Future Grid Strategy

A summary of the key focus areas for our Future Grid Strategy that underpins the 2024-29 Regulatory Proposal

Endeavour Energy

POWER together

Contents

1. Purpose

Our Future Grid strategy outlines our approaches to navigate the energy transition – success will be measured not only by ensuring electrical services can be maintained or new services made available, but that electricity becomes more affordable, and can be delivered with a lower environmental impact to all customers.

The purpose of the Future Grid Strategy is to:

1. Define the emerging challenges and opportunities for our customers generated by the energy transition.
2. Outline our approach to investment in our Future Grid programs.
3. Ensure investment line-of-sight between the long-term interests of our customers, our corporate strategy and Network Business Strategy and other major sector reform initiatives.

Defining **Future Grid**: *A future state of our network (and our business) that is an outcome of the energy transition and our responses to it. A simplified visualisation of what this means for our customers, our network and our business is provided in* Appendix A – Visualising the Future Grid

2. Context

The transformation of the energy sector is accelerating. Our customers and our network are at the very centre of the change. Whether it be the huge popularity of rooftop solar, the increasing ubiquity of behind the meter and community energy storage, the rise of Electric Vehicles (EVs) and the rising ambitions of our community to achieve net-zero - there is a once in a lifetime transformation underway.

The seven external drivers identified in our Business Narrative also shape our Future Grid Strategy as well as the expectations of our customers. Our current and future investments in the Future Grid address the implications they pose and manage the uncertainties that exist within them

Table 1 – External Drivers and Strategic Implications

Customer Centricity	• Much of the change in the electricity sector has been customer led. We play an important role in enabling and providing more ways to participate but need to understand the trends and behaviours to optimise our services. • Customer preferences are likely to continue to evolve rapidly, with increased demand for more choice, convenience, and control ("the 3Cs"). • The evolution towards decentralisation will push us to transform our traditional one-sided market model into a data-driven, two-sided marketplace platform – becoming a Distribution System Operator. • Our revised tariff strategy will make energy more affordable by providing customers with the information they require to improve network utilisation by making informed and efficient decisions about their use of the network and their investment in new technologies such as solar, batteries and electric vehicles. Tariffs that deliver future services equitably.
Trust, reputation and purpose	• People and communities play an active role in granting ongoing acceptance and approval of our operations and services. • We have a responsibility to maintain and continue to build social license – and quite pertinent, plan for a Future Grid that is fair for those with and without access to DER. • Customers expect to help shape the direction of the business through deep engagement on regulatory proposals and beyond.

Economic volatility and cost of living pressures	• Energy costs for consumers (both electricity and other fuels) have increased significantly, driven by international market exposure as well as short and longer term economic, political and weather-related events, contributing to rising inflation. Cost of living pressures are increasingly centre of mind now for all customers. • Improving efficiency and transitioning to lower cost fuel sources (in many cases through electrification) can realise long term value for customers and increase energy security. • It also requires considered and prudent navigation of short and long term interests in a cost-conscious environment with considerable inequity.
Western Sydney regional growth	• At Endeavour Energy, we are one of the few networks building considerable new infrastructure to service growth – this presents an opportunity and responsibility to leap-frog traditional approaches to electricity services and design networks with the future state in mind. • We will need to continue to develop new and innovative ways to connect customers and deliver energy solutions that will meet our future energy needs.
Climate change and extreme weather events	• Greater frequency and intensity of extreme events - such as storms and bushfires. To continue to maintain and improve service levels we will need to develop more resilient service delivery (which means a resilient business and a resilient network) • This will require: – greater understanding of the conditions in which our assets will operate – flexibility in the way energy services can be delivered – integrated planning approaches to optimise efficiency and where necessary, add redundancy – well designed, constructed and managed infrastructure
The evolving grid within a low carbon economy	• Proliferation of commitments by nations, organisations and customers towards net zero. Electricity is seen as one of the easiest sectors to decarbonise (technologies are available now) – and thanks to rooftop PV has already made considerable progress. • Abundant clean electricity will lead to the electrification of heat and transport, and this will mean considerable evolution of demand curves. • Rooftop solar is now regularly the largest generator (4-5x) in the NEM – this has security implications. The technology has the capabilities to support the grid but with increasing dependency of Inverter Based Resources in the distribution system.
Efficient and effective service in the digital age	• Rapid digitalisation enables efficiency gains across operations – in essence, this enables us to do more with less. • For customers, digitalisation will allow them to manage and value their load and their distributed energy resources or to have them managed on their behalf. • Adoption of IoT, advanced analytics into asset management driving efficiency and reliability • Machine learning and artificial intelligence, virtual /augmented reality and automation and robotics driven efficiencies in back-office and field jobs • Increased risk to grid security from cyber threats • Smart-meters/real-time meters driven behind-the-meter innovations driving new information and data economy in the energy sector, enabling entry of new competitors

3. Future Scenarios

To plan for the Future Grid we need to understand and accept the uncertainty involved in forecasting and plan to adapt as the future unfolds. Scenario planning helps us to best manage this uncertainty and allows transparency in not only identifying needs and their timing but also the trade-offs involved in the “What if?” scenarios.

Our approach has been to adopt and translate the AEMO ISP scenarios as credible external reference points to plan and compare different outcomes. The energy transition involves a great number of stakeholders and coordination is one of the greatest challenges. We believe referencing the NEM operator ensures that there can be coordinated planning across the entire industry (and we note other DNSPs are doing the same). Adopting and standardising industry DER forecasts is referenced as one of our Network Objectives. As will be outlined later in this strategy, translating the ISP distribution network is not perfect and we seek to enhance capabilities required in the next regulatory period to make more informed forecast for our distribution network.

