westernpower

Distribution Storage Opportunities

Information Paper 2020

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Contents

Glossary

Term	Definition
Active power	The power which is actually consumed or utilised in an AC Circuit is called active power or real power. Active power is measured in watts (W).
Behind the meter	Located on the customer's side of the Western Power meter
Distributed Energy Resources	Distributed Energy Resources, or 'DER', are smaller–scale devices that can either use, generate, or store electricity and form a part of the local distribution system, which serves homes and businesses. DER can include renewable generation, energy storage, electric vehicles (EVs), and technology to manage load at the premises.
Distribution network	Any apparatus, equipment, plant or buildings used, or to be used, for, or in connection with, the transportation of electricity at nominal voltages of less than 66 kV and which form part of the South West Interconnected Network.
Distribution System Operator	A Distribution System Operator (DSO) enables access to the network, securely operates and develops an active distribution system comprising networks, demand, and other flexible distributed energy resources (DER).
In-front of the meter	Located on the distribution network side of the Western Power meter (i.e. not behind the meter).
Low voltage	Any nominal voltage of 1 kV and below.
Medium voltage	Any nominal voltage above 1 kV and less than 66 kV.
Network apparatus	Any equipment, plant or buildings used for, or in connection with the transportation of electricity on the SWIS.
Network constraint	When a section of an electricity network approaches its technical limits.
Reactive power	Reactive power is a necessary component of alternating current electricity which is separate from active power and is predominantly consumed in the creation of magnetic fields in motors and transformers and produced by equipment such as alternating current generating units, capacitors and network elements. Reactive power is measured in volt-ampere reactive (var).
South West Interconnected System	The transmission and distribution system in South West of the state of Western Australia, extending from Geraldton to Albany areas and across to the Eastern Goldfields, as defined in the Electricity Industry Act 2004 (WA).
Technical Rules	The technical requirements to be met by Western Power on the transmission and distribution systems and by users who connect facilities to the transmission and distribution systems.
Transmission network	Any apparatus, equipment, plant or buildings used, or to be used, for, or in connection with, the transportation of electricity at nominal voltages of 66 kV or higher, and which forms part of the South West Interconnected Network.

Abbreviations

Term	Definition
BESS	Battery Energy Storage System
DER	Distributed Energy Resources
DSO	Distribution System Operator
DSTR	Distribution transformer
EOI	Expression of Interest
ESS	Essential System Services
GTEng	Grid Transformation Engine
kW	Kilowatt
kWh	Kilowatt hour
LV	Low Voltage
MV	Medium Voltage
MW	Megawatt
MWh	Megawatt hour
NCS	Network Control Service
NOM	Network Opportunity Map
PV	Photovoltaic
RFP	Request for Proposal
RFT	Request for Tender
SHE	Safety Health and Environment
STATCOM	Static Synchronous Compensator
SVC	Static VAR Compensator
SWIS	South West Interconnected System
VAR	Volt-ampere reactive

1. Introduction

1.1 Background

The Energy Transformation Strategy, developed by Energy Policy WA, aims to ensure the delivery of secure, reliable, sustainable and affordable electricity to Western Australians now and into the future.

A key workstream of the Strategy focuses on Distributed Energy Resources (**DER**). The DER Roadmap[1] has been developed and it outlines a set of actions that are required to realise a future where DER is integral to a safe, reliable and efficient electricity system and where the full capabilities of DER can provide benefits and value to all customers.

This paper relates to Action 5b of the Roadmap and is referred to as the Distribution Storage Plan.

