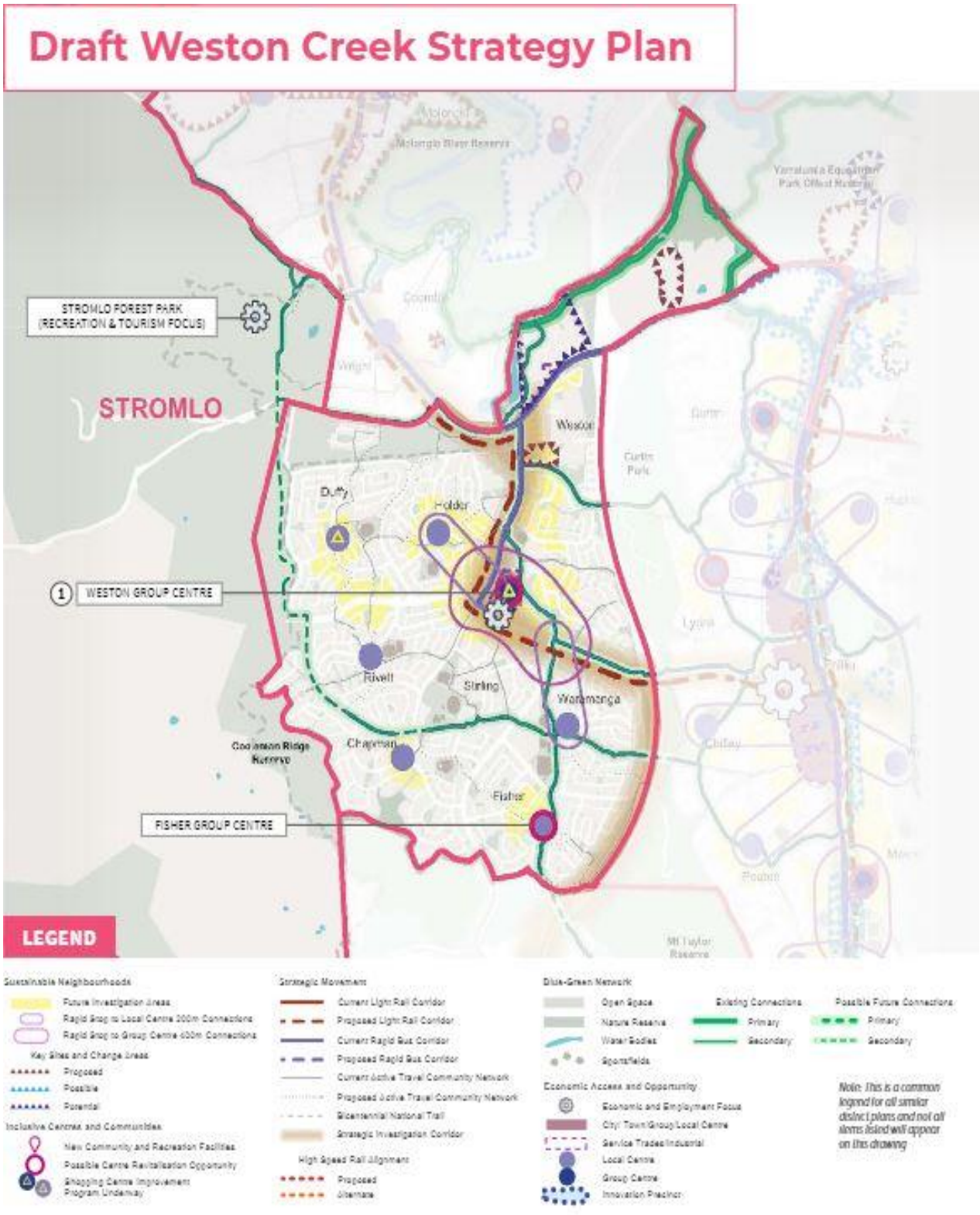


FIGURE 33. WESTON CREEK DRAFT ACT GOVERNMENT STRATEGY

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

Evoenergy has not identified major existing or medium-term constraints in the Weston Creek area which need to be addressed through augmentation. However, the table below flags potential long-term needs resulting from the transition to net zero and impact of electric vehicles and gas-to electricity conversion.