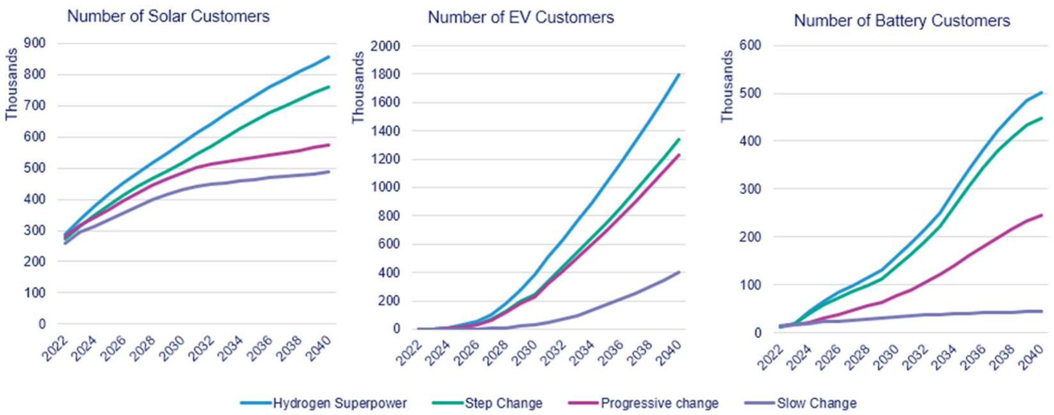


Figure 1: Projected DER uptake on the Endeavour Energy Network for the AEMO ISP Scenarios

We have taken our forecast for a “step change” scenario as a central case but will continue to consider other scenarios and pursue adaptive planning as we monitor and evaluate uptake. Step change involves high levels of decentralisation and ambitious steps in decarbonisation. This was a favoured approach from both our customer groups and the broader stakeholder groups involved in the AEMO’s 2022 ISP. We also note it has the second highest uptake of DER. It is logical considering the path dependency – the negative effect on the network and on our customers of underestimating DER uptake is high (high curtailment, poor customer outcomes, slower decarbonisation), whereas overestimating DER uptake risks delivering capability before it is needed.

Table 2 – Projected DER uptake on our network under AEMO’s 2022 “Step Change” Scenario

	Total Number of Customers	Annual Total Energy (TWh)[1]	Customers with PV	Customers with Battery Systems	Customers with EVs
2022	1,027,000	16.7	225,000 (22%)	5,000 (1%)	2,000 (0%)
2024	1,075,000	17.0	350,000 (33%)	34,000 (3%)	6,000 (1%)
2030	1,219,000	18.2	518,000 (42%)	131,000 (11%)	246,000 (20%)

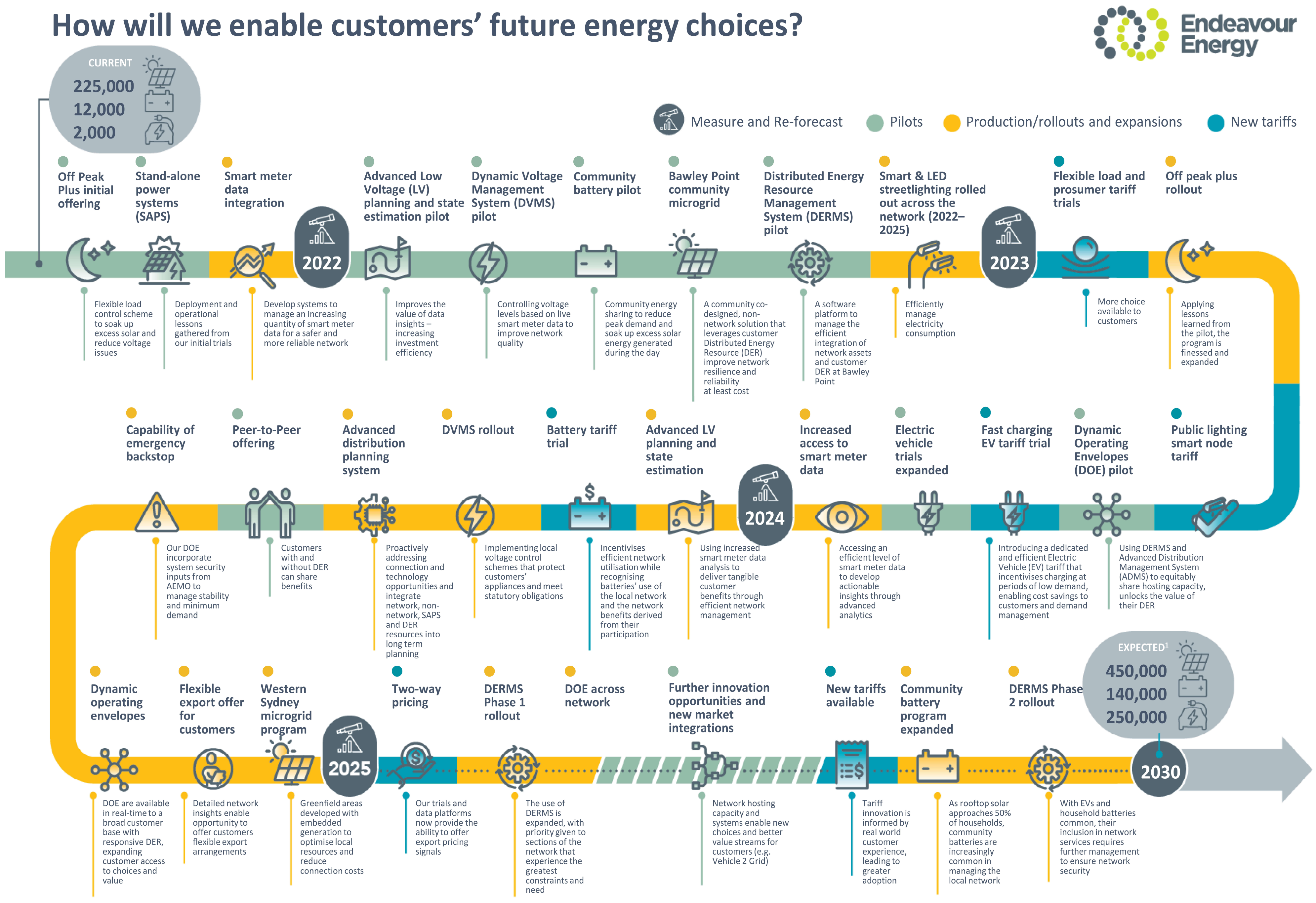
[1] Current energy forecast not including the optimised response of DER

