Essential Energy

7.01 DER Integration Strategy 2024–29

January 2023

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1. Why create a Distributed Energy Resources integration strategy?

This document outlines our approach to integrating:

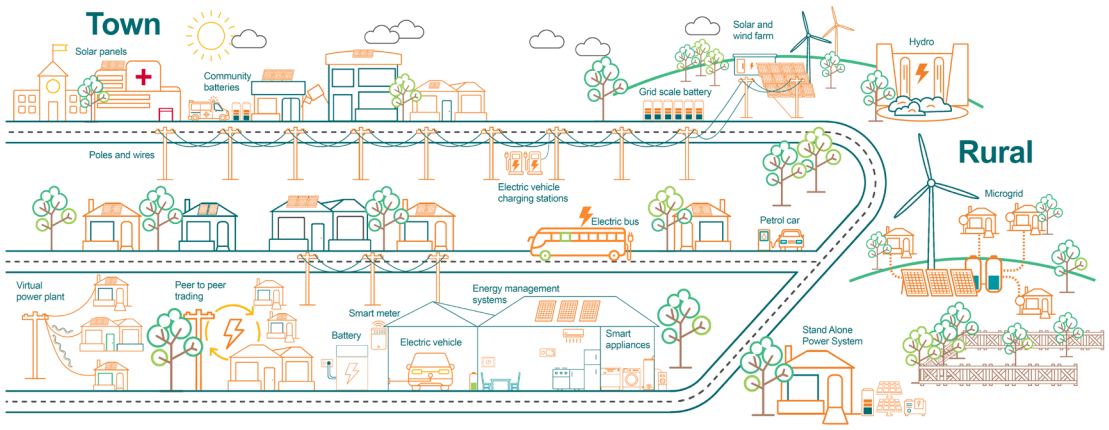
- consumers' energy resources (CER) installed on consumers' side of the electricity meter, such as rooftop solar, small-scale batteries, electric vehicles (EVs), energy management systems and other smart devices
- other third-party distributed energy resources (DER) that may be connected to our network, like community batteries, grid-connected batteries and other small and large-scale renewable electricity providers
- network-owned DER that will improve reliability for remote communities and help us to transition customers with a high cost-to-serve to more efficient and reliable solutions.

These resources are collectively referred to as DER for the purpose of this document.

We know that customers invest in DER for various reasons, including wanting to help combat climate change, embrace new technology, take control of their energy bills or access new markets. Our customers increasingly expect us to plan and integrate renewables and new technologies into our network in sustainable ways.

To deliver on our customers' future network vision and meet their priorities we need to ensure our network can safely and reliably accommodate these resources. We crystalised our customers' vision and priorities (shown to the right) during the engagement program that informed our 2024–29 Draft Regulatory Proposal (see *Attachment 4.02*). We need to ensure that the costs of accommodating DER are efficiently managed and fairly shared among our customers.

Customers' future network vision



Customers' priorities

Traditionally, our challenge has been managing peak demand, and this remains important with increasing levels of load-drawing DER. However, many DER technologies also export electricity into our network. While our network has some inherent capacity to accommodate exports, that capacity is being reached as more and more customers export ever-growing amounts of energy. As such, we now need to invest to manage this modern network challenge.

Without reform, customers face increasing power quality issues and curtailment of their exports, along with increased investment (and prices) to meet increasing peak demand and peak exports. Unlocking the generation potential of DER will enable us to achieve the safety, power quality, reliability, and capacity standards that Essential Energy's customers and stakeholders require at the lowest cost.

This strategy outlines how we intend to manage DER on our network, including:

- our forecast uptake of DER and associated exports
- why we need to adapt our business for the increasing uptake of DER
- our toolkit of solutions for integrating and managing increasing DER and how they work together to deliver a prudent and efficient customer solution
- our activities and expenditure in the current regulatory period to manage DER
- how our DER integration related solutions are reflected in our 2024–29 Proposal.

We aim to provide a comprehensive overview of our coordinated approach to DER integration across tariff design, capital and operational investments and other innovative programs, such as demand management. It is aligned with customers' preferences as we engaged closely with them on pricing and transitioning to a smarter network in developing our Proposal.

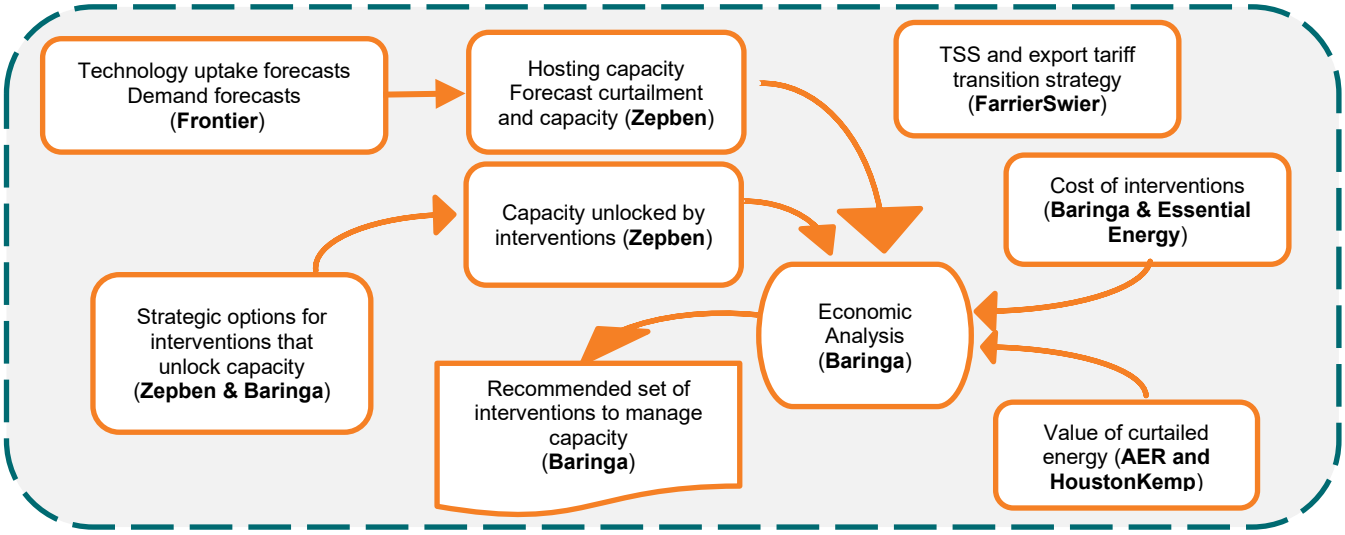
It is worth highlighting that our Proposal contains a mix of investments based on current forecasts and best estimates. We will also undertake more detailed business case assessments closer to the time of undertaking an investment to ensure that we deploy the most prudent and efficient solution. The proposed approach and associated investments seek to appropriately balance our customers' expectations around electricity exports with their affordability priority.

Key documents that underpin and support this strategy

- *Hosting Capacity Study (Zepben) – Supporting document 7.01.01* to our Proposal
- *Future Network Business Case Overview – Attachment 10.05* to our Proposal
- *Forecasts of customer numbers, energy consumption and demand – Attachment 11.01* to our Proposal
- *2024–29 Tariff Structure Statement* (TSS) and the accompanying *Tariff Structure Explanatory Statement (TSES) – Attachment 12.01* to our Proposal
- *Appendix A – Summary of engagement outcomes* in our Proposal and *Attachment 4.02 How engagement informed our Proposal*
- *Demand management plan – Supporting document 10.01.02*
- 7.8 Export Services tab in the Reset RIN

A multi-faceted approach to building our strategy

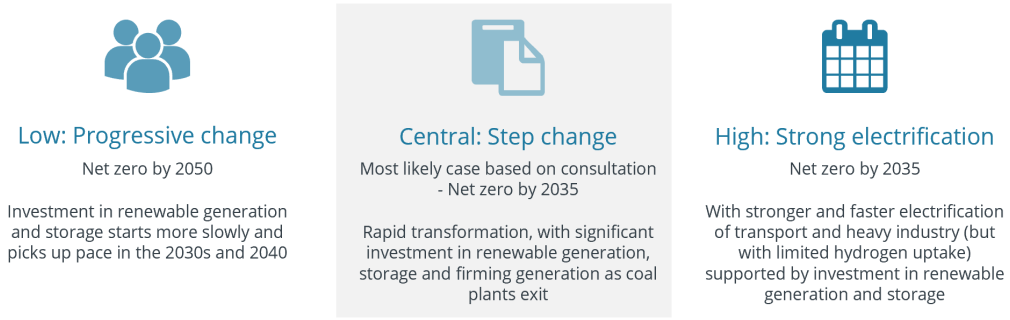
We have consulted expert advice as shown here:



We have co-designed this Strategy with our customers and our primary stakeholder reference groups for the 2024–29 Proposal and the 2024–29 Tariff Structure Statement – our Stakeholder Collaboration Collective and our Pricing Collaboration Collective. You can read the details of this engagement in *Attachment 4.02 – How engagement informed our Proposal*.

A summary of the key external advisors and their role in development of this Strategy is outlined below.

FarrierSwier	Contributed to developing our TSS and export tariff transition strategy (ETTS)
HoustonKemp	Quantified the benefits of each additional megawatt hour (MWh) from DER exports
Frontier Economics (Frontier)	Provided: > Maximum demand forecasts at zone substation and transmission node identifier level, as well as aggregated to Essential Energy's total system load for a most likely scenario. > Energy and customer number forecasts by customer segment, tariff, and location (zone substation) for a most likely scenario. Frontier's modelling of current and future demand draws on AEMO's Integrated System Plan (ISP) for 2022 – with the step change adopted as the basis for its 'central case'.
Zepben	Modelled our current DER hosting capacity and how this could be increased under different reforms and interventions. It identified: > the size, frequency and distribution of voltage and thermal constraints that are caused by DER uptake over time > the ability of the network to accommodate a specific installed capacity of a particular DER technology.
Baringa	Led the overall future network business case and cost–benefit analysis and supporting work for this strategy. This included: > developing use cases and corresponding roadmap > scoping and costing prioritised, high value use cases that support future network capability uplift > developing a tool to value DER integration and cost–benefit analysis > preparing a detailed business case.