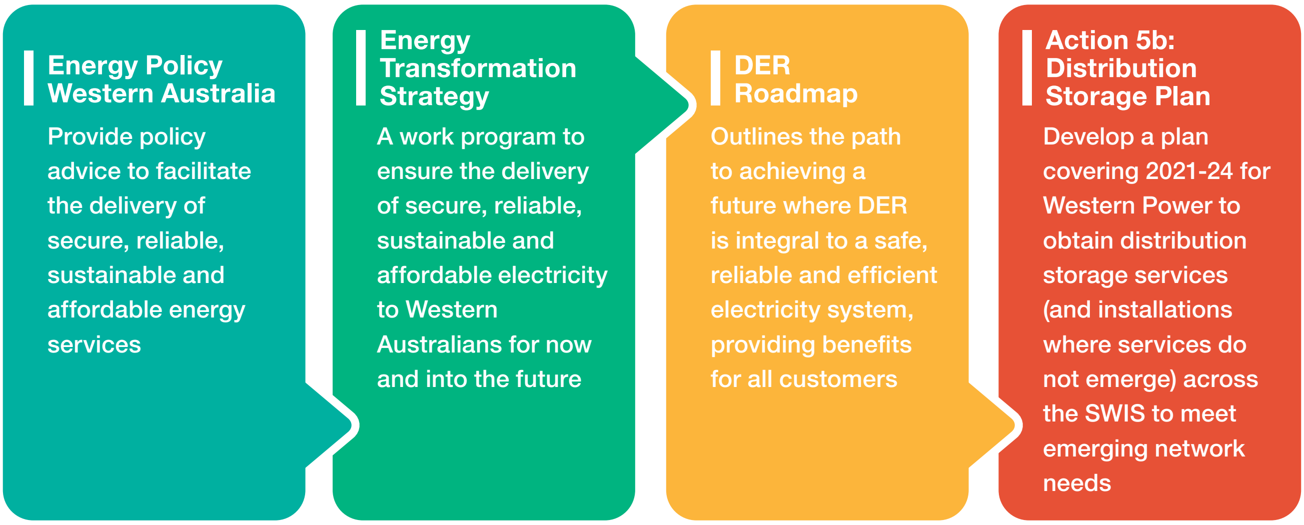


Figure 1. Where does this paper sit?

1.2 The objective

This paper outlines the opportunities where Western Power may obtain distribution storage services and/or installations across the South West Interconnected System (**SWIS**) to meet emerging network needs. The paper will describe some of the current and emerging issues on the SWIS, outline how storage could assist to alleviate these issues, and next steps for storage opportunities.

Western Power also seeks input from industry to help determine the optimal approach to widespread deployment of distribution storage, seeking the best long-term outcomes for the community.

1.3 What type of storage is considered?

The opportunities discussed in this paper relate to storage connected to the distribution network (voltages from 415V to 33kV inclusive). Transmission storage opportunities are beyond the scope of this paper, see figure 2. Western Power is agnostic to the storage technology utilised and the point of connection to the network (e.g. in-front of the meter or behind the meter), provided it meets minimum standards specified by Western Power and the product or service can effectively address the identified network issue in a safe and efficient manner.