To support this rapid growth, we will need to evolve our operations and innovate. Our network and our business will transform into a platform – connecting and coordinating a broader range of physical assets, technologies and management systems, with options to optimise the grid through better data, systems and operation approaches.

4. Roadmap for the Future Grid

The roadmap overleaf transparently explains how we intend to enable our customers future energy choices. This is not intended to be exhaustive, and naturally will be subject to change as plans develop. Annual measure and reforecast points will be important opportunities to adjust course as actuals are realised and technology and service developments occur.

How will we enable customers' future energy choices?



5. Investment Priorities

We are planning three investment priorities related to the Future Grid Strategy. These are tabled firstly in terms of purpose, justification, and expenditure category. A description of each program is then covered in more detail in the following subsections.

Table 3 – The Key Investment

Investment Name	Purpose & Justification	Expenditure Category
DER Integration Strategy & Business Case	The DER Integration Strategy sets a longer-term vision to guide and align DER integration investments in the Endeavour Energy network. Specifically, it: • Provides a credible long-term DER penetration forecast • Details how tariff reform will be used to accommodate the forecast and reduce network investment. • Reviews current and past investments into DER integration to track their effectiveness in delivering customer outcomes. • Develops a portfolio of credible and industry leading options for better integrating DER and equitably managing and sharing network hosting capacity. • Details our plans to implement Dynamic Operating Envelopes **Investment Justification:** DER offers inherent value to all customers, but may be curtailed due to limitations on our network. Alleviation of constraints can be made through investments justified against the value of the otherwise curtailed DER. This investment approach is aligned with the AERs VaDER framework and DER integration guidance note.	**OPEX** (e.g. Visibility & analytics, Solar Soaking, Transformer Tap changing, customer investigations etc.) **ICT CAPEX**[2] (Flexible exports, DERMS and DOEs) **CAPEX** (Network Augmentation)
Next Gen Planning System (NGPS)	This investment will target a significant capability uplift in network planning in the energy transition and external drivers. With increasing digitisation of the grid comes an opportunity to use this data in smart ways to plan the network better. This investment will help Endeavour more efficiently plan for changes in energy markets, changes in regulations, changes in demand, new technologies and changing behaviours of consumers, etc. This system will deliver planning efficiencies and also proactive responses for all non-network and future energy choices of our customers. **Investment Justification:** Improving the sophistication and accuracy of forecasts will result in savings in future capital investments through deferred or avoided investments.	**ICT CAPEX** (Enhancement and integration of new and old platforms and systems)
Innovation Investment	Through deliberative forums we have heard that 85% of the Customer Panel believe that Endeavour Energy should prepare for either a rapid or an accelerated energy transition. We are therefore proposing an Innovation Investment of $25M ($20M Capex + $5M Opex). **Investment Justification:** Customer and stakeholder support for the application and development of new services.	**Additional to DMIA** **Excluded from Capital efficiency mechanism (CESS)** **Bias toward CAPEX**

[2] The important distinction is made between the ICT CAPEX investment from the DER Integration Strategy and the Next Gen Planning System. For the DER Integration Strategy this relates to the systems required to gather and analyse large smart meter data sets as well as operational systems we will need to develop to enable Dynamic Operating Envelopes for effective management of hosting capacity within the network. The Next Gen Planning System by contrast is a longer term scenario analyser that will help plan the broader network impacts of DER and greenfield areas in the changing context of net zero and electrification of heating and transport. A benefit will be the improved assumptions and accuracy of models such as those used in the DER Integration Strategy but more broadly for all AUGEX and REPEX planning.

5.1 DER Integration Strategy

This investment priority links to our Network Business Strategy [6.8] through subobjective:

- *Enable DER uptake and fulfillment of value to customers through the improvement of network hosting capacity.*

A major milestone for the energy transition was the release of the AEMC Access Pricing and Incentive arrangements for DER in 2021. Previously the rules were written in the context of energy services delivered as a one-directional flow. This rule change was significant as it now allows networks to recognise our role in enabling customer exports and multidirectional flow. In the context of our network planning and the upcoming Regulatory Proposal, this is significant as it recognises that network investments may be needed to enable DER participation and the emergence of a new expenditure category. The rule change also obligates us to prepare a dedicated DER Integration Strategy and business case which also forms part of our Regulatory Proposal. A summary is provided here but readers are encouraged to refer to the DER Integration Strategy document.