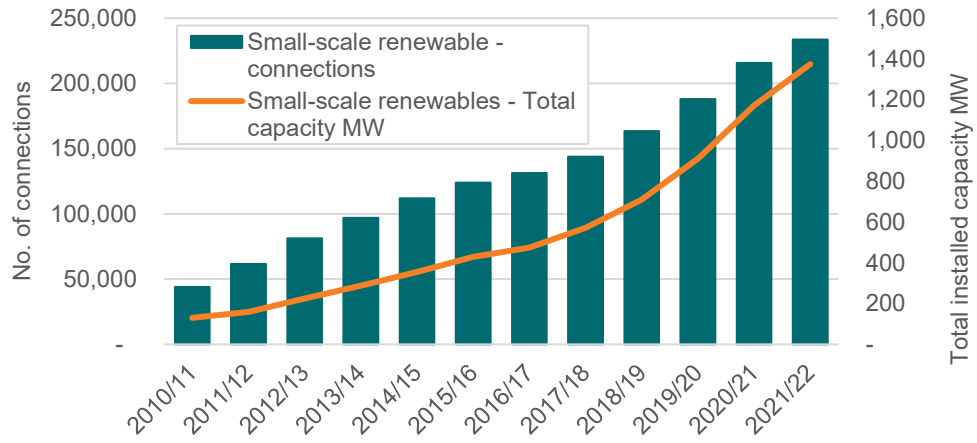
*Source: Frontier Economics (**Attachment 11.01**)*

2. The energy transformation

The way customers use our network is changing

There has been a gradual change in how customers interact with our network since the introduction of residential rooftop solar. The annual growth in small-scale solar system connections was steady through to 2017-18, but the number of connections and the size of those installations have since grown.

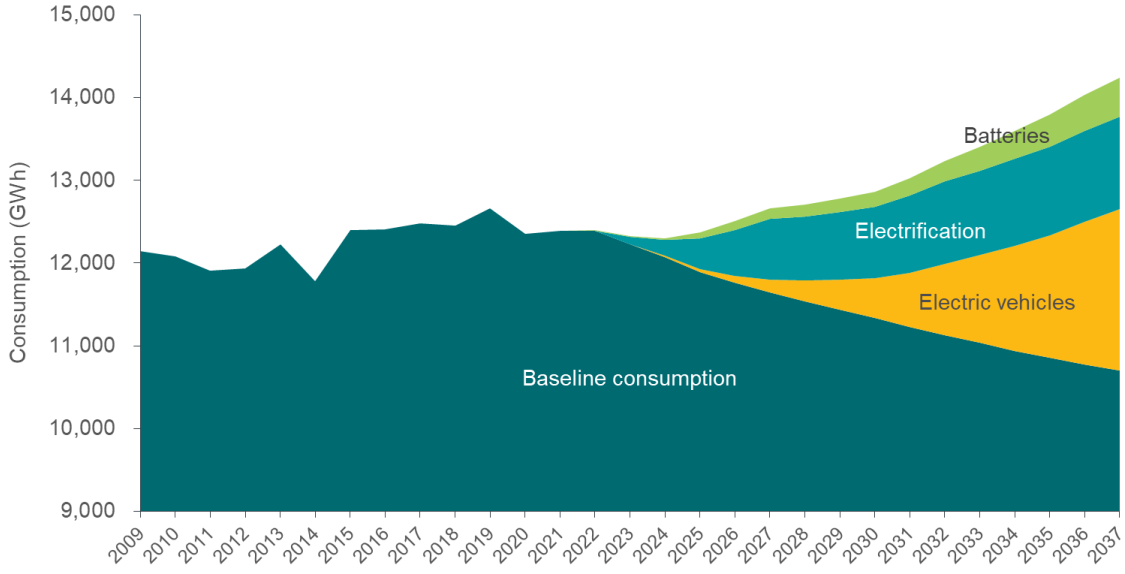
The growth of small-scale renewable connections on our network



By 30 June 2022, more than 26 per cent of our customers have installed rooftop solar with a combined capacity of around 1.5 gigawatts (GW). The size of an average system has doubled from 5 kilowatts (kW) in 2017 to just over 10 kW today. Our distribution network has the highest penetration of rooftop solar in New South Wales, accounting for more than one-third of all rooftop solar installations in New South Wales and also the Australian Capital Territory. Electricity consumption from our network comprises only one-fifth of New South Wales's total consumption.

This uptake means the amount of electricity customers consume from our network, to meet traditional demands, is forecast to decline as more households and businesses install rooftop solar to meet their electricity needs. Continued advancement in energy efficiency also contributes to this decline. This is shown in the declining baseline consumption forecast in the figure below.

Forecast electricity consumption on our network



*Source: Frontier Economics (**Attachment 11.01**)*

At the same time, new electric technologies supporting the decarbonisation of the economy are expected to come online, leading to an increase in total electricity consumption. The electrification of gas is expected to be material, along with EVs and, to a lesser extent, battery demand.

Seasonal consumption changes are also anticipated. Currently, our maximum demand is not considerably higher in summer months compared to winter months but over the next five years we expect our winter peaks to become higher than our summer peaks. This is due to increasing demand from electrification and, to a lesser extent, EVs and the fact that the increasing uptake of rooftop solar will help to reduce peak demand in summer more than in winter.

Changes in technology and the way customers use electricity are driving the need for a very different network. We now need to facilitate more two-way flows of electricity as customers export surplus solar generation into the

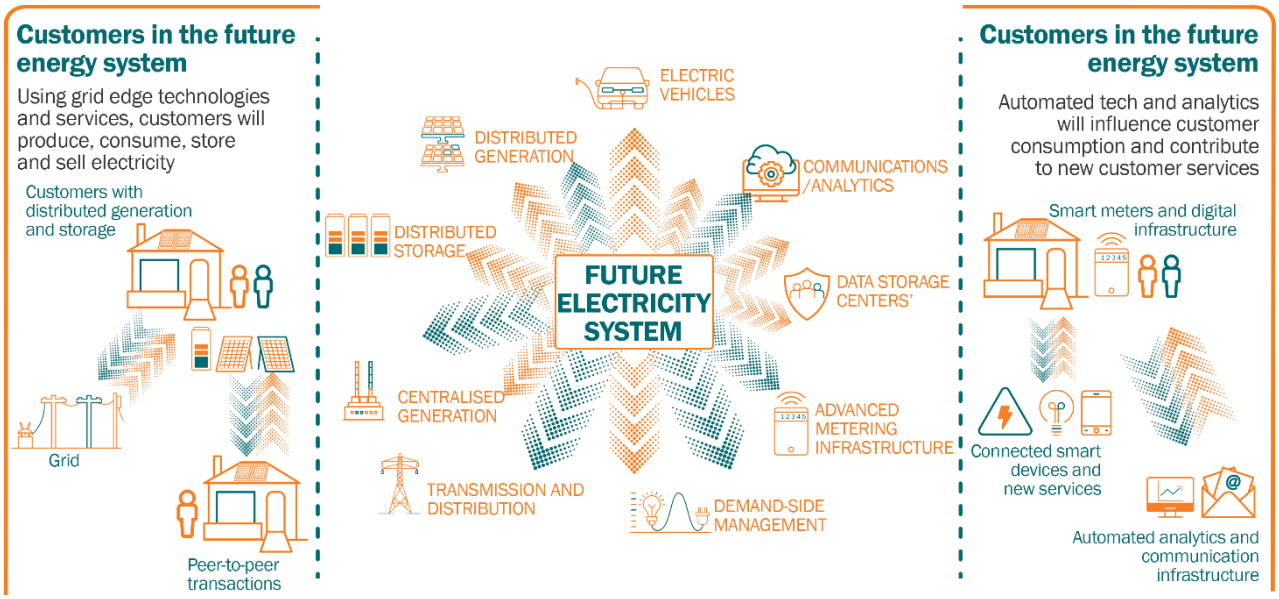
distribution network. We want to encourage consumers to use our network and their DER assets efficiently, including batteries and EVs, which both consume and export electricity.

New technologies, like smart meters and home energy management systems, are also expanding customers' options to manage their flexible demand, such as for running air conditioning and pol pumps in summer, and heating and storing hot water year round

Customers' expectations are also changing

Customers are taking a central and more active role in the evolution of the electricity system, exercising more choices to consume and share energy, and connect to the network.

In line with customers' future vision, new opportunities and markets are developing. In time, virtual power plants and electricity trading at a local level will become commonplace, giving customers more control and choice, increased competition will further contribute to changing customer expectations.



While safety, reliability and affordability remain the top three priorities with electricity supply, the importance of resilience and collective benefit have emerged – the latter ensuring that the benefits of the energy transition are fairly shared between our customers.

Our customers have told us that they expect us to proactively plan for and integrate renewable energy and new technologies in a sustainable manner, to avoid over-investment and maintain affordability (see the *Identifying Customer Priorities* section of *Attachment 4.02* to our Proposal).

Customers have emphasised a desire for DER integration outcomes and have indicated their willingness to pay for the associated investments. They support us introducing flexible connection agreements, for new and upgraded connections, so we can more efficiently manage power quality on the network until such time that a network investment 'stacks up' (see *Appendix A – Summary of engagement outcomes* in our Proposal as well as *Phases 2 to 4* in *Attachment 4.02* to our Proposal).

Falling technology prices create new network solutions

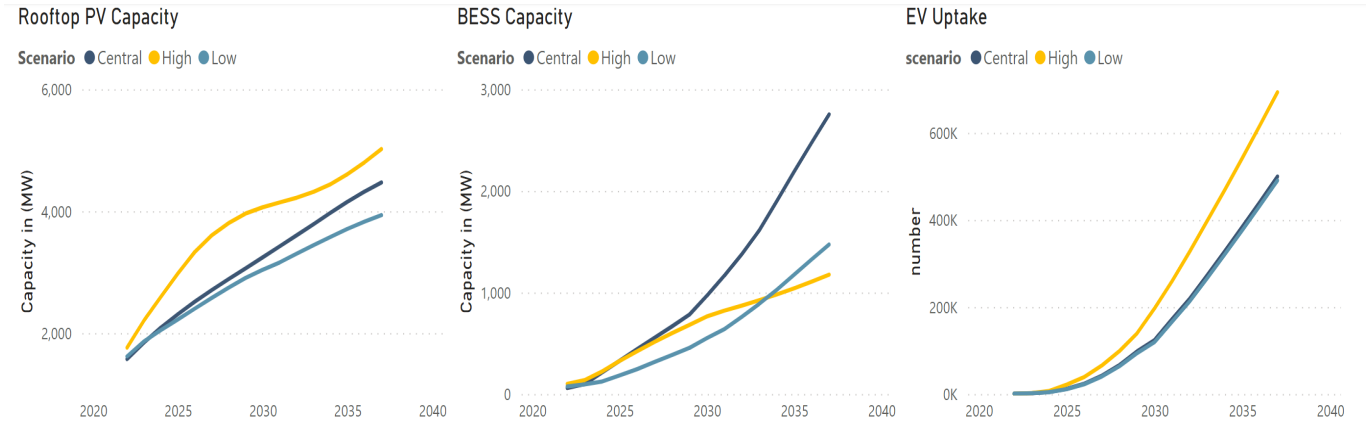
Falling technology prices are also making less traditional network solutions more cost-effective for our business. Investing in regulated stand-alone power systems (SAPS), microgrids and batteries will become part of our business-as-usual operations during the 2024–29 regulatory period.