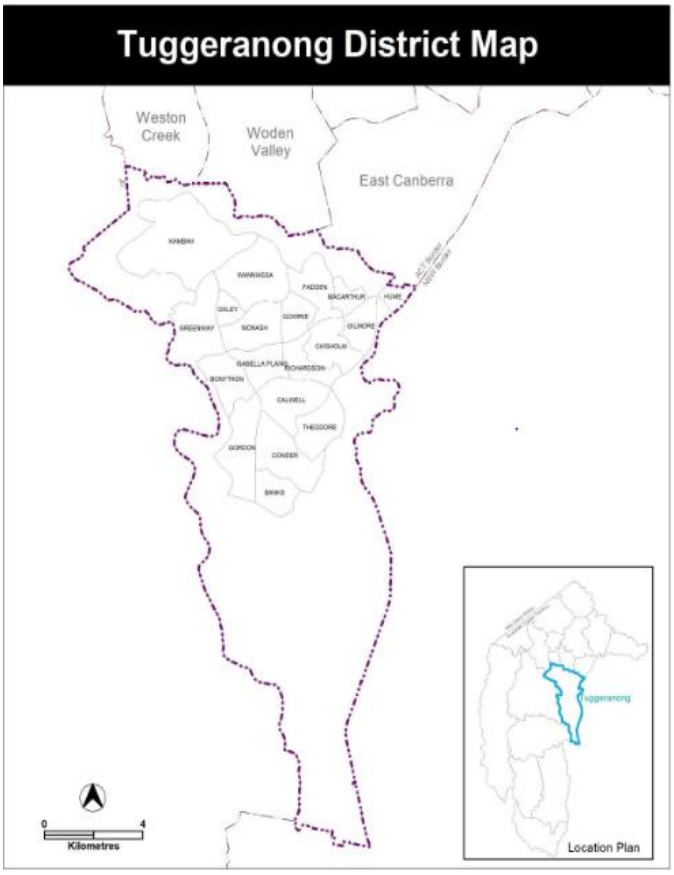
There are no other significant requirements identified for this district.

TABLE 12. WESTON CREEK. MEDIUM-TERM AND LONG-TERM PROJECTS.

Future projects – proposed and potential	**Medium-term and long-term requirements**		**Comment**
	Medium-term Up to 2029	**Long-term After 2029**	
Distribution feeders to support NZ45 transition*		✓	Subject to further studies

* It is anticipated that that augmentation of the distribution network is likely to be required to support the transition to net zero 2045 target and corresponding demand from electric vehicle chargers and gas-to-electricity conversions.

TUGGERANONG DISTRICT



Tuggeranong is the southern most urban district of Canberra. Generally, the sprawling suburbs of Tuggeranong are experiencing growth below the growth of more central locations. However, there is an expected increase in demand resulting from the continuing developments in the Tuggeranong town centre.

The map below provides an overview of the ACT government current development plans for Tuggeranong.

The demand in the town centre has increased in recent years due to high density residential and mixed-use construction in the town centre. Furthermore, a substantial increase in electrical demand is expected due to the planned electrification of the bus depot. Town centre has been also identified as the area with expected above average take up of electric vehicles and chargers. In addition, Kambah, Monash, and Wanniassa are noted for expected higher than average number of the electric vehicle registrations. The opportunities for urban development intensification are limited outside the town centre. However, major transport routes are designated for future investigations.

The bulk of electrical demand in Tuggeranong is supplied from Wanniassa Zone Substation and Theodore Zone Substations. Some loads on the eastern side are supplied from Gilmore Substation. Wanniassa and Theodore substations have sufficient capacity to cater for the growing demand in the foreseeable future. However, Wanniassa Zone Substation has been assessed to require switchboard extension to connect future distribution feeders. Consequently, the planning for Tuggeranong did not identify major constraints in the transmission network. Identified distribution network constraints are due to known major point loads, bus depot electrification and ongoing town centre development.