How we are forecasting hosting capacity

There are multiple possible approaches to simulating and assessing DER hosting capacity, or inversely quantifying the DER curtailment due to voltage or capacity constraints. Endeavour Energy has developed a deterministic LV simulation tool in partnership with researchers at the University of Wollongong's Australian Power Quality and Reliability Centre (APQRC).This simulation tool:

- Builds customer load profiles from an available sample of smart meters, solar profiles based on historical irradiance data, and assumed battery and EV charging profiles from AEMO and CSIRO.
- Builds LV models for each of Endeavour Energy's residential LV circuits based on the ADMS LV network electrical model data.
- Adjusts customer profiles based on our DER forecast and forecast scenario.
- Runs average daily as well as full year time series power flows simulations between now and 2040, calculating inverter curtailment energy as well as baseline and forecast power flows and voltage levels.

Running this system across the entire LV network requires approximately 20 billion power flow simulations and results in several hundred gigabytes of data.

Endeavour Energy is using this tool to quantify and value service outcomes (DER curtailment) using the AER's Value of DER (VaDER) methodology, of which a key input is the Customer Export Curtailment Value (CECV). The tool can simulate the benefits of operational interventions such as distribution transformer optimisation and Dynamic Voltage Management as well as identify which LV circuits remain constrained after applying operational optimisation and where a network investment intervention is economically justified.

How we are proposing to improve hosting capacity

Our DER Integration Strategy outlines seven intervention actions that alleviate curtailment and enable the integration of higher levels of DER without significant impacts to our customers. Our plans prioritise customer and operational solutions prior to considering traditional augmentation, underpinned by investments in the foundational systems required to enable this. Our DER Integration Plan is outlined below in Figure 3 with the intervention actions grouped into three key focus areas:

- Tariff reform and demand flexibility,
- Network capability and operational optimisation, and
- DSO Operations

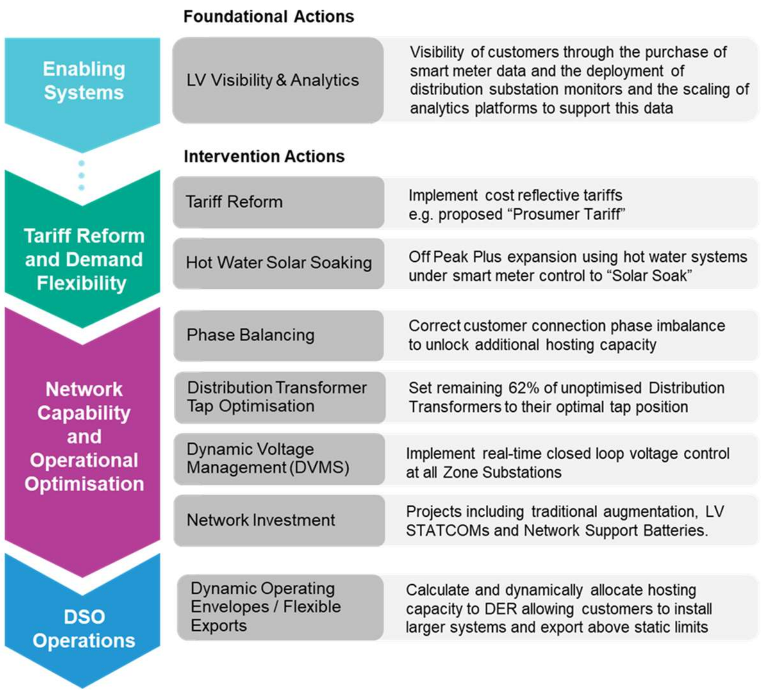


Figure 2: DER Integration Plan

Complete details of the DER Integration Strategy and Business Case are available in the dedicated document.

5.2 Next-Gen Planning System (an Advanced Distribution Planning System)

It follows from the six external drivers that planning and operating the Future Grid is becoming increasingly complex. 15 years ago, customers would connect to the distribution network with a relatively straightforward load requirement. Today many are connecting with a load requirement but also with plans for significant onsite renewable generation capacity, ambitions to capture value streams of embedding storage and an ambitious net zero strategy, which will likely entail electrification of heating and transportation for which no baseline yet exists. Challenges are equally present in adapting existing customer connections in brownfield areas with similar changing customer requirements and within the constraints of an already built and ageing network.

A traditional, one directional "fit and forget" model of distribution planning is inadequate to efficiently plan for the future grid. Our current deterministic approach is expected to lead to over investment in many areas whilst in other areas we are blind to the service deficiencies that are developing. The accelerating trends of the energy transition mean that this mismatch will only grow.

It will instead require a paradigm shift in planning capability to deal with the larger datasets, more complex control scenarios and possibly requiring more frequent planning cycles. This to cater for more frequent inflection points in policies, standards, regulations, and the technologies in use.

Investments will need to be made to develop a Next-Gen Planning System (NGPS) – which allows both top-down and bottom-up planning approaches to combine and optimise, together with Repex and Opex optimisations. In order to develop a complete enterprise solution that combines real time data from our network models, scenario and forecasts, we expect this will require additional dedicated funding. The investment case is justified by the overall capital efficiency improvements of more informed process.

Some of the capabilities that have immediate need but will realistically need to be developed over the short to medium term include:

1. Developing a more informed basis for scenarios and advanced DER forecasting - currently these are based on the AEMO ISP scenarios downcast to our network, but will in future require a much

more robust approach to actively link Endeavour Energy's actual data and more granular customer data. With increasing smart meter data acquisition from the DER Integration Strategy, these could be attributable to individual NMIs and thus aggregable across the entire network.