3. What this means for our network

Forecast uptake of DER

We commissioned Frontier to adapt AEMO's DER technology forecasts for New South Wales to our network, accounting for multiple AEMO demand scenarios. The high-level forecasts and overview are shown below, (more details available in *Attachment 11.01 - Non-financial forecasts*):

DER technology forecasts for our network



*Source: Frontier Economics (**Attachment 11.01**)*

Rooftop solar

Over 26 per cent of our customers already have rooftop solar and Frontier's forecasts show a continued, consistent growth in capacity and generation. Rooftop solar capacity is expected to increase to between:

- 2.1–2.6 GW by the start of the 2024–29 regulatory period
- 2.9–4.0 GW by the end of the 2024–29 regulatory period
- 3.6–4.5 GW by the end of the following regulatory period.

Rooftop solar remains the most immediate and pressing challenge for our business in integrating DER on the network, especially as communities seek to move collectively to renewable power supplies.

Electric Vehicles

While EV uptake on our network is currently low, our forecasts expect this to materially change in the medium term, even after accounting doe slower growth in rural versus urban areas. EV growth is expected to take-off significantly across all demand scenarios on our network – during the 2024-29 regulatory period and escalating from 2028 onwards.

EVs require large volumes of power, but their impact on the network depends on the local network capabilities (capacity) at the time charging and how they are charged:

- EV fast chargers draw a large load, but over a short period of time
- Trickle chargers draw a small load, but over a long period of time
- Second-tier chargers (dedicated EV wall chargers) can charge across this spectrum and offer customers the benefits of management by third parties.

Batteries

We currently have only a small number of battery energy storage systems (BESS). Frontier's forecast of batteries focuses on behind-the-meter batteries and assumes that battery uptake will continue to be paired with rooftop solar, consistent with historical trends. Growth in batteries is also expected to take-off significantly in coming years and is forecast to be strongest under the central scenario shown below. Utility scale batteries are considered in the context of embedded generation.

Other factors

The challenges of integrating DER into the network are broader than just managing the uptake of rooftop solar. They also include:

- The demand to connect large solar and wind farms to the high voltage network, particularly in regional areas that are emerging as renewable energy hubs
- the roll-out of smart meters by retailers that can be used to control customers' net energy load as a substitute for existing hot water–load control services
- the requirement to assess the optimal location of EV fast-charging across the New South Wales road network to accommodate the anticipated EV roll out
- the increasing number of applications to evaluate large-scale battery storage viability that address network constraints and provide local community benefits.

As Customers become increasingly adaptive and flexible, and generation becomes more distributed and variable, our network needs to adapt so it:

- is capable of managing local voltage levels and providing the export services customers expect
- can work with the wider electricity system to bridge the gap between when (and where) energy supply is abundant and when it is required by our customers and communities.

In the absence of change, the impact of the growing changes in consumption and exports will give rise to increasing power quality issues.

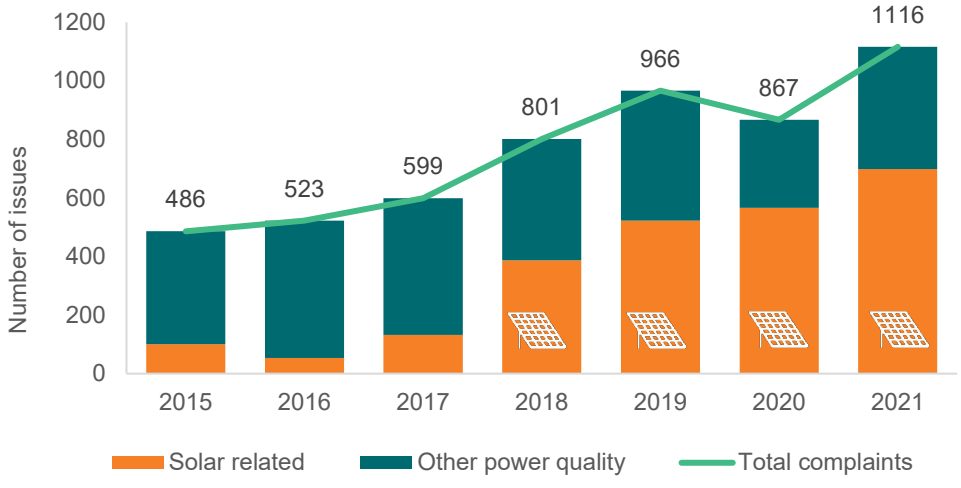
Managing power quality

Power quality is a subset of reliability and is about ensuring that our network operates safely within its technical limits (voltage levels). Power quality can be likened to water pressure – you need enough water pressure to deliver water to all the taps in different households, but not so much pressure that the pipes burst. If the voltage in a section of our network drops too low, customers will experience brown outs and flickering lights. If the voltage rises too far, it can damage our network assets and customers appliances and equipment.

In the absence of demand for electricity, high levels of solar exports in an area of our network increase the network voltage. This causes issues for voltage regulators, protection and control equipment, and distribution transformers with a limited tapping range, which are all used to maintain voltages within safety and quality limits. If the voltage threshold is exceeded, our network safety protection equipment will automatically turn affected customers' solar systems off.

Networks have always managed power quality. Controlled load of customers' hot water systems and in-slab electric heating are some of the earliest forms of power quality management. In the early 2000s, the rapid growth in domestic air-conditioners caused significant voltage management issues. The same is happening now with increasing amounts of DER on our network, particularly solar panels. Power quality related complaints are more common across our network and more of these issues are related to DER.

Power quality issues are increasing with a growing proportion related to DER



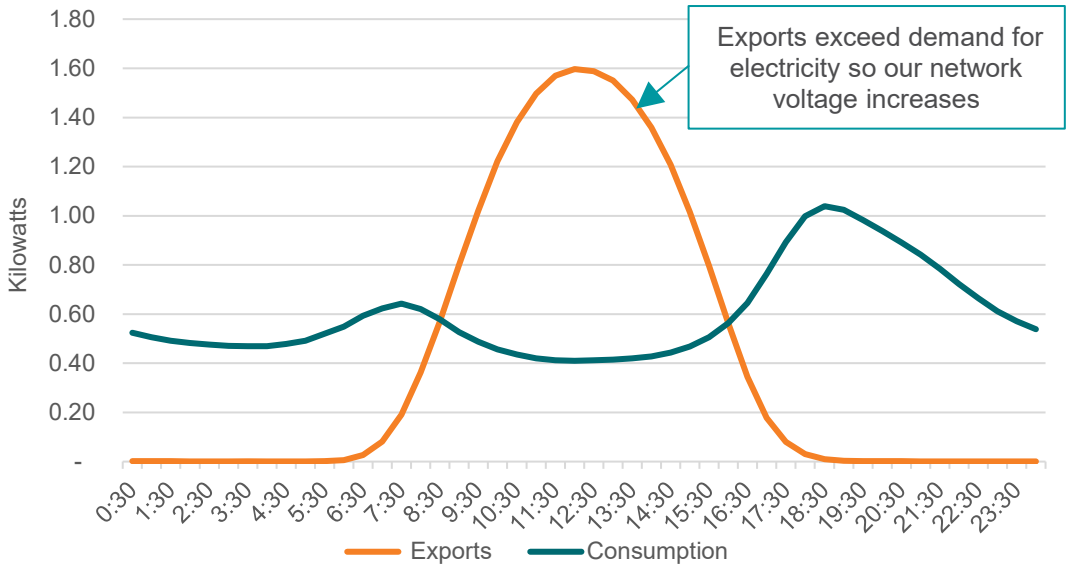
The inherent unpredictability of DER causes rapid voltage fluctuations on the network.

For example, when a cloud goes over a neighbourhood the level of solar output (voltage) suddenly drops in that area.

When the cloud passes, exports suddenly resume creating a large voltage rise.

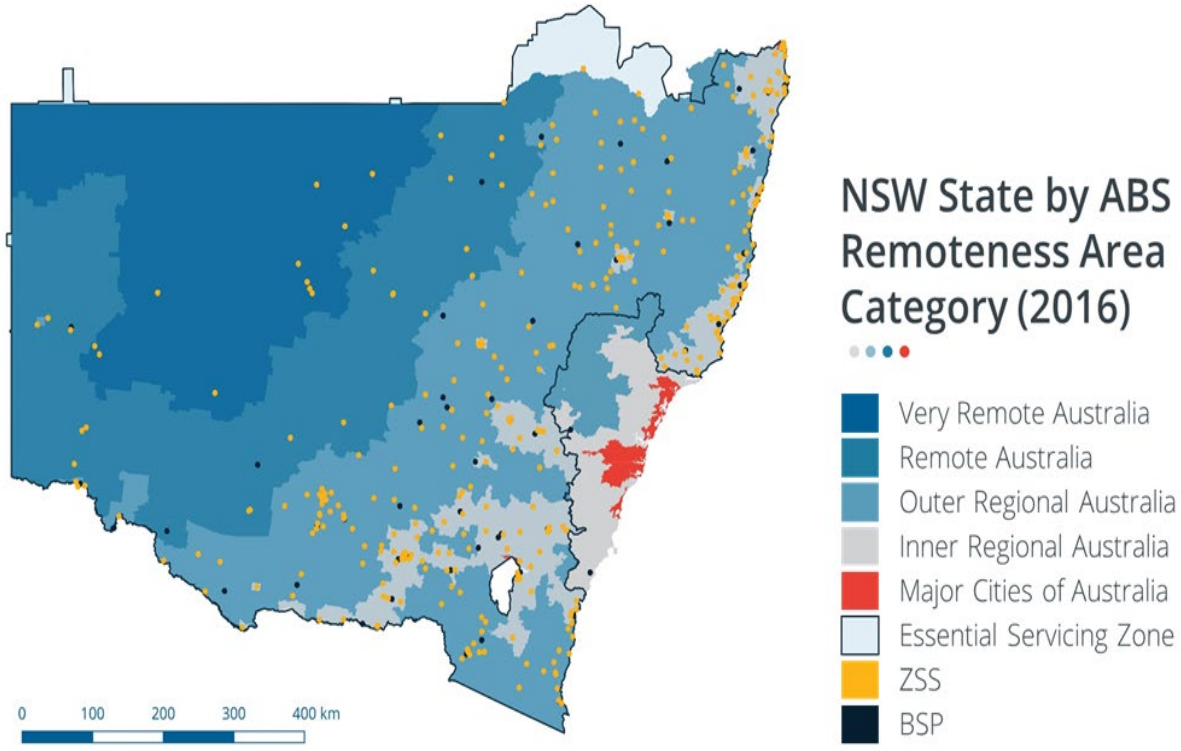
DER creates power quality issues because most residential customers typically have low electricity demand during the window that our network is experiencing peak exports.