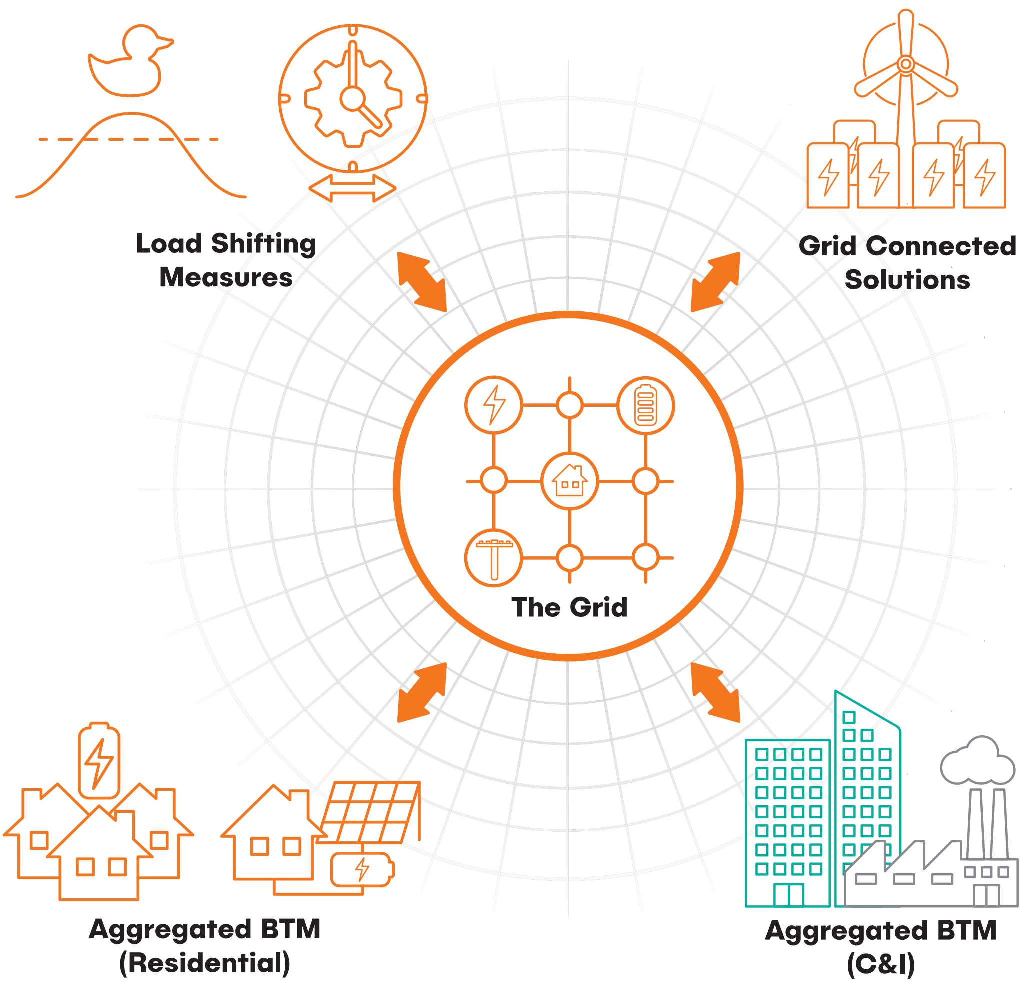


Figure 2. What type of storage?

1.4 Why now?

Western Power believes now is the correct time to deploy Distribution Storage as:

- **It will maximise the utilisation of the network** and ensure that optimal value is extracted from existing assets
- **It will play an important role** in ensuring power system stability and security in an increasingly decentralised power system
- **The technology has matured** leading to significant advancements in capability, efficiency and reduction in cost, providing an increasingly viable alternative to traditional investment options
- **It will facilitate further investment in renewable energy** whilst assisting in maintaining a sustainable and affordable electricity supply
- **The network benefits have been proven.** Western Power has already demonstrated the benefits in front of the meter storage can provide to the network through various trials on the SWIS
- **Recent development of advanced planning tools and scenario planning,** has shown via proof of concept demonstrations that correctly located distribution storage can be a no regrets investment during a time of significant change and uncertainty.

1. www.wa.gov.au/sites/default/files/2020-04/DER_Roadmap.pdf

1.5 Distribution Storage Value Streams

A key advantage of distribution storage compared to traditional investment options is that it has the potential to access multiple value streams, including:

- **Customer self-consumption:** Storage can provide customers with an opportunity to achieve maximise consumption of any self generated energy
- **Network Capacity & Support:** Distribution Storage can provide capacity value by deferring or avoiding investment in network assets
- **Network Reliability:** Storage can improve reliability performance though providing an alternative supply to customers when the main grid supply is unavailable
- **Essential System Services (ESS):** Storage may provide flexibility value across a range of ESS such as frequency control
- **Reserve Capacity:** Storage could be used as an alternative supply of capacity
- **Wholesale Energy:** Storage could provide energy value through energy arbitrage if it displaces the need to produce energy from another generating resource

As the Distribution System Operator (**DSO**) in the SWIS, Western Power is focussed on procuring solutions that address Network Capacity & Support and Network Reliability only. As such, the remainder of this paper will focus on opportunities within these value streams.

However, it is important to note that an alternative options service provider engaged by Western Power could access additional value streams to maximise their value stack, provided the opportunities align with the agreed operating arrangement for provision of network services under an alternative options service contract.