2. Extend forecast layers to both distribution feeders and distribution substations.
3. Link and integrate historical smart meter data and perform weather corrections.
4. Enable easy Time Series Analysis, eg, extract time series load forecasts for network elements. This is critical to assess behaviour of non-networks and flexibility services.
5. Provide an easy to navigate geospatial interface - spatial connection of the network and modelling two-way energy flows for time series across our network elements.
6. Integrate hosting capacity analysis for existing network elements both for current and future state (and geospatial exploration of constraints) to support the DER Integration Strategy.
7. Advanced and automated modelling of different investments that can resolve constraints (including Non-Network Options).
8. Account for distribution impacts of current and future embedded generation and storage.
9. Advanced Minimum Demand forecasting such as to allow the effective modelling of uptake scenarios and potential impact of tariff responses.
10. Expanded network planning scenarios – i.e. analysis of prospective components
11. Greenfield Area forecasts and alternative network design impacts.
12. More Advanced DER Forecasting (improve on downcasting AEMO) e.g., integrate physical, demographic or social factors that will affect demand and DER uptake (including decarbonisation and the electrification and changing profile of use) – potentially a separate research and input task (and could be done earlier).
13. Verification of SAPS opportunities on our network.

Complete details of the NGPS are available in the dedicated CFI and NPV model.

Future Grid Innovation Investment

> This investment priority links to our Network Business Strategy 6.8 through the following subobjectives:
>
> - *Test and prove innovative Future Grid concepts that are potentially transformative for our customers, our network, and our business.*
> - *Secure and utilise innovation funds based on approved projects and in alignment with direction of industry and customer choice.*

Our Future Grid strategy is informed by the needs and preferences of our customers, our business narrative and emerging trends within the industry. The ultimate goal is to develop services to meet the future needs of every Endeavour Energy customer. Part of the challenge of this future focussed view is that it requires us to identify needs that customers cannot yet articulate themselves and which the conventional regulatory framework is slow to unlock.

It is well described that a significant step change is under way in the electricity value chain and the industry is following a familiar customer driven pathway experienced by other service industries. In the Australian context, this can be shown in developments of foundational reforms as outlined in the graph below. In the context of our network and our customers, this familiar S curve will either be hastened, enabled or suppressed by our networks ability to innovate.

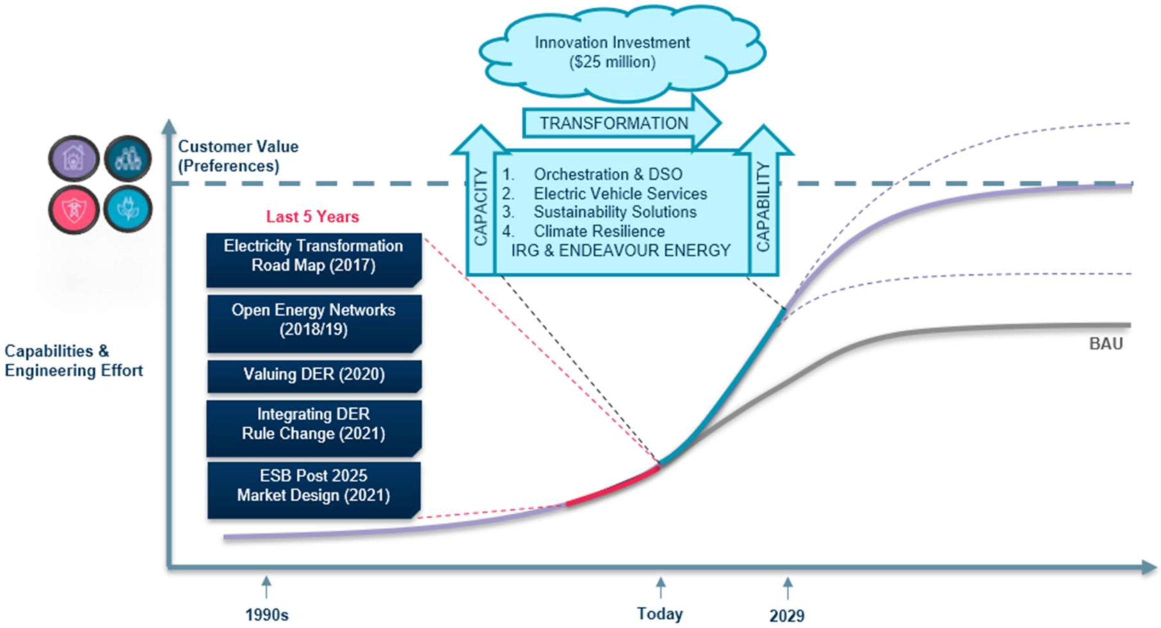


Figure 3 – Stepping up on Innovation

Today, innovation funding for networks is derived primarily from Demand Management Innovation Allowance (DMIA), however the scope is mostly limited to innovation related to demand management. This has provided considerable value to the business through our prior and active programs, but has still been limited in its application. It should be noted that the term Demand Management is rooted in the conventional paradigm. Given the accelerating pace of the energy transition we do not believe that this will be sufficient to tackle the quantum of innovation needed to facilitate the fast-paced energy transition.

As a key participant in the energy transition, we have both an aspiration and need to be more innovative. To that end, we seek in our Regulatory Proposal a dedicated innovation allowance of $25m ($20m Capex + $5m Opex) over the 2024-29 period to prudently deliver innovation that both de-risks our essential obligation to our community from protect us against disruption by:

- Accelerating our participation in emerging technology in an agile manner;
- Incubating fast-growing use cases (that may currently be further away from our core operations), issues and opportunities beyond demand-management such as the benefit that electrical vehicles may have in soaking up excess solar and also providing network support under emergencies;
- Maintaining the radar for emerging and unforeseen technology and business model innovations; and
- Bringing forward successful trials for productisation earlier that could become material drivers of consumer benefits.

The establishment of the fund was strongly supported by our RRG, subject to further details of oversight and ongoing engagement as provided in the Innovation Investment Proposal Document.

We have identified the following four key themes for investment that represent a step change for our business and our customers.