The mismatch between exports and electricity demand *based on January to August 2022 residential Time of Use interval tariff data*



Our network characteristics also exacerbate power quality issues. When our network was built, electricity was only envisaged to flow one way so, cost-effective, high resistance steel conductors were extensively used, especially in rural and remote areas. This allowed for fewer poles and larger spans but at the expense of voltage drops during distribution. Transformers were designed to assist in compensating for voltage drop, with voltages traditionally set slightly high to maximise system capacity for customers, this has created a legacy challenge in accommodating exports which further increase network voltage.

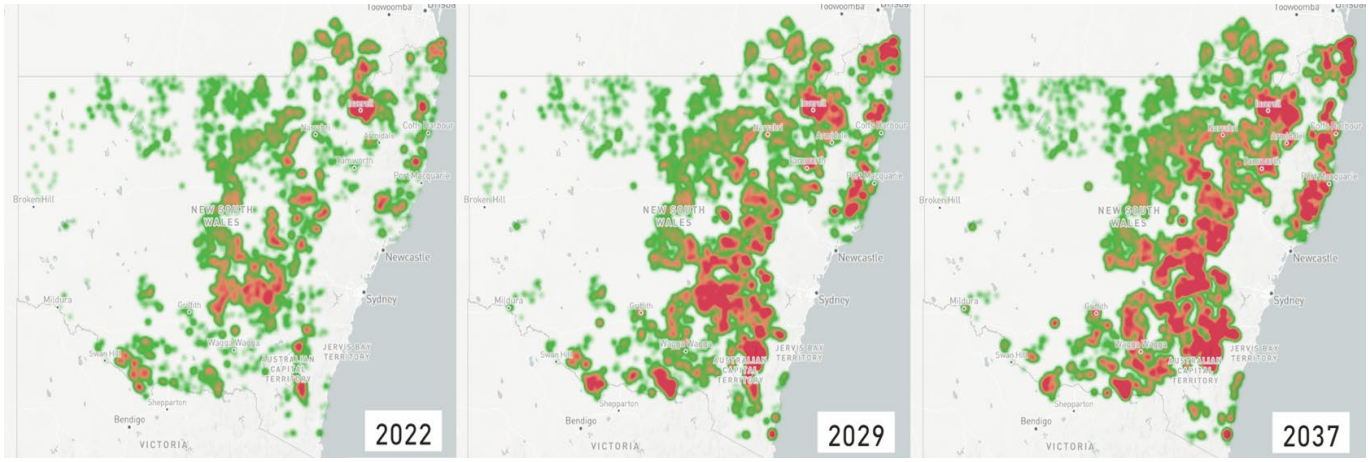
Remoteness of Essential Energy network area



*Source: Frontier Economics (**Attachment 11.01**)*

The technical constraints of our network vary by location. Constraints are also influenced by the number of customers, their demand for electricity over the day, their level of exports and the size of the network assets installed in the area. This means that our network performance is not homogenous and if we do not intervene to manage performance, areas of our network (especially rural parts) will weaken over time and experience over voltage events (shown in red in the figure below).

Forecast increase in over voltage events in the absence of intervention



*Source: Hosting Capacity Study (**Attachment 7.01.01**)*

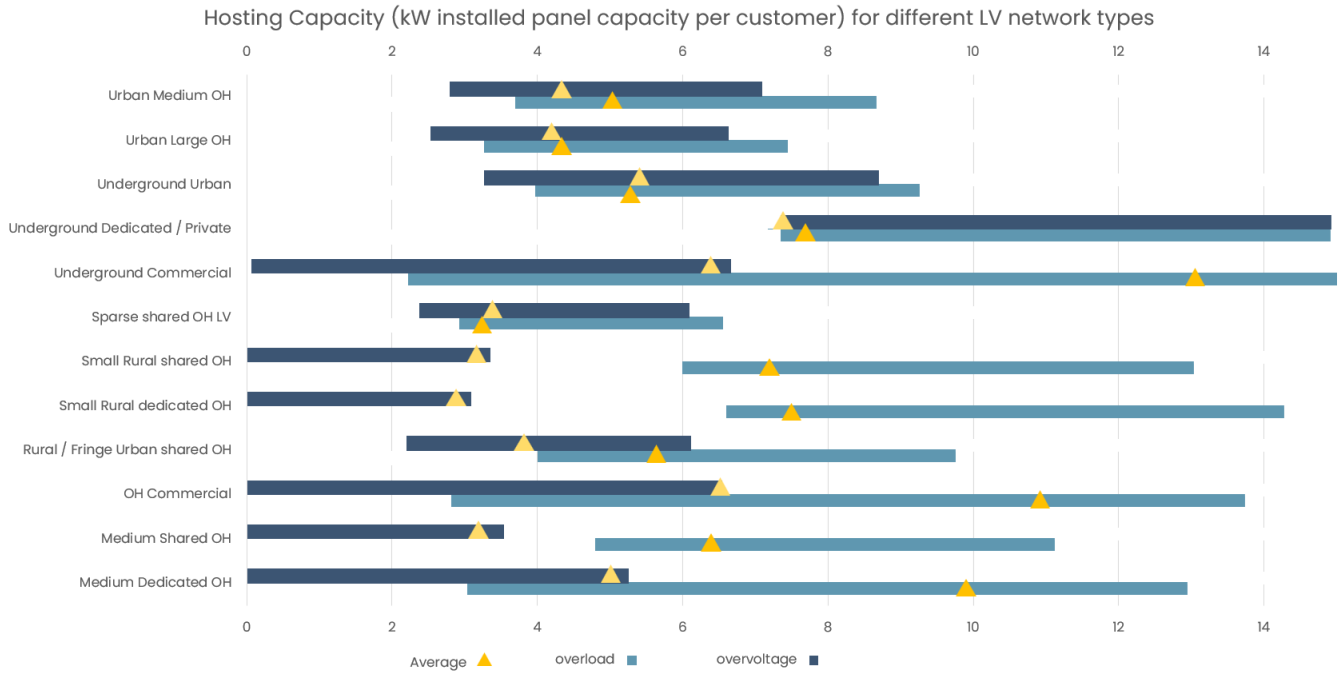
It is worth noting that these voltage issues will usually occur for a few hours on a few days each year – mainly sunny days in the shoulder seasons (spring and autumn), when customers tend to run their air-conditioners or heaters less.

Accommodating customers' exports

Voltage constraints are highly localised and as DER uptake is not evenly distributed throughout our network, it is possible to hit constraints in any portion of our network. However, constraints are much more common in areas with higher penetration of DER and overhead substations.

The figure below shows the low-voltage generation capacity for our various network types. It indicates the range of generation capacities that can be hosted before the voltage and thermal capacity limits of the network are breached. The yellow triangle indicates the average capacity limit performance of each network type.

Solar photovoltaic hosting capacity for different low voltage network types



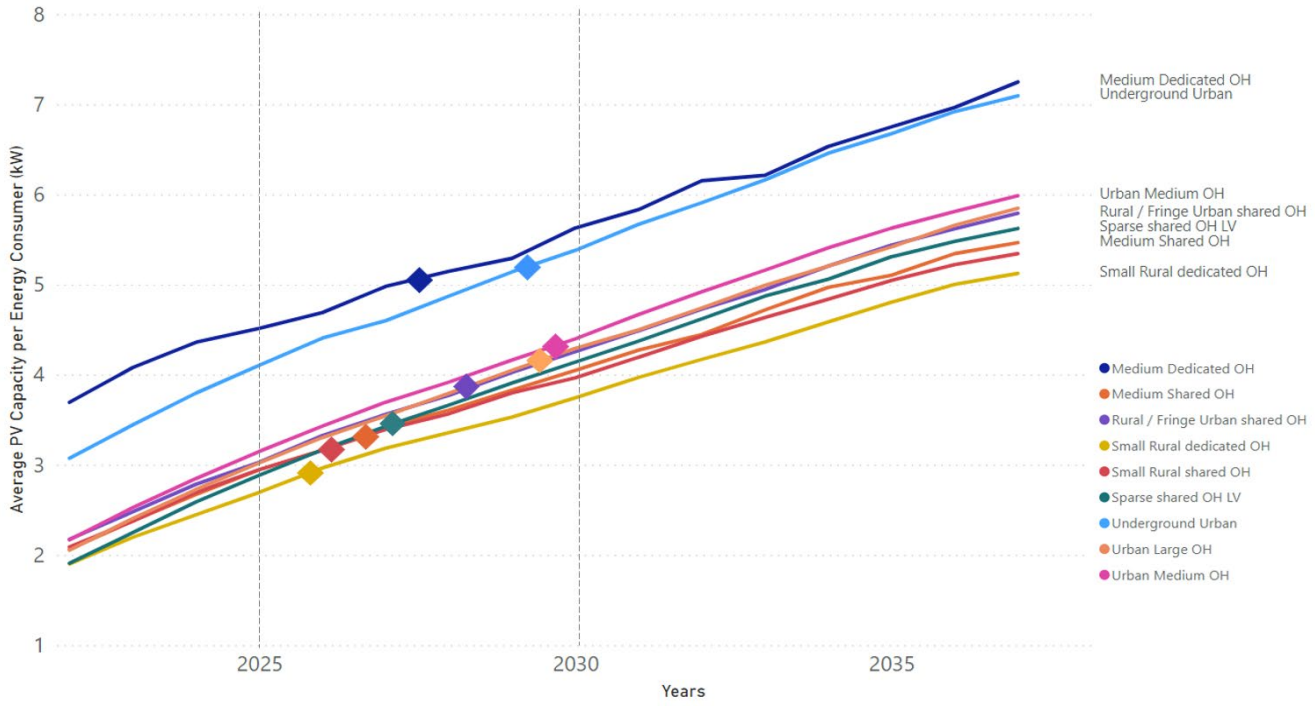
*Source: Hosting Capacity Study (**Supporting document 7.01.01**)*

The figure shows that:

- there is a wide range of variation between our network types, highlighting our challenge in providing standardised export services to customers
- overhead substations show lower hosting capacity
- generally, voltage limits are the binding limitation for solar hosting capacity.