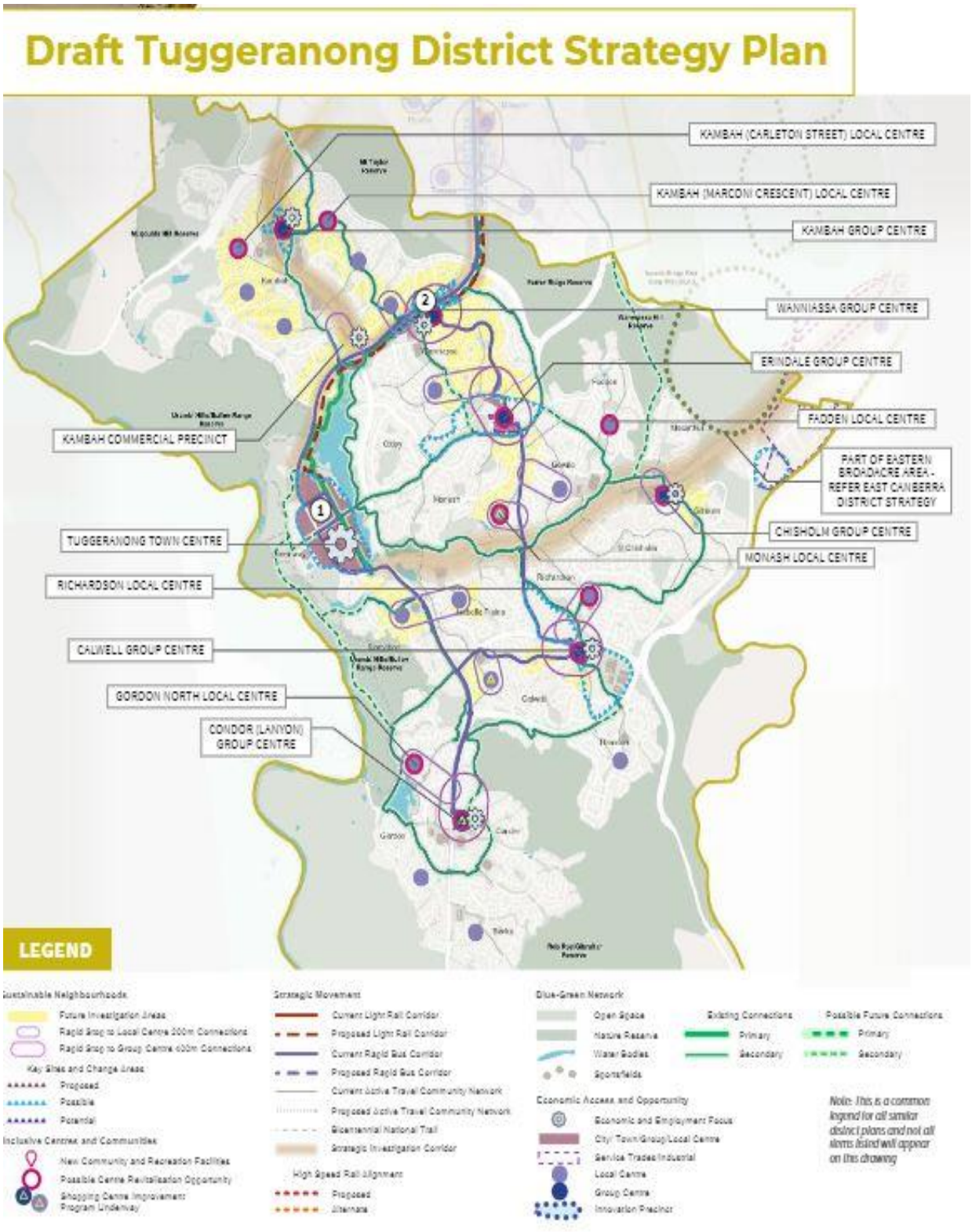


FIGURE 34. TUGGERANONG – DRAFT ACT GOVERNMENT PLAN

Source: https://yoursayconversations.act.gov.au/act-planning-review/draft-district-strategies

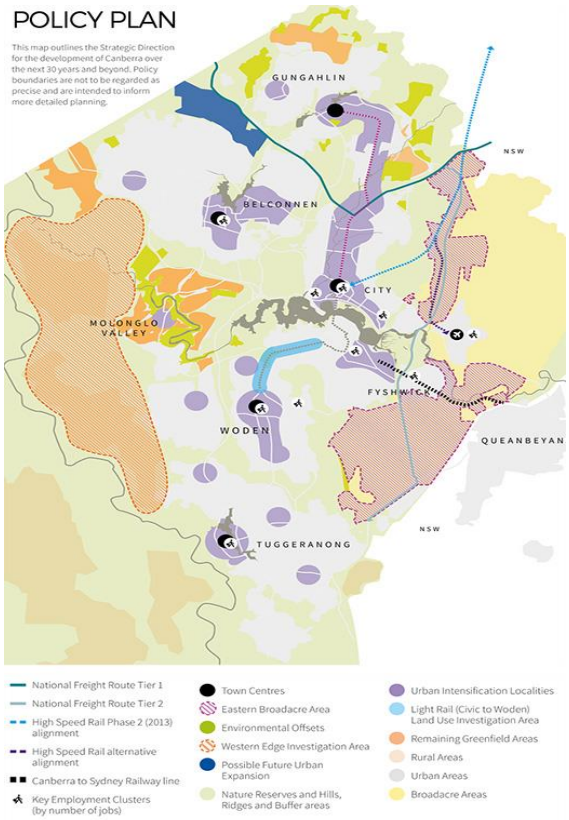
The table below provides a summary of the proposed and potential future projects. The Annual Planning Report, available on the Evoenergy website, and the Demand Driven Augmentation Capital Expenditure Business Case contain detail of the proposed medium-term projects.