The innovation investment is proposed to support projects and trials under 4 innovation themes to modernise our network and services raised on through the customer engagement program established for the regulatory proposal:

- Orchestration & DSO (facilitate consumer participation in the energy market rather than building more infrastructure and go beyond “poles and wire”)
- Electric Vehicles Services (enabling grid stability and flexibility as EV uptake rises)
- Sustainability Solutions (sustainable services from renewable-based supply, electrification of emission intensive activities and improvements to energy efficiency)
- Climate Resilience (adopting climate resilience measures that contribute to improve electricity access and network services for communities)

Complete details of the Innovation Investment and justification are available in the dedicated document.

Putting it all together – Investments Mapped to Capabilities

This multi layered approach ensures consumer centric future service delivery for our customers is integrated across the business and energy eco-system. A capability map of these as a network transitions to a consumer centric Distribution System Operator (DSO) is shown below against the service outcomes.

	Historical Approach to DER	DER Integration Strategy and Business Case	Next Gen Planning System	Innovation Investment
Maintain Network Reliability / Manage Faults				
Respond to customer complaints	■			
Improved understanding of LV network performance		■	■	
Proactive response to customer issues		■	■	■
Increase and Manage Hosting Capacity				
Detailed understanding of hosting capacity		■	■	
Operationally optimised hosting capacity (Tap changing, DVMS etc)		■		
Unlocking highest value hosting capacity		■	■	■
Fair allocation of hosting capacity		■		■
DSO Enablement		■	■	■
Meet Export Obligations				
A static limit	■			
Limit based on informed hosting capacity		■	■	
Flexible Exports / DOEs		■	■	
Enabling New Technologies to be available for use on the network				
New technology option analysis		■	■	■
New technology pilots & partnerships				■
EV integration & service models		■	■	■
Decarbonisation		■	■	■
Integrate Future Grid into Network Planning				
Integrated planning of network, DER & non-network		■	■	
Co-optimisation of REPEX and OPEX		■	■	

**These ranges will be determined through the LV hosting capacity model that is being developed with University of Wollongong for time series analysis as well as CECV value.*

Emerging Customer Challenges and Opportunities

As customers seek to connect more distributed energy resources and increasingly use sophisticated digital platforms, the network and its management must evolve. Our objective is to enable customers' future energy choices for a sustainable future, moving use towards the future integrated and low carbon energy system. In terms of customer outcomes, our expectations based on this approach is summarised below.

Outcomes for all customers:

<table>
<tr><th colspan="2">Today</th><th>Over the next 5 years</th><th>Beyond 5 Years</th></tr>
<tr><td rowspan="4">Electrical Services</td><td>Customers are connected to the network but may experience outages or interruptions due to upstream events, the duration is actively reduced by our programs such as FLISR (a digital technology)</td><td>Increased resilience for some customers through initiatives such as Bawley Point whereby local generation and DER resources can be utilised to reduce the frequency and duration of outages</td><td rowspan="4">Increased resilience for most if not all customers – Grid forming inverters will be increasingly common in providing system strength and maintaining supply during network disturbances.</td></tr>
<tr><td>Digital Services Platform – for active participation in demand management incentive programs offering better customer experience and to be heard (Voice of the customer).</td><td>Digital Services Platform data used to drive better outcomes for non-DER consumers.