The chart below shows the forecast growth for installed DER and the expected year when the average installed capacity will reach the constraint level. All our network types are expected to hit their constraint level in the 2024–29 regulatory period.

Forecast timing of network types reaching average hosting capacity limits – Central Scenario



*Source: Hosting Capacity Study (**Supporting document 7.01.01**)*

We have traditionally managed power quality issues via manual methods that involve site visits to adjust asset settings. This reactive approach may give rise to safety issues and means customers' exports are frequently limited or shut off by our network until we attend the site. Even then, manual adjustments usually only provide a temporary solution given increasing levels of DER uptake (see the following section). They area also costly, given it is resource heavy. You can read more about our hosting capacity analysis in *Supporting document 7.01.01* to our Proposal.

There are smarter, more innovative ways to manage power quality. These require investment in a data management system, data and dynamic network assets such as network batteries and remote tap changing.

As mentioned previously, we engaged with customers on the power quality outcomes and associated investments they were prepared to pay for as part of our 2024–29 Proposal engagement program. These customer-supported investments form part of this strategy.

What we have already invested

We have undertaken a number of tactical activities such as network upgrade and augmentation, and localised voltage adjustments in response to power quality complaints. We have also been trialling SAPS, microgrids, batteries, and tariffs as well as undertaking the hosting capacity study to support the development of our Future Network Business Case Overview (**Attachment 7.05**) to meet our obligations for DER enablement. We forecast our total expenditure in relation to managing DER integration during the 2019–24 regulatory period at $50.7 million.

Actual and forecast Export Services expenditure for 2019-24

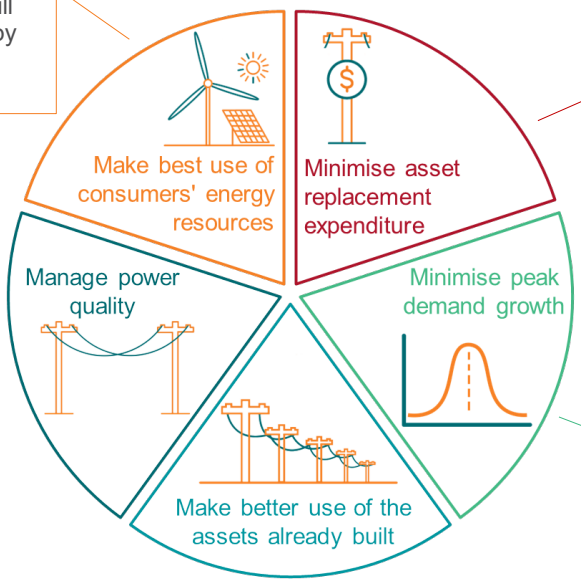
$FY24	FY20	FY21	FY222	FY23	FY24
Capex	$7.3M	$5.7M	$7.1M	$7.9M	$8.3M
Opex	$2.0M	$2.5M	$2.4M	$2.3M	$5.2M

4. Integrating and managing DER on our network

Our network challenges

Below is a summary of our five key network challenges. Some of these challenges influence each other:

Encouraging customers to use their DER in a manner that assists the network. For example, reducing exports in the middle of the day, to reduce power quality issues, and increasing exports at times that will help support electricity demand, thereby deferring or reducing the need for expensive network upgrades.



Maintaining downward pressure on our regulatory asset base by transitioning high cost-to-serve customers and communities to stand-alone-power Systems (SAPS) and microgrids where it makes economic sense to do so.

Ensuring our network operates within its technical capabilities. With the increase in exports during the middle of the day there is an increase in voltage fluctuations, leading to power quality issues.

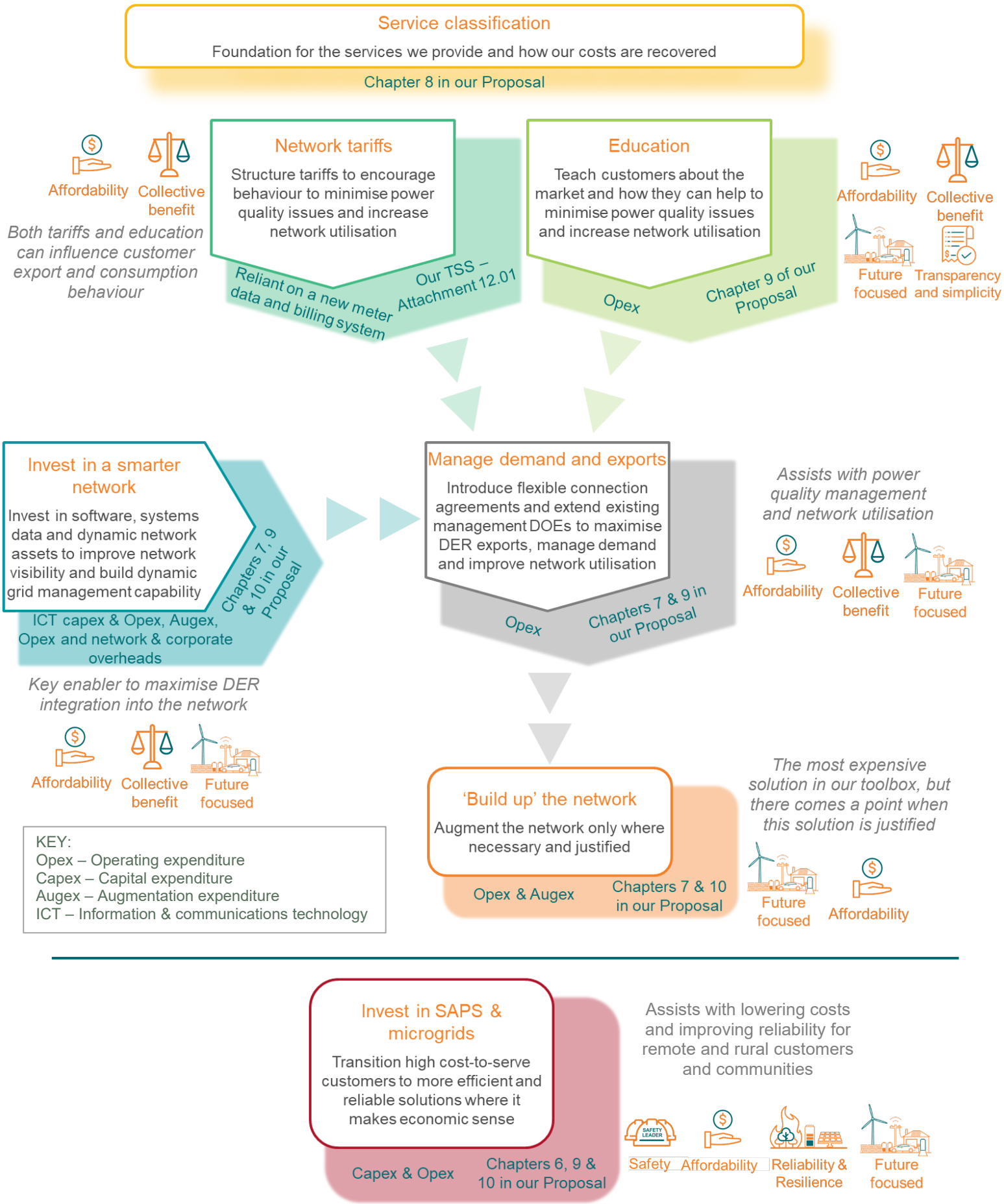
Just as roads have peak hour traffic, the electricity network experiences peak demand when lots of people want to use electricity at the same time. We have traditionally built our network for this peak but minimising its growth will help keep our costs as low as possible for customers.

This challenge is linked to peak demand. It is about making better use of the spare capacity we already have on our network at other times of the day, before we build new assets at an increased cost to customers.

Our toolbox of solutions

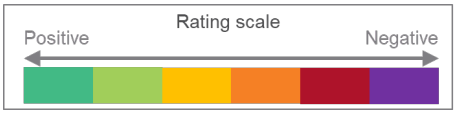
Service classification	> Ensures customers have access to the electricity services they require > Determines how regulated services costs are recovered from customers
Use tariffs to help modify behaviour	> Pricing can help address all our network challenges, except for 'minimise asset replacement expenditure'
Use education to help modify behaviour	> Education can also help address all our network challenges, except for 'minimise asset replacement expenditure'
Invest in a smarter network	> Invest in a data management system, data and dynamic assets to better manage power quality issues at a lower cost
Manage demand and exports	> Manage power quality through customers' devices, either directly or through a third party
'Build up' the network	> Investment using either traditional methods or new technologies, like batteries
Invest in SAPS & microgrids	> Transition high cost-to-serve customers to more efficient and reliable solutions

How these solutions interact to deliver to customers' priorities and how they tie to our Proposal



As we've just shown, there is no single solution to integrating and managing DER on our network. Our strategy combines all solutions as we believe they all have a role to play in addressing customers' priorities and future network vision. We ran through many of these solutions with our customers as part of our Phase 3 deep dive (see *Attachment 4.02*)

More details on these solutions and their interactions with each other follows. Where we refer to the different attributes of each solution below, we are using the rating scale shown at right.



1. Service classification

Service classification defines the type of distribution services we are allowed to provide to our customers and other network users over a regulatory period. These high level decisions for the 2024–29 period have largely already been established through the *Framework and Approach for NSW distributors* which the AER published in July 2022.[1]

Service classification is important to customers as it determines which network services are included in basic electricity charges that all customers pay for, and the services that are specific to individual customers and paid for directly by them. By default, it also determines which services are not subject to regulation and can be delivered by the competitive market.

There are relatively new and emerging markets around the provision of generation services, battery value stacking and exports as a network service. The relevant 2024–29 service classification updates to our strategy, including services that are undefined or yet to be captured by the AER, are described below.

2024–29 AER changes to service classification

Export services

Included as part of the *common distribution service*. This means that exports are now a recognised service that we must provide in line with our customers' expectations and willingness to pay.

SAPS

Activities related to regulated SAPS are included as part of the common distribution service. This means that when we convert a customer to a network owned SAPS, we will be able to respond and repair any outage they report – the same way we would respond to faults and emergencies for customers connected to the distribution network.

Services yet to be defined or captured

System support services

Our network is becoming a platform for new services. We want to ensure we support the development of a two-sided market to help customers make the most of their DER investments. This will help lower our costs and improve service outcomes for our customers.