Ellenbrook Powerbank

1.6 Distribution Storage Opportunities plan

Table 2 and Figure 3 illustrate Western Power's plan for distribution storage. The steps outlined are designed to deliver on Western Power's obligations to the DER Roadmap as part of the Energy Transformation Strategy. Further details of each step are in section 4 of this document.

Step	What is involved?	When?
Step 1: Distribution Storage Opportunities – Information Paper	The first step of the process for identifying how best to procure storage to meet emerging network needs on the SWIS.	Dec 2020
Step 2: Discrete opportunities released to market	If a network need identifies a potential requirement for distribution storage prior to the release of the Alternative Options Strategy (step 3), discrete opportunities will be released to market via a commercial process.	As required between 2020 - 2021
Step 3: Publication of Alternative Options Strategy and Network Opportunities Map (NOM)	In accordance with changes to the Electricity Networks Access Code (Access Code), Western Power is required to publish an Alternative Options Strategy and NOM	Oct 2021
Step 4: Ongoing assessment of distribution storage opportunities	Western Power will engage with alternative solutions providers and consider non-network options for addressing system limitations as per the Alternative Options Strategy.	As required

Table 2. Distribution Storage Opportunities Plan

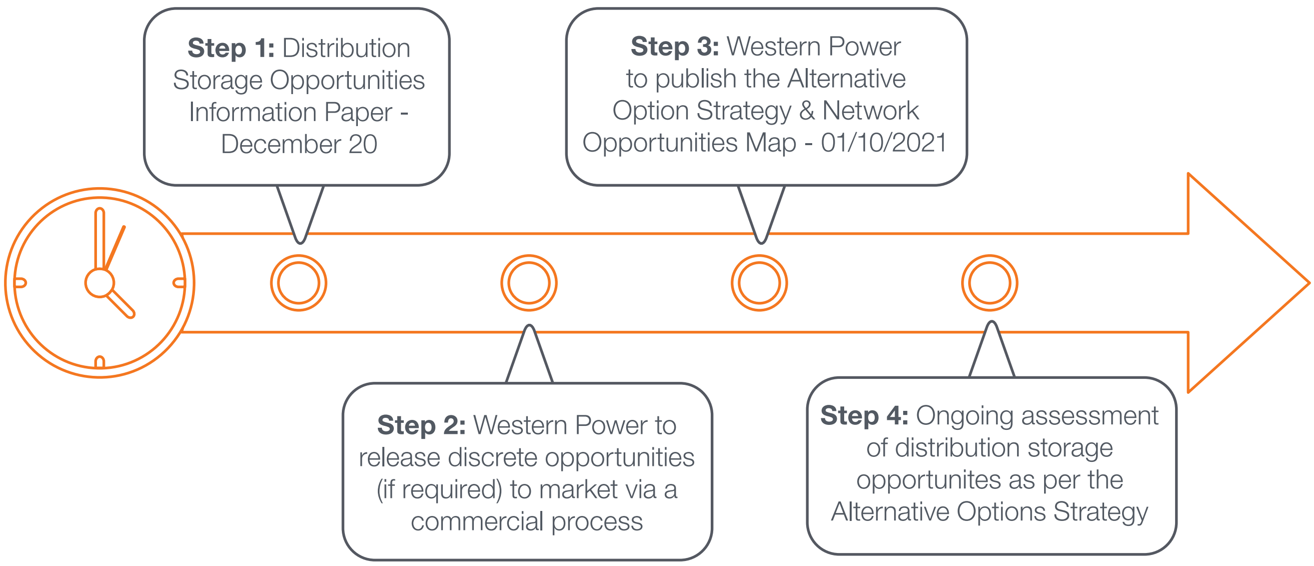


Figure 3. Western Power's Distribution Storage Opportunities Plan Timeline

2. Network Investment Triggers

This chapter aims to highlight some common issues on the transmission and distribution network which require augmentation, for which distribution connected storage may be an alternative option. Table 3 (and Figure 4 Typical Network Investment Triggers) briefly describe each trigger, when they likely occur, their impact and an example of how they are addressed through traditional network investments.

Investment Trigger	What is the issue?	When does it occur?	Potential impact if not addressed	Traditional network solution?
Transmission Voltage Constraints	Voltages levels