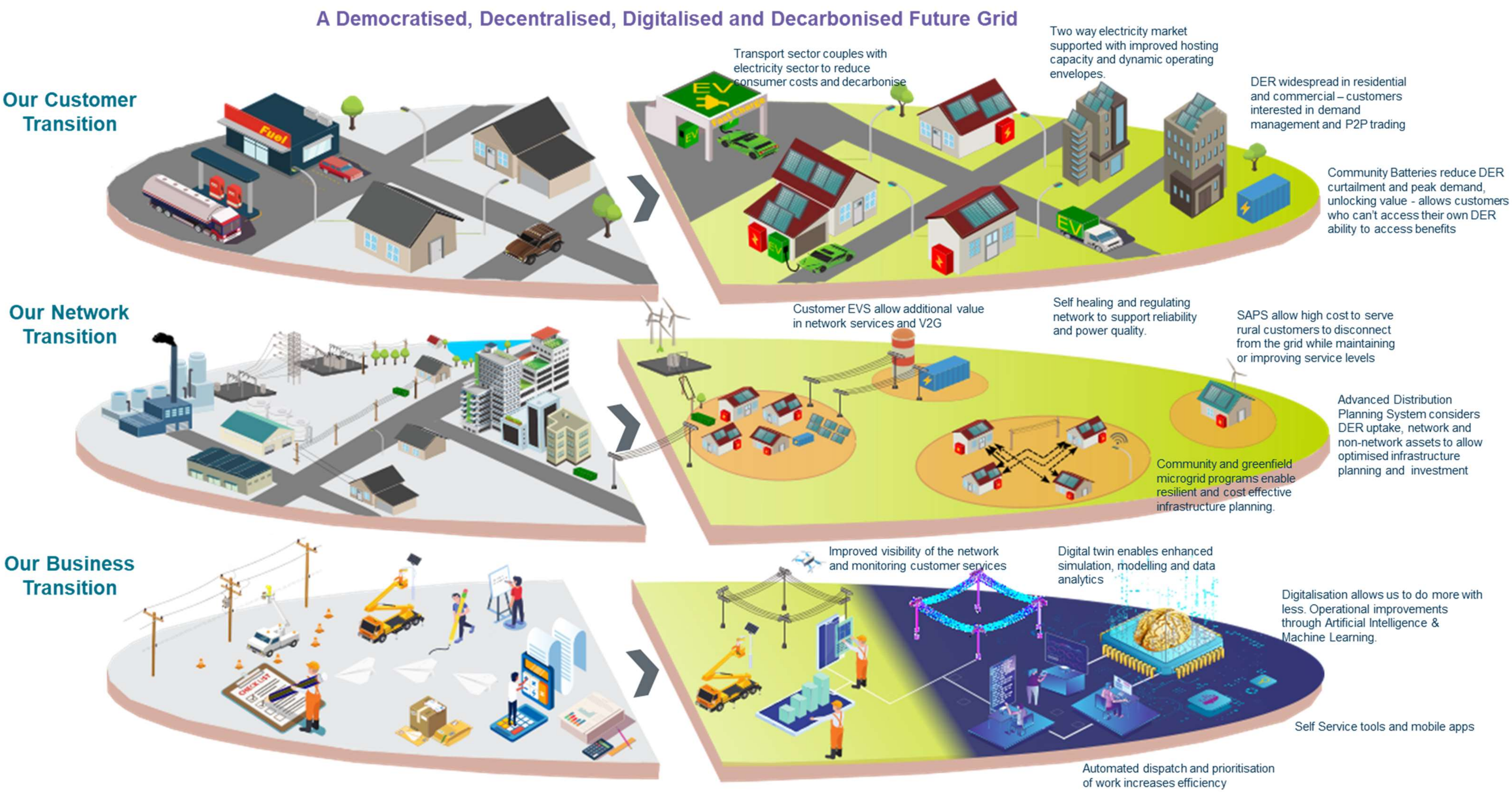
Implement voluntary demand response programs that makes it easier for customers to participate and earn incentives.</td></tr>
<tr><td rowspan="2">More options for services which reduce customer consumption and become more energy efficient.</td><td>The ability for Non-DER customers to access excess solar through community batteries and P2P.</td></tr>
<tr><td>Improved visibility of their service connection, outage information and identification of issues.</td></tr>
<tr><td rowspan="2">Tariffs and Charges</td><td>Cost reflective tariffs are not being passed through to customers.</td><td>Export pricing will mean greater equity for Non-DER customers</td><td rowspan="2">Long term customer benefits through optimal integration of DER and Non-Network Options will mean that energy is generated as close as possible to where it is consumed, such that the need for such large capacity network assets is reduced and leading ultimately to lower infrastructure establishment costs.</td></tr>
<tr><td>DER uptake to date has led to downward pressure on wholesale prices (a portion of customer bills) as recognised through the CECV.</td><td>Improved hosting capacity will mean more DER exports and cheaper wholesale prices (a portion of customer bills) for Non-DER customers</td></tr>
<tr><td rowspan="2">Societal and Environmental</td><td rowspan="2">Carbon intensity of electricity is improving, reducing the customer's footprint.</td><td>Carbon intensity of electricity is significantly reducing customer carbon footprints

Increased DER hosting capacity will allow more solar, batteries and EVs to connect to the grid, which helps to decarbonise the industry faster.</td><td>NSW Growth and the need to be efficient and effective with sentiments from Non-DER customers are integrated seamlessly into plans, this will be met using advanced digital technologies.</td></tr>
<tr><td>Electric Vehicles are assisting with broader decarbonisation goals and local air /noise quality.</td><td>NSW Government 35% emissions target by 2030 supported by DER Enablement</td></tr>
</table>

Outcomes we expect for customers with DER:

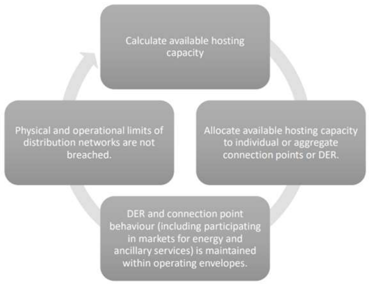
	Today	Over the next 5 years	Beyond 5 Years
Customers with Solar	When customers connect we currently uniformly cap the amount a solar system can export.	As we have more information about the local constraints, we will be able to dynamically decide the limits on a solar system to ensure the best value for all customers.	In terms of DER, the suite of tools we can use to reduce network curtailment has expanded to include widespread community batteries and improved dynamic management capabilities (allowing a "wider" DOE). The system is smart by definition. (digitalisation maturity is high)
	Customers often have to report (voltage induced) solar export limitation before we know about it (and only then something can be done about it).	With improved visibility on our network, any limits to the customer solar exports will be known immediately, and could even be predicted and resolved before it happened (e.g. through tap changes, DOE, DERMS, DVMS).	
	Currently the market pays a flat export price through the retailer – the value of which will gradually reduce as solar becomes ubiquitous.	Through cost reflective tariff (export pricing) customers could be charged to export at certain times of the day - incentivising customers to self-consume or institute active control.	
	Currently the solar output in the day may be underutilised, exporting when flexible local loads could instead be offset.	Solar exports are better coordinated with flexible loads (such as hot water systems, home energy management systems and electric vehicles). Ability to participate in community battery programs which makes access to energy storage more equitable, giving everyone the ability to save on their electricity costs.	
Customers with Batteries	Customers can sign up with aggregators and VPPs to provide network support and unlock further value of the behind the meter BESS investments.	Aggregators and VPPs can work with new DSO functions (linking to system operations and integrated planning – for better visibility of dispatchable capacity, greater efficiency and more customer value).	P2P sharing of stored energy capacity.
Customers with EVs	EV connection is not coordinated with network planning, which reduces the value proposition for charging and potentially future V2G and increases the network augmentation costs.	More integrated smart charging will allow better coordination with our networks services and reduce the overall burden of new load connections. Initial V2G capabilities available but not ubiquitous or fully integrated with market services.	V2G services means that customers can participate in new markets and unlock new value streams and household energy consumption can be optimised. The system is smart by definition. (digitalisation maturity is high)
	EV cost of ownership is higher without dedicated tariffs.	Dedicated EV tariffs will help reduce cost of ownership and incentivise behaviour which benefits the common network needs.	P2P sharing of stored energy capacity.
		Electric Vehicles are assisting with broader decarbonisation goals and local air quality.	