The AER has not yet classified or listed system support services but may reconsider this as a material change in circumstance if required.

Leasing of excess battery capacity

The leasing of excess battery capacity (and the associated facilitation of leasing services) is not a classified service and is subject to the obligations set out in the recent amendments to the AER's ring-fencing guideline. This means this service can currently be provided as an unregulated service with waivers providing the necessary flexibility where networks can demonstrate benefits and reduced harms to consumers.

How service classification impacts our 2024–29 Proposal

Now that exports are a recognised network service, the AER must consider our reasons for changing tariffs and any investments we put forward to improve these services in line with customers' expectations. This includes our investment for providing system support services. We intend to:

- roll-out regulated SAPS as part of our business-as-usual operations where it makes economic sense to do so
- invest in network batteries or third-party owned batteries as a service where it makes economic sense to do so

All of these are discussed in the following solution sections.

[1] *Framework and approach – Ausgrid, Endeavour Energy and Essential Energy (NSW) – Regulatory control period commencing 1 July 2024*, July 2022, AER July 2022

2. Network tariffs

Ability to solve the network challenges	Cost of the solution	Success at integrating DER
Assists	Low	Assists

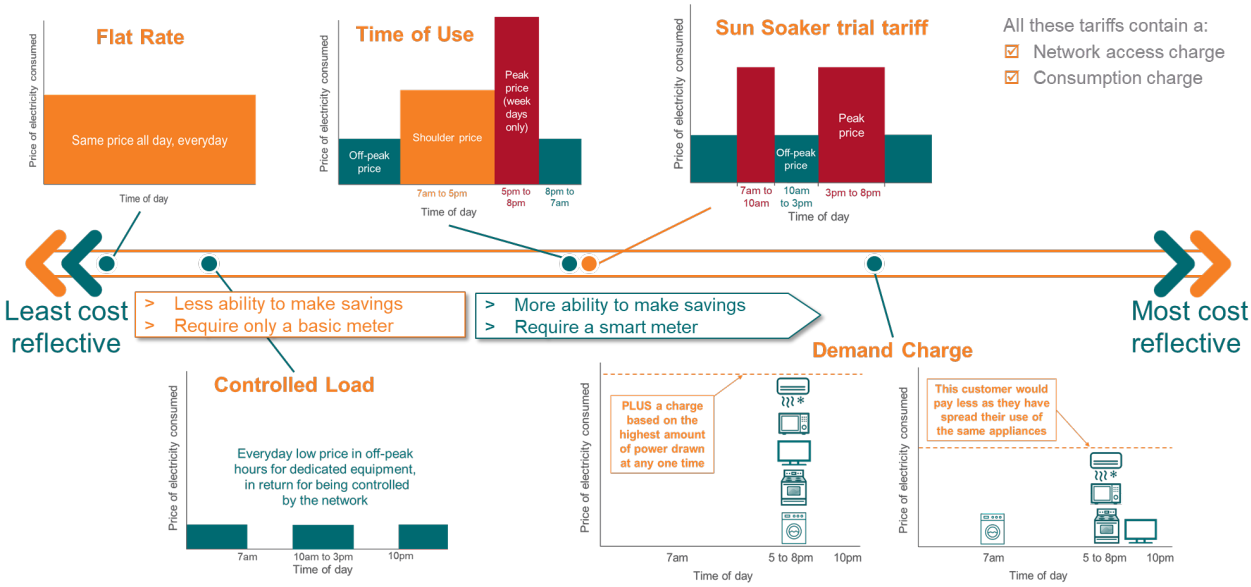
We can use tariffs to more accurately reflect the costs that customers impose on our network, but also to encourage certain behaviours to defer (or even avoid) the need for network investment.

In this regard, tariffs provide a low-cost solution that can assist with four of our five network challenges as well as the integration of DER.

Typically, more cost-reflective tariffs require a smart meter and are more complex to build in systems and for customers to understand. The ability for networks to charge for customers' exports, where they are causing issues, is a new consideration in our network tariff design.

Our current suite of consumption tariffs, including our Sun Soaker trial consumption tariff, against a scale of cost-reflectivity is shown below.

Cost-reflectivity of our current consumption tariffs



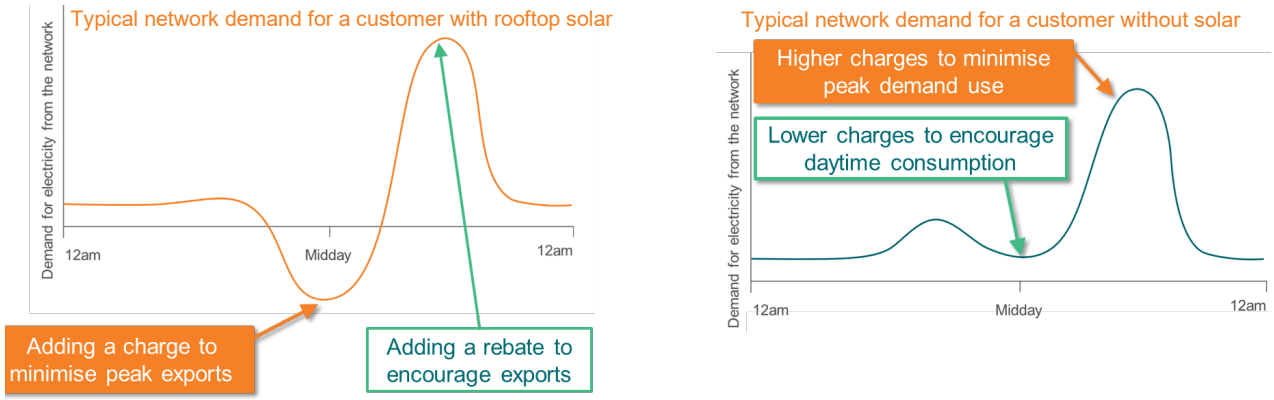
Given our tariffs are designed for retailers and aggregators, who create the retail tariffs that customers sign-up to, complexity is less of a concern. So long as the underlying tariff structure assists with managing both retail and network interests, it is likely to be replicated to some degree in associated retail offers. A significant penetration of smart meters is crucial to retailers' uptake of cost-reflective network tariffs.

We can also build signals into our tariffs to help tackle our network challenges from the opposite side.

An example of using tariffs to tackle network challenges from the other side

Considering the typical electricity demand over the day for a residential customer with and without solar, we could:

- offer lower consumption charges over the middle of the day when exports are creating issues – increased demand may help reduce power quality issues and the associated investment need
- offer a rebate for exports into the network over the evening peak – increased exports may assist with meeting local peak demand issues, thereby deferring the need for network investment



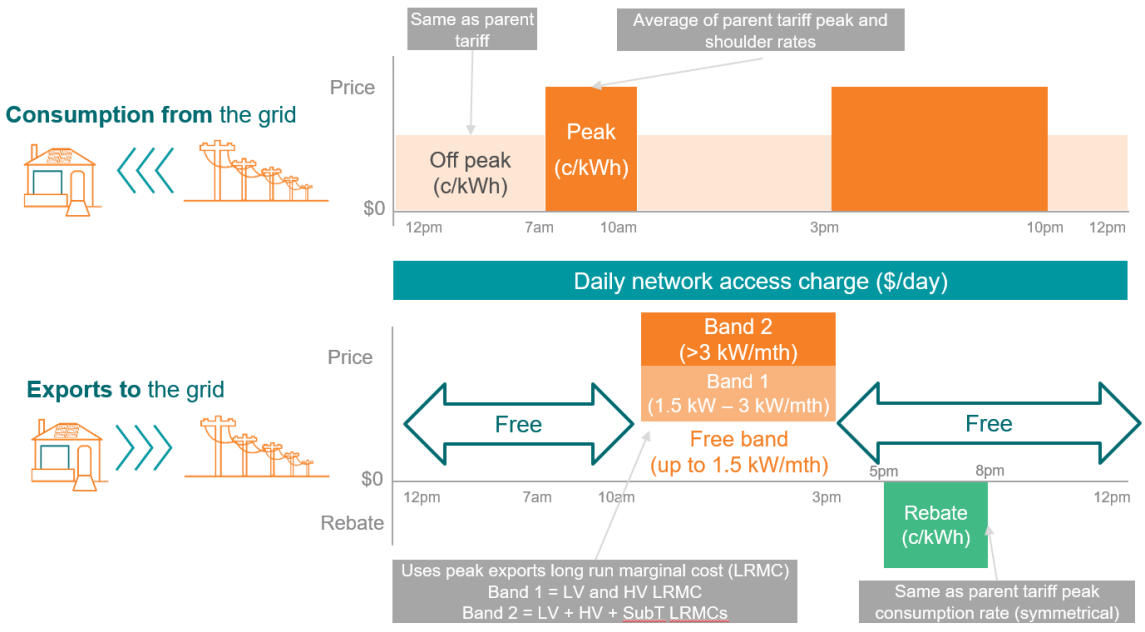
How network tariffs impact our 2024–29 Proposal

To improve fairness in the respective prices that our customers' pay, we are proposing to introduce two-way prices (those that charge for both consumption and exports) in our 2024–29 regulatory period for low-voltage connected customers, in line with our ETTS (see *Attachment 12.02 – TSS Explanatory Statement*). We heard from customers that they want consumption and export prices to be consistent across our network, regardless of location (see *Appendix A – Summary of engagement outcomes* in our Proposal and *How engagement informed our Proposal Attachment 4.02*)

The proposed form of our export tariff was designed in conjunction with customers and stakeholders. It includes a charge for exports into the network between 10am and 3pm as well as a generous rebate for exports between 5pm and 8pm. This tariff is currently being trialled for both small customers (residential and small business) as well as for a grid-connected battery. As mentioned above, we are also currently trialling a Sun Soaker Time of Use consumption tariff that includes a solar soak window between 10am and 3pm to try and tackle the power quality issue from the consumption side.

Together, these two components form our proposed Sun Soaker two-way default tariff for new smart meter customers in the 2024–29 period.

The design of our Sun Soaker two-way tariff structure



We are also testing two other tariff components. Our tariff trials are being claimed under the Demand Management Innovation Allowance Mechanism (DMIAM). We will consider the results of these trials in conjunction with customers and stakeholders as part of our engagement program for our Revised Proposal and TSS in the second half of 2023.

The trial results will inform an assessment as to the success of the tariffs and the final structure of our respective tariffs. The data may also prove useful for:

- identifying opportunities for other non-network solutions to capacity constraints
- facilitating engagement with energy service providers on the broader range of non-network solutions that are beginning to emerge as new technology platforms enable aggregation of flexible loads such as hot water, pool pumps, air-conditioning, and EV chargers.