TABLE 13. TUGGERANONG. MEDIUM-TERM AND LONG-TERM PROJECTS

Future projects – proposed and potential	**Projects addressing above constraints**		**Comment**
	Medium term Up to 2029	**Long term After 2029**	
Feeder from Wanniassa ZS to the town centre	✓		Subject to further studies
Two feeders from Wanniassa ZS for bus depot electrification	✓		Proposed
Wanniassa ZS switchboard extension	✓		Proposed
Distribution feeders to support NZ45 transition		✓	Subject to further studies

***** It is anticipated that that augmentation of the distribution network is likely to be required to support the transition to net zero 2045 target and corresponding demand from electric vehicle chargers and gas-to-electricity conversions.

WESTERN EDGE



Western Edge refers to a major area located in the western part of the ACT outside the current network development boundary and the existing urban area. Potential development of the Western Edge has been recognised in the strategic planning for the ACT. The plan is a long term (35 years) view of the development direction. The ACT Government is investigating land to the west of Canberra's metropolitan area. The area potentially can accommodate up to 100 000 residents which would have to be supported by a substantial electrical network. Several studies are planned in coming years to identify future uses for the land.

The next step is undertaking a Capability and Suitability Assessment of the Western Edge to identify areas that may be suitable for new nature reserves, environmental offsets, heritage conservation, other uses (e.g., rural, broadacre, infrastructure, transport, and services) and potential urban settlement. This assessment has started and is expected to be completed in the near future. This will lead to further studies.

The Western Edge Investigation area is shaded in transparent orange in the below image from the ACT Government. Figure 24shows an overview of the ACT Plan including a large Western Edge area earmarked for further study and potential development.

Due to the long-term nature of development in this region as well as uncertainty around the planning Evoenergy has not yet proposed specific augmentation projects in the coming regulatory cycles. However, the following general points can be made on potential constraints and opportunities in the area based on available information:

- The Western Edge area is not serviced by the existing Evoenergy electricity network
- There are no existing zone substations close to the study area
- Very limited supply support may be available from the future Molonglo Substation, Wanniassa Substation, and Strathnairn Substation (further comments below)
- At this stage Molonglo Zone Substation is expected to require two permanent transformers by 2028 to supply planned developments in the Molonglo Valley. This zone substation will be able to accommodate a third transformer which is expected to be able to supply any initial stages of western edge development further north
- Assuming additional electricity supply would be required for 50,000 to 100,000 residents (20,000-50,000 residential customers) with no natural gas supply Evoenergy expects that between 1 and 2 new zone substations would be required. The options detailed below show a single new zone substation in the middle of the investigation area. This location is indicative only and the number of zone substations as well as their location are to be confirmed in later stages
- Evoenergy has a general preference for the staging of the development from North to South.
- With the proposed relocation of the future Strathnairn Zone Substation site to adjacent to Stockdill Substation, Strathnairn Zone Substation may be able to supply initial stages of the development in the northern region
- Woden Zone Substation (see Figure 2) is close to full capacity, so would not be able to supply any new suburbs to the south of the western edge investigation zone
- Wanniassa Zone Substation would have some capacity to supply initial stages of the most southern part of the western edge investigation zone

Evoenergy intends to participate and contribute to the future studies of the Western Edge development and update network plans as appropriate.

APPENDIX B – DEMAND FORECAST METHODOLOGY

The following document provides details on the maximum and minimum demand forecasting methodology as adopted in the Evoenergy Annual Planning Report (APR) 2022.

OVERVIEW

Maximum demand forecasts provide long-term summer and winter maximum demand estimates conditional on observed annual historical data during those seasons. Similarly, minimum demand forecasts provide long-term daytime and night-time minimum demand estimates conditional on observed annual historical data during those time-of-day periods.

In alignment with previous years' reports and compliant with AEMO's revised connection point forecasting methodology, forecasts provide

- seasonal maximum demand (as apparent power in MVA) for the zone substations Belconnen, City East, Civic, East Lake, Fyshwick, Gilmore, Gold Creek, Latham, Telopea Park, Theodore, Wanniassa and Woden,
- seasonal maximum demand (as real power in MW) for the bulk supply points Canberra Bulk Supply Point, Queanbeyan Bulk Supply Point, Williamsdale Bulk Supply Point, and
- seasonal maximum and time-of-day minimum demand (as real power in MW) for the system.

The forecasting horizon is 10 years except for Fyshwick Zone Substation and Queanbeyan Bulk Supply Point for which the forecasting horizon is 3 years (due to the decommissioning of Fyshwick Zone Substation by 2024).

Also included are seasonal 10-year maximum demand forecasts for the new Stockdill Bulk Supply Point, which are based on seasonal Canberra Bulk Supply Point forecasts and a load flow analysis, as summarised in the "Bulk Supply Points Demand Forecasts" section below.

DEFINITIONS

Maximum demand

Zone substations

For zone substations, maximum demand is defined as the maximum apparent power S (in MVA) recorded during a specific financial year and season.

$$\begin{aligned} \text{Maximum demand (in MVA)} &= \max_t S_t\,, \quad \text{and} \\ t^{\text{Maximum demand}} &= \arg\max_t S_t\,. \end{aligned}$$

Annual & seasonal zone substation maximum demands are non-coincident maximum demands, i.e. maximum demands correspond to the absolute maximum values recorded at every individual asset, and timestamps of the individual assets' maximum demands do not coincide with the timestamp of the overall system maximum demand.

Bulk supply points

For bulk supply points, maximum demand is defined as the maximum real power P (in MW), recorded during a specific financial year and season.

$$\begin{aligned} \text{Maximum demand (in MW)} &= \max_t P_t\,, \quad \text{and} \\ t^{\text{Maximum demand}} &= \arg\max_t P_t\,. \end{aligned}$$

As with the zone substation maximum demands, annual & seasonal bulk supply point maximum demands are non-coincident maximum demands.

System

The annual & seasonal system maximum demand is the overall maximum of the coincident sum of individual maximum demands (in MW) measured at every bulk supply point (BSP). The time t covers all 15-minute intervals within a specific financial year and season.

$$\text{Maximum demand (in MW)} = \max_t \sum_{i \in \text{BSP}} \text{Maximum demand (in MW)}_{i,t}\,.$$

Minimum demand

The system minimum demand is defined as the minimum of the coincident sum of individual maximum demands (in MW) measured at every bulk supply point (BSP). The time t covers all 15-minute intervals within a specific financial year and time of day.

$$\text{Minimum demand (in MW)} = \min_t \sum_{i \in \text{BSP}} \text{Maximum demand (in MW)}_{i,t}\,.$$

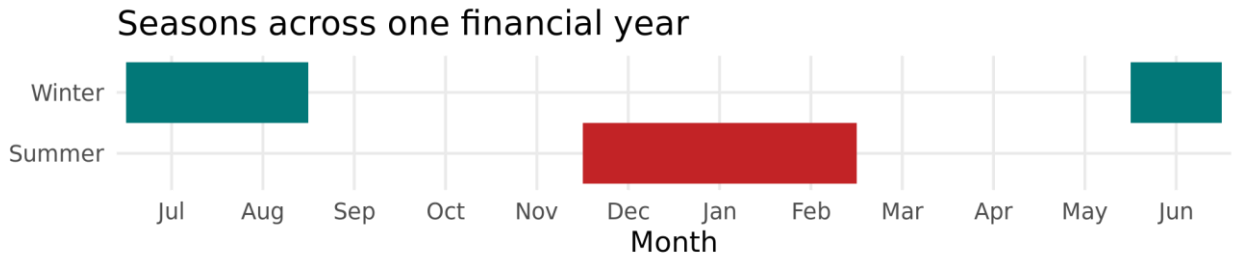
Financial year

A financial year (FY) is defined as the period from (and excluding) 1 July, 00:00 AEST until (and including) 1 July, 00:00 AEST (right-inclusive interval). Throughout this section, the terms “year” and “financial year” are used interchangeably, and always refer to a financial year as the unit of time.

Season

The summer and winter seasons are defined by the months

- “Summer”: December, January, February,
- “Winter”: July, August, June.



Note that “Winter” is a non-contiguous period.

Time-of-day periods

The daytime and night-time periods are defined by hours

- “daytime”: 8am - 8pm
- “night-time”: 8pm - 8am

Probability of exceedance

Compliant with the National Electricity Rules (NER) on load forecasting, forecasts show estimates for “least-likely” and “most-likely” scenarios. Specifically, the forecasting model provides estimates for the maximum and minimum demand data (both historical and forecasts) at different probability of exceedance (PoE) levels; maximum and minimum demands at the 10%, 50% and 90% PoE level correspond to values that are expected to be exceeded in 1, 5, and 9 out of 10 years, respectively.

SOURCE DATA

Maximum demand data

Historical data of seasonal maximum demands during previous financial years excluding the current financial year (FY21/22) for the zone substations (in MVA), bulk supply points (in MW) and the system (in MW) are taken from the Annual Planning Report 2019.

Data for the current financial year (FY21/22) are extracted from measured energy values recorded by network metering installed at bulk supply points (operated by TransGrid) and zone substations (operated by Evoenergy).

Energies are then converted to powers as follows: Active (real) powers P and reactive powers Q are calculated from the corresponding real and reactive energy consumptions, by assuming uniform usage during the time interval

$$\begin{aligned} P \text{ [in MW]} &= 4 \times 10^{-3} \times \text{active energy consumption [in kWh]}, \\ Q \text{ [in MVAR]} &= 4 \times 10^{-3} \times \text{reactive energy consumption [in kVARh]}. \end{aligned}$$

The factor of 4 is because there are four 15-minute intervals per hour, and consumptions are measured in kilowatt (volt ampere reactive) hours over a 15-minute interval.

For zone substation data, the apparent power S is then calculated from P and Q as

$$S = \sqrt{P^2 + Q^2}.$$

Minimum demand data

All historical data are extracted from measured energy values recorded by network metering installed at the bulk supply points (operated by Transgrid).

Real energy consumption values at the bulk supply points are converted to real power values, again assuming uniform usage during the 15-minute interval and as detailed in the previous subsection.

Block loads

In addition, forecasts account for known commercial and residential block loads. The block load information was collated on the connection enquires, applications and government land release programs, as shown in Table 14 and Table 15.

TABLE 14: SUMMER BLOCK LOADS (MVA)

Zone	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Belconnen	0.7	0.7	0.7	1.0	1.1	1.0	1.3	1.4	1.1	1.3	1.4
City East	1.8	2.9	3.4	3.3	3.1	3.5	4.0	4.7	5.5	6.3	7.0
Civic	1.5	2.2	2.9	2.8	2.5	2.6	3.1	3.0	2.7	2.5	2.8
East Lake	0.0	8.6	18.4	1.6	1.9	2.1	1.3	0.8	0.9	0.9	0.9
Fyshwick	0.0	2.8	0.5	1.5	0.0	0.0	0.5	0.0	0.0	0.5	0.0
Gilmore	0.0	0.1	0.6	0.6	0.9	0.9	1.0	1.0	1.1	1.2	0.8
Gold Creek	0.1	1.0	0.3	0.4	0.5	0.6	0.8	1.1	1.5	1.7	2.0
Latham	0.6	1.0	1.5	1.5	1.6	1.6	1.7	1.8	2.3	2.1	2.5
System	1.4	1.4	5.1	7.0	7.7	9.2	10.9	11.7	13.7	15.7	17.9
Telopea Park	0.3	0.2	1.9	2.5	1.9	1.7	1.9	2.3	2.5	2.9	2.8
Theodore	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5
Wanniassa	0.1	2.8	3.4	1.0	1.5	1.9	1.6	1.8	2.4	1.8	2.0
Woden	0.2	1.3	1.9	2.6	2.3	2.4	2.4	2.6	3.0	3.4	3.9

TABLE 15: WINTER BLOCK LOADS (MVA)

Zone	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Belconnen	1.0	1.0	0.9	1.4	1.4	1.3	1.9	2.1	1.8	2.0	2.2
City East	2.4	3.9	4.6	4.7	4.7	5.4	6.1	7.1	8.3	9.5	10.5
Civic	1.8	2.5	3.3	3.2	3.0	3.3	3.8	3.8	3.7	3.7	4.1
East Lake	0.0	10.7	22.9	1.7	2.0	2.3	1.3	0.9	1.0	1.0	1.1
Fyshwick	0.0	2.7	0.5	1.5	0.0	0.0	0.5	0.0	0.0	0.5	0.0
Gilmore	0.1	0.1	0.6	0.6	0.9	1.0	1.0	1.1	1.3	1.4	0.8
Gold Creek	0.2	0.9	0.4	0.6	0.7	0.9	1.2	1.6	2.1	2.5	2.9
Latham	0.8	1.4	1.7	1.8	1.9	2.0	2.3	2.6	3.3	3.1	3.7
System	2.0	2.0	6.0	8.5	9.5	11.2	13.9	15.6	18.8	21.7	24.8
Telopea Park	0.4	0.2	2.0	2.6	2.3	2.4	2.8	3.3	3.8	4.4	4.7
Theodore	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7
Wanniassa	0.1	3.0	3.6	1.6	2.0	2.5	2.3	2.5	3.2	2.7	2.9
Woden	0.2	1.8	2.6	3.5	3.1	3.3	3.3	3.6	4.3	4.9	5.5

Network scale and community batteries

Batteries can be applied to mitigate peak demand in the specific locations in the network. Nevertheless, at this stage, this emerging technology is not yet universally applied to manage demand in the network. The forecast has not been adjusted for the potential future installation of batteries. The underlying assumption is that batteries will not have material impact on the peak demand at the network and the zone substations levels

during the forecast period. However, for individual constraints, batteries are to be considered on a case-by-case basis as a potential solution and an alternative to network investment.

Behind the meter batteries

Installation of behind the meter batteries is growing albeit at a lower rate than the distributed energy resources. The peak demand forecast based partly on historical trends for the network and zone substations. Therefore, the existing battery installation trends embedded in historical demand figures have been reflected in the peak demand forecast. The forecast assumes continuation of the trend with no additional adjustments made to account changes in existing trend.

Gas to electricity conversion

The forecast assumes that in the medium-term gas to electricity conversion is progressed on “ad hoc” basis and not driven by the planned government timetable. On balance, the forecast assumes that any additional reduction in peak demand resulting from any increased batteries up-take (above current trends) would be offset by increases resulting from ad hoc gas conversion to electricity. Gas energy is largely used in the ACT for residential heating which has morning and evening peaks and is expected to translate into the electricity network in largely the same way.

Forecasting model

A new fully Bayesian model for seasonal maximum and time-of-day minimum demand data was developed, motivated by the need for coherence, plausibility and parsimony of model assumptions and predictors affecting long term demand forecasts. The predictive performance of the model was assessed by comparing maximum demand forecasts with those from last year’s annual planning report using the same historical data. 10-year forecasting results using the new parsimonious Bayesian model match those based on the Monash Electricity Forecasting Model (MEFM) and demonstrate the suitability and elegance of the Bayesian model framework for long term demand forecasting, both minimal and maximal.

The new long-term demand forecasting model implements a joint model for temperature T and maximum/minimum demand MD as a function of time (corresponding to a specific financial year and season/time-of-day) t. Specifically, the maximum/minimum demand of measurement i is

$$\begin{aligned} \text{MD}_i &\sim N\left(\mu_{\text{MD},i}, \sigma_{\text{MD}}\right), \\ \mu_{\text{MD},i} &= \mu_{\text{baseline},i} + \mu_{\text{temp},i} + \mu_{\text{growth},i}, \end{aligned}$$

Where,

$$\begin{aligned} \mu_{\text{baseline},i} &= \beta_{00,\text{MD}} + \sum_{k=1}^{N_{\text{ch}}} I\left(t_i, t_{\text{ch, k}}\right)\beta_{0k,\text{MD}}, \\ \mu_{\text{temp},i} &= \begin{cases} \beta_{1,\text{MD}}(T_i) & \text{maximum demand modelling}, \\ 0 & \text{minimum demand modelling}, \end{cases} \\ \mu_{\text{growth},i} &= \beta_{2,\text{MD}} t_i, \end{aligned}$$

and the likelihood of T is modelled using a Gumbel distribution

$$\begin{aligned} T_i &\sim \text{Gumbel}\left(\mu_{T,i}, \sigma_T\right), \\ \mu_{T,i} &= \beta_{0,T} + \beta_{1,T} t_i. \end{aligned}$$

The following (weakly) informative priors are used for maximum demand modelling:

$$
\begin{aligned}
\beta_{0,T} &\sim \mathrm{N}(0,1)\,, \\
\beta_{1,T} &\sim \mathrm{N}(0.01/\sigma_{\mathrm{T}},\mathrm{N}(0.001/\sigma_{\mathrm{T}})\,, \\
\sigma_T &\sim \text{Half-Cauchy}(0,2.5)\,, \\
\beta_{00,\mathrm{MD}} &\sim \mathrm{N}(0,1)\,, \\
\beta_{0k,\mathrm{MD}} &\sim \mathrm{N}(0,1)\,, \\
\beta_{1,\mathrm{MD}} &\sim \mathrm{N}(0,1)\,, \\
\beta_{2,\mathrm{MD}} &\sim \mathrm{N}(0,1)\,, \\
\sigma_{\mathrm{MD}} &\sim \text{Half-Cauchy}(0,2.5)\,.
\end{aligned}
$$