Appendix A – Visualising the Future Grid



Appendix B - Explanation of Future Grid Programs in the Roadmap

Component	Description	Customer Outcomes
Advanced LV Planning and State Estimation Trial	Data Engineering turns smart meter data into real visibility of the distribution network so Endeavour Energy can pinpoint capacity constraints at the right time and the right place for demand management. Data Engineering also executes analytics and automates actions back into operational systems such as SCADA, ADMS and DERMS to manage performance in pseudo real-time.	• Integrates more consumer renewables (DER), more quickly into networks.
Community Batteries	Community Battery is a term which has more than one meaning, and could be defined as: • A grid battery deployed for network support in a community or locale to address a specific supply problem i.e. peak demand, voltage issues, poor reliability etc. • A storage system installed in a new network build, in which the battery is an integral part of design and can reduce the overall build cost, or fast track service provision in a microgrid or 'thin grid' • As a shared asset which in addition to providing network support, provides energy storage services to customers and retailers	• When deployed in a focussed strategy, provides a shared asset for the benefits of the network and all consumers alike, in an efficient and a highly coordinated way.
Distributed Energy Management System (DERMS)	A DERMS is a software platform that allows coordination of DER resources (both behind and in front of the meter) with our network assets to optimise dynamic two-way flow of energy. This could include rooftop PV paired with behind-the-meter batteries, or a fleet of electric vehicles to provide grid stability and services, or load control to help manage flexible demand.	• Improved access and opportunity for DER participation in new market services. • Optimised and fair allocation of available hosting capacity. • Plays an enabling role in microgrid operations, improving asset utilisations and resilience.

Component	Description	Customer Outcomes
Dynamic Operating Envelopes (DOE)[3]	 *Figure 1. The lifecycle of an operating envelope in each time interval.* A dynamic operating envelope is an allocation of available hosting capacity to individuals or aggregated DER or connection points within a segment of an electricity distribution network. This is usually allocated into discrete time intervals (usually 5 or 30 minutes).	• Improved hosting capacity of the network means improved opportunity to export. • Hosting capacity can be managed in a way that is fair to all exporting customers. • Network utilisation can be optimally configured, with reduced uncertainty and less need for conservative operational strategies.
Dynamic Voltage Management System (DVMS)	A Dynamic Voltage Management System (or DVMS) is a system to adjust zone substation target voltage settings through SCADA by leveraging near real time customer smart meter voltage data feedback. This is one of many fundamental capabilities required as networks transition to a Distribution System Operator (DSO) role, optimising the network for increasing two-way power flows. Energy is actually saved as Conservation Voltage Optimisation (CVO) reduces real network losses.	• Additional hosting capacity and reduced curtailment (more exports) for solar customers. Non-solar customers benefit through secondary means. • Contribution to system security under AEMO's RERT scheme as well as potentially a contribution to frequency management through FCAS. • Improved solar hosting capacity and reduction in customer complaints. • Reduction in customer appliance energy wastage and the avoidance of associated emissions. • Improved customer appliance lifetimes.

[3] Diagram sourced from ARENA knowledge sharing report "On the calculation and use of Dynamic Operating Envelopes"

Component	Description	Customer Outcomes
LV STATCOM	A low voltage **St**atic **Com**pensator is a device which dynamically reduces voltage variations on Low Voltage circuits. It does this by injecting or absorbing reactive power in a similar manner to a smart inverter's "Volt-VAR" mode, however at higher power levels and continuously 24/7 (not just during sunlight hours). LV STATCOMS are effective at improving voltage variations and unbalance on open wire overhead LV circuits.	• Improved Quality of Supply • Improved DER hosting capacity • The tightening of the voltage window allows systems such as DVMS to operate more effectively improving hosting capacity for a broader customer base.
Off Peak Plus	Load control schemes offer significant benefits to customers, retailers, network operators and generators. Load control equipment has historically been used by Endeavour Energy to facilitate its load control program (particularly control overnight of off-peak hot water heaters) and offer customers cheaper savings through Controlled Load tariffs. The Off Peak Plus is used to activate hot water heaters during high solar energy injection periods from rooftop PV in order to reduce voltage issues on the network a process of *soaking up* excess solar energy.	• The data from the meters has also been used to detect broken neutrals in the area of application, which have been rectified and therefore avoiding potential customer shocks. • The data also allows Endeavour Energy to better manage voltage and unlock further solar hosting capacity. • Advanced meters are a key foundation for the transformation of the energy market. They enable customers to better understand and control their electricity use and costs and enables them to access new services. • Advanced meters are a pre-requisite for the implementation of cost-reflective tariffs, which will deliver significant savings in network costs and average prices for consumers.
Stand Alone Power Systems (SAPS)	These provide both network and consumers benefit in certain locations on the network via Stand Alone Power Systems.	• Reduces upstream Load at Risk at some zone substations. • Provides certainty of supply in areas where there are seasonal peaks such as holiday seasons and other events. • Provides a least regrets solution when there is uncertainty in capacity for future connections. • Alleviates voltage regulation and management issues. • Provides greater network Resilience and Bushfire Risk mitigation.

Component	Description	Customer Outcomes
		• Meets customer and community ambitions to be self-reliant. • Provides the opportunity to replace diesel generators. • Utilises significant existing, customer investment in DER when that already exists.

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