Our ETTS outlines our phased approach to implementing export tariffs to all low-voltage connected customers, and provides transparency to customers who are considering investing in DER. Our trials and ETTS will work to ensure an equitable transition for customers moving to two-way pricing.

You can read more about our:

- Tariff Trials and the design of our trial tariffs in *Attachment 4.02* to our Proposal
- Our proposed tariffs in *Chapter 12* of our Proposal as well as our *TSS*
- How we derived our export price in our *TSES – Attachment 12.01*

3. Customer education

Ability to solve the network challenges	Cost of the solution	Success at integrating DER
Assists	Low	Assists

Similar to network tariffs, education may assist with encouraging:

- customers to consider how and when they consume electricity to help reduce pressure on the network
- consumers to right-size their rooftop solar for self-consumption or position it where it can assist networks to keep their investment costs as low as possible. This allows them to take advantage of any network export rebates that may be offered
- consumers to self-consume more of their generated electricity at times when it causes network issues and export it when it will assist the network.

Education is another low-cost solution we can use that can assist with four of our five network challenges, as well as the integration of DER.

How customer education impacts our 2024–29 Proposal

We are currently undertaking an education trial as part of our 2019–24 small customer tariff trials to determine the extent that messaging around electricity use plays into customers' social good. We seek to understand how willing households and businesses are to change their own electricity usage if it would universally reduce – similar to how households bucket water onto their gardens during times of drought to assist with water supply. The key message is asking customers to shift some of their electricity use to between 10am and 3pm. You can read more about this trial in *Attachment 4.02* to our Proposal.

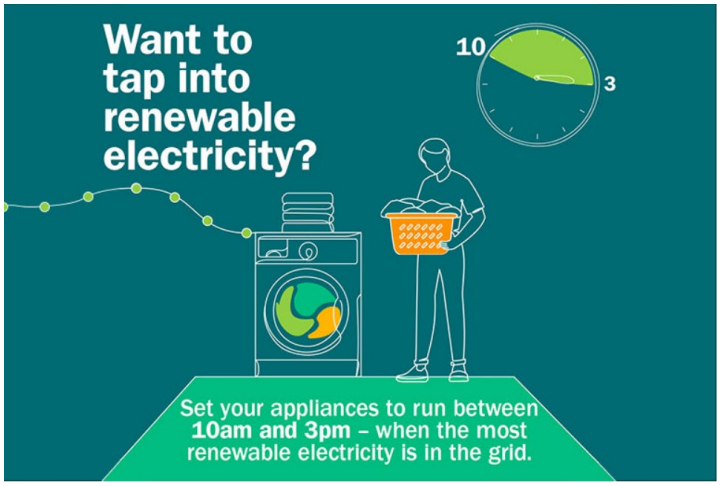
We will use the results of the trial to assess how education encouraged customers to shift some of their electricity use, as well as to assess the success of messaging through various media channels.

Our Proposal also contains a commitment to undertake extensive customer education in the lead-up to and throughout the 2024–29 regulatory period concerning:

- the current and emerging network challenges
- how smart meters can help customers lower their electricity bills
- the importance of shopping around for a retail offer
- the introduction of two-way prices and how this may impact customers' solar panel installation decisions.

This aligns with consistent feedback from customers and stakeholders throughout our engagement program that we need to educate households and businesses about our network challenges and how customers can help to alleviate them, as well as the benefits of tariff reform and the changing network (see *Appendix A* in our Proposal as well as *Attachment 4.02*).

Item	Expenditure type	Where reflected in our Proposal
> Education campaign	> Operating expenditure	> Chapter 9 of our Proposal



4. Invest in a smarter network

Ability to solve the network challenges	Cost of the solution	Success at integrating DER
High	High to establish capability	Successful
	Moderate thereafter	

This refers to investment to allow for dynamic management of the network, namely:

- a data management system
- assets that provide data about what is happening on the network and automate power quality management
- the purchase of customers' smart meter data.

Investing in a smarter network will assist with integrating DER on our network as it assists with managing four of our five network challenges. It does require a significant up-front cost to implement the data management system, though the on-going costs would be lower.

We are undertaking targeted investment in the business-wide integration of DER in the last two years of the current regulatory period, focusing on technology and tariff trials, improving the customer connection process and investments to increase network hosting capacity and network visibility (what is happening on our network).

Further investments in this area will provide us with near real-time visibility and some ability to automatically adjust voltage levels using dynamic assets or through the management of demand and exports (see the following *Manage demand and exports* section).

In terms of customer outcomes, investments will allow us to:

- deliver a faster response to power quality issues compared to our current, reactive manual approach
- vary customer export limits dynamically through the use of dynamic operating envelopes (DOEs). In combination with the introduction of flexible connection agreements (see the *Manage demand and exports* section below), DOEs limit exports to absolute necessity and allow customers to export more electricity than they otherwise could
- allow more DER to connect to our network than would otherwise be the case
- improve network utilisation which helps to reduce our unit costs for our customers
- provide higher-quality information to third parties to improve their decision making about where to connect on our network. This avoids possible constraints, takes advantage of new market opportunities and adds value to the wider electricity system through the provision of flexibility services or virtual power plant solutions.

How investing in a smarter network impacts our 2024–29 Proposal

Along with our traditional demand management techniques such as controlled load and network support payments, we intend to invest in developing basic DOE capability and undertake DOE trials in the 2024–29 regulatory period. Our basic DOE capability will focus on large numbers of small residential customers in targeted network areas where hosting capacity is most constrained. If the trials are successful, we intend for a wider rollout of advanced DOEs and a full network model in the following regulatory period.

We intend to allocate DOE capacity in line with customers' preferences – initial thoughts were captured as part of our Phase 4 Proposal engagement program and customers supported larger exporters losing more than smaller exporters. We will use our Peoples' Panel to further inform these discussions once the capability constraints of the associated systems and technologies are known. You can read more about our engagement, our Peoples' Panel and our customers' investment preferences in *Appendix A* in our Proposal, *Attachment 4.02* and our *Future Network Business Case Overview* (*Attachment 10.05.*).

Our Proposal includes investment in:

Item	Expenditure type	Where reflected in our Proposal
> A new data management system	> ICT operating and capital expenditure - Export Services	> Chapter 7 A network fit for the future > Chapter 9 Operating expenditure > Chapter 10 Capital expenditure
> Software licensing and subscription costs	> ICT operating costs – Export Services	
> On-load tap changers	> Capital expenditure (Export Services Augex)	
> Closed-loop voltage control	> Capital expenditure (Export Services Augex)	
> Line drop compensation	> Capital expenditure (Export Services Augex)	
> Smart meter data	> Operating expenditure	
> Establishing basic DOEs	> Network and corporate overheads	

5. Manage demand and exports

Ability to solve the network challenges	Cost of the solution	Success at integrating DER
Moderate	Minimal	Successful

This solution allows the network or third parties to control the demand and exports of customers' appliances or equipment to help manage power quality on the network.

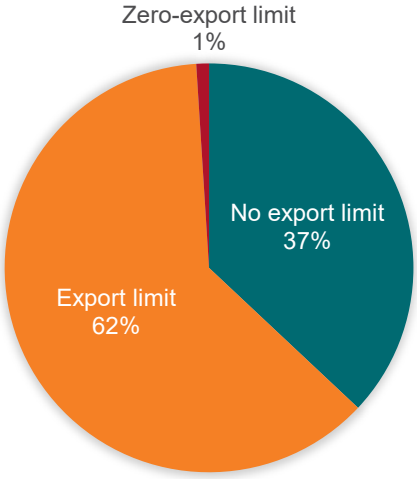
Our investment in a smarter network is key to building up capability in this area, thereby allowing us to better integrate DER on our network and manage several of our network challenges at a lower ongoing cost.

Historically, the focus has been on managing demand and this will remain an important feature as DER uptake continues. For example, customers who elect to have the demand of their EV or battery managed, will benefit from cheaper tariffs. But we can also use technology and third parties to help manage customers' exports.

When a particular network segment, such as a distribution substation, reaches a constraint, we cannot connect further DER without export limiting the new connections. This reduces the benefits of DER for customers, the network and society. As outlined in the *Managing power quality* section above, the connection of DER changes the daily magnitudes and direction of power flow on our network. This may require us to place limits on our customers' ability to export their surplus electricity.

Our current connection agreement automatically approves small customer exports to 3kW in rural areas and 5kW in urban areas. Installations larger than this are assessed by Essential Energy and, if necessary, the level of export is limited or curtailed. Most of our residential network was built to supply 3kW per house at peak times, yet the typical size of new solar DER systems is closer to 8 to 10 kW. Under our current arrangements, many customers are being curtailed year-round because their rooftop solar system is larger than their export limit.

Current limits on residential customer exports



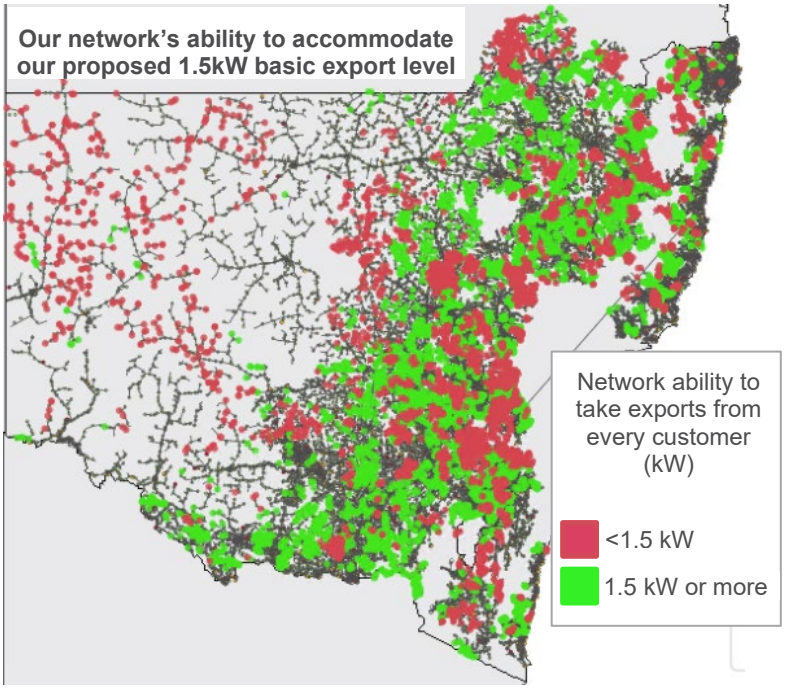
Even though our power quality issues may only occur for a few hours on a few days each year, the number of our residential customers facing static export limits is increasing. Static means the maximum level the customer can export is limited every single day of the year. Prior to 2018, around 98 percent of new rooftop solar applications for residential customers had no export limit applied. Since then, the proportion of new solar applications placed on export limits continues to increase with the current split shown in the chart to the right.