The following (weakly) informative priors are used for minimum demand modelling:

$$
\begin{aligned}
\beta_{00,\mathrm{MD}} &\sim \mathrm{N}\left(\text{mean(MD)}, 10\sqrt{\text{abs(mean(MD))}}\right)\,, \\
\beta_{1,\mathrm{MD}} &\sim \mathrm{N}(0,1)\,, \\
\sigma_{\mathrm{MD}} &\sim \text{Half-Cauchy}(0,2.5)\,.
\end{aligned}
$$

Key features of the model can be summarised as follows:

- MD is decomposed into a baseline, temperature and (organic) growth component. All three components have either a direct (baseline, growth) or indirect time dependence (temperature).
- The baseline component allows for historic block loads by fitting a piecewise constant to the observed data using the indicator function $I(t_i, t_{\mathrm{ch},k}) = \begin{cases} 1 & \text{if } t_i \geq t_{\mathrm{ch},k} \\ 0 & \text{else} \end{cases}$, where $t_{\mathrm{ch},k}$ is the time of the kth change point (block load).
- For maximum demand modelling, the temperature component uses recorded annual extremal temperatures (maximum temperatures for the summer MD model, minimum temperatures for the winter MD model) for the years with recorded historical MD data. Simultaneously, the model estimates the parameters of the underlying Gumbel temperature distribution using *all* available temperature data. Annual extremal temperature data are available from 1996 onwards and were averaged across two weather stations in the ACT (Canberra Airport and Isabella Plains (Tuggeranong)). Characterising both models jointly ensures that uncertainties in the parameter estimates from both the MD and T models are properly included in the long-term MD forecasts. For minimum demand modelling, a narrow and strongly informative prior centred around zero is chosen for $\beta_{1,\mathrm{MD}}$, whose regularisation properties characterise the lack of any strong temperature dependence in minimum demand data.
- In alignment with model parsimony, organic growth is modelled using a simple linear time dependence; it was confirmed that a higher-order polynomial fit to the historical MD data does not provide better forecasts. The organic growth component can be interpreted as the compound effect that captures economic growth as well as the MD offset due to increased PV generation.
- As with all Bayesian models, using sensible prior distributions on all parameters is critical to obtaining meaningful posterior densities. Specifically, a narrow and informative prior was chosen for $\beta_{1,T}$ to include a small and realistic time-dependent global warming effect. The mean time-dependent effect of 0.01 °C per year is in agreement with the observed changes in the global Australian climate system of about 1 °C since 1910 [*Australian Government Department of Agriculture, Water and the Environment, Climate change*]. All other weakly informative priors are chosen in agreement with common prior choice recommendations [*Gelman, Prior Choice Recommendations*].

Forecasts are then obtained following a three-step process:

1. First, forecasts of temperature values T_{pred} for future years t_{pred} are obtained based on the fitted Gumbel model with posterior densities for the location μ_T and scale parameters σ_T.
2. Posterior predictive densities of T_{pred} as well as posterior densities of all MD model parameters are then used to obtain MD predictions as posterior predictive densities $\mathrm{MD}_{\mathrm{pred}}$ for all future years.
3. Posterior predictive densities of maximum demand estimates are then adjusted for future block loads using afore-mentioned indicator function $I(t_i, t_{\mathrm{ch}})$ which shifts the posterior predictive density by the future block load BL_{q} at time t_q. A table summarising future block loads is given in Table 29. Final MD estimates at the $100\alpha\%$ level are then obtained from the $100(1-\alpha)\%$ quantiles of the posterior

predictive MD density at every year. Posterior predictive densities of minimum demand densities are not adjusted for future block loads, as the effect of block loads on minimum demand is difficult to assess; consequently, minimum demand estimates provide a lower bound on the forecast minimum demand trends.

All models are fitted to maximum and minimum demand data using the Bayesian inference framework and probabilistic programming language Stan [*Stan Development Team, 2020, Stan Modeling Language Users Guide and Reference Manual*] through the R interface `rstan` [*Stan Development Team, 2020, RStan: the R interface to Stan, R package*

VERSION CONTROL

VERSION	DETAILS	APPROVED
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