Our Connection Policy *(Attachment 10.04)* and Connection Agreement define how much customers can export to our network. If structured appropriately, these items work together with our investment in a smarter network to allow customers to export more than they otherwise could under fixed export levels.

Our Connection Policy

Our Connection Policy sets out the connection services we offer as well as any connection charges and how those charges are calculated. Connection charges refer to the costs that customers pay upfront to connect to our network. The Connection Policy must now also define our basic export level (the level of exports that customers can access for no charge).

We have set our basic export level at 1.5kW and, consistent with customers' preference (see *Attachment 4.02 – How engagement informed our Proposal*), this 1.5kW level applies to all our low voltage customers, regardless of their location.



The map to the right uses data from our hosting capacity analysis and shows which areas of our network can currently accommodate every single customer exporting a maximum of 1.5kW (shown in green). The areas shown in red will require some investment to allow customers to export at this level. Although there are a number of locations showing less than 1.5kW, we are proposing to allow all customers across the network to export a maximum of 1.5kW at all times, striking balance between costs being borne by induvial customers and the broader customer base.

Our Connection Agreement

Our Connection Agreement defines the connection attributes we offer our customers. It is usually filled out by a customer's solar installer and would be one of the forms that a customer signs when they agree to a solar installation. It currently defines the 3kW rural and 5kW urban automatic export approvals described above.

In line with our customers' preference (see *Attachment 4.02 – How engagement informed our Proposal*), we will be altering our Connection Agreement over the next year. New and upgrading customer connections will sign up to a flexible connection agreement that will allow them to connect and export larger amounts than is allowed under our current Connection Agreement, or to a fixed lower export level of 1.5kW.

With falling technology costs, the types of DER being installed will change over time and the projected uptake will rise. With this change to our Connection Agreement, an increasing proportion of DER will be able to be dynamically controlled. Dynamically controllable DER provides customers with further value opportunities, such as contribution to system security and reliability, and the ability to moderate wholesale prices.

Limiting customer exports would not appear to assist with integrating renewables. Yet adopting flexible connection agreements will do just that. In conjunction with our smarter network investments, it will provide an interim, cost-effective solution to addressing power quality issues caused by excessive exports, until it makes economic sense to 'build up' the network.

How flexible connection agreements impact our 2024–29 Proposal

Together with our investment in a smarter network and DOEs, dynamic management will allow us to improve our network utilisation by using DER to increase demand on the network when it is required. Export limits are applied only when necessary so customers can export more electricity than they otherwise could. In time, DOEs will support the efficient management of other demand-side resources, such as electric vehicles, batteries and flexible smart home devices.

In line with customers' preferences (see *Appendix A* in our Proposal as well as *Attachment 4.02*), our Proposal is based upon:

Item	Expenditure type	Where reflected in our Proposal
> A refreshed Connection Policy that outlines the circumstances under which we may offer a static zero export level	> n/a	> Chapter 10 Capital expenditure > Attachment 10.04 to our Proposal
> Flexible connection agreements being operational	> n/a	> Chapter 7 A network fit for the future
> Payments for third-party services	> Operating expenditure	> Chapter 9 Operating expenditure

6. 'Build up' the network

We can invest to increase the ability of our network to cope with increased levels of DER exports. This could be through traditional solutions, like larger transformers or reconductoring, or through the use of newer and more innovative technologies, like batteries.

Ability to solve the network challenges	Cost of the solution	Success at integrating DER
Low	Very high	Successful

Building up the network does assist with integrating DER, but it only assists with two network challenges and is, usually, the most expensive solution in our toolbox.

We can also not undertake such investment unless the benefits outweigh the associated costs. The AER has defined a method for calculating the value of customers' curtailed exports. However, given power quality issues generally occur for only a few hours across a small number of days each year, it will require many customers in an area to be losing significant amounts of exports before an investment could be justified as prudent and efficient.

How building up the network impacts our 2024–29 Proposal

Our future network modelling indicates a need for minimal investment in this area.

It is not economically justifiable to undertake traditional network augmentation to guarantee export from all customers – this approach would not deliver net value for our customers. However, there are areas that do require targeted network interventions which demonstrate that it can be prudent and efficient to augment the network to allow additional DER to connect and export. The benefits delivered by allowing additional generation on the network under this approach accrue over a long period of time. These interventions sit outside our traditional augmentation expenditure program.

In line with the AER's regulatory framework, avoided/deferred augmentation has been identified as a benefit associated with a DER integration investment and captured within the cost benefit analysis model underlying the Future Network Business Case. This is because increased DER capacity avoids or defers augmentation by reducing peak demand at our upstream distribution network assets.

In line with customers' preferences (see *Appendix A* in our Proposal as well as *Attachment 4.02*), our Proposal is based upon:

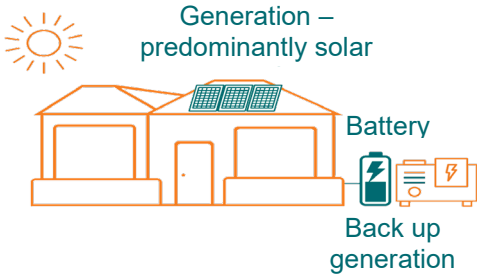
Item	Expenditure type	Where reflected in our Proposal
> Batteries as a service	> Operating expenditure	> Chapter 7 A network fit for the future > Chapter 9 Operating expenditure
> Reconductoring > Transformers	> Capital expenditure (Export Services Augex)	> Chapter 10 Capital expenditure

7. Invest in SAPS and microgrids

This solution is aimed at solving one-network challenge – minimise asset replacement expenditure, but with the benefits of improved reliability and resilience for impacted customers as well as lowering on-going operating and maintenance costs for all customers.

Ability to solve the network challenges	Cost of the solution	Success at integrating DER
Low	Varies Low to High	Successful

SAPS are an innovative technology that provide customers with solar panels, a battery, and a backup generator to supply all the electricity for their home and property. The solar panels generate electricity during daylight hours with any excess energy charging the battery. The battery then provides power at night or when the weather is overcast for long periods of time. A diesel generator provides back up on the occasions when energy use is higher than what the solar panels and battery can supply.



SAPS can be used to power homes, sheds, workshops, offices, and accommodation. The system is optimised to meet individual customer needs. As the SAPS generates and supplies electricity directly to the customer, their reliability and resilience is improved – they no longer suffer when a tree falls on the power lines 20 kilometers away and they can still use electricity to pump water as required.

SAPS provide a more cost-effective and reliable source of power where long sections of powerlines serve very few customers. As we remove power lines that are no longer required due to SAPS installations, all our customers save money in the longer term through lower costs as we no longer have to inspect, maintain and replace those lines.

We are allowed to transition network connected customers to a SAPS or a microgrid (larger SAPS that serves more than a handful of customers) where it is economically beneficial. These customers will instead receive an identical Essential Energy service. We will maintain and service the SAPS and remain just a phone call away for any faults or issues.

We have already trialled SAPS across our network to assist our learning and knowledge of the systems and impacts to customers. We are well advanced in our process of identifying customers who would benefit from the installation of SAPS.

How SAPS impacts our 2024–29 Proposal

We are proposing to pursue a proactive roll-out of 400 SAPS in remote and hard to access areas. This allows customers to benefit from improved resilience and reliability during the 2024-29 regulatory period and aligns with their preferences (see *Appendix A* in our Proposal as well as *Attachment 4.02*).

It is worth noting that we will only be installing a SAPS where a customer agrees to be removed from the network. We think it may take time and hearing the positive stories from customers who have moved to a SAPS, for some customers to feel comfortable to sever their network tie. Removal of the overhead network will not occur until at least six months after installation of the SAPS. Significant operating cost savings from SAPS are not expected to be realised this regulatory period.

Item	Expenditure type	Where reflected in our Proposal
> Payments to leave the network	> Operating expenditure	> Chapter 7 A network fit for the future > Chapter 9 Operating expenditure
> SAPS investments	> Operating expenditure > Capital expenditure (Repex)	> Chapter 7 A network fit for the future > Chapter 9 Operating expenditure > Chapter 10 Capital expenditure
> Microgrids	> Capital expenditure (Augex)	> Chapter 7 A network fit for the future > Chapter 10 Capital expenditure

Appendix 1 - Compliance with AER expectations

This Strategy addresses the AER's expectations in the *June 2022 Final guidance note on DER integration expenditure*. How these expectations have been addressed is shown in the table below.

AER's expectations on what information should be included in a DER Integration Strategy

AER expectations	Essential Energy response	Section where this can be found
Network voltage analysis	We engaged Zepben to undertake advanced electrical modelling of network voltage and hosting capacity	*Managing power quality* and *Accommodating customers' exports*
DER forecasts for DNSP's network over at least 10 years and the expected forecast demand for export services on network	We have gone beyond minimum expectations and commissioned 15-year forecasts from Frontier Economics and Baringa extrapolated these forecasts to perform a 20-year cost-benefit analysis	*Forecast uptake of DER*
Evidence of how DNSPs will structure their tariffs to meet the forecast increase in demand for export services (supported by consumer behaviour modelling)	We engaged FarrierSwier to help us define an equitable tariff structure as DER uptake increases. Baringa modelled the impact of these changes and incorporating into the base case scenario assessment	*Network tariffs*
A clear summary of the various elements of DER integration expenditure, in terms of augmentation, ICT capex and opex.	We have separately identified the expenditure forecast elements specific to DER integration and considered the inter-linkages and impacts with other parts of our expenditure proposal	*How these solutions interact to deliver to customers' priorities and how they tie to our Proposal* *Customer education* *Invest in a smarter network* *Manage demand and exports* *'Build up' the network*
Details of the DNSP's plan (if any) for the implementation of DOEs, which may include the timing of trials, methods for capacity allocation and consumer engagement	We engaged Baringa to model the resulting impacts on our network and extensively consulted with customers. We propose to introduce DOEs in the 2024-29 period	*Invest in a smarter network*
Details of activities undertaken and actual expenditure in the current regulatory period to manage DER integration	We have provided transparent information on our track record for DER integration management	*What we have already invested*
Transparent references to expenditure items in the reset RIN.	Our expenditure forecast has been captured in the RIN and is consistent across our submission	See 7.8 Export Services tab in the Reset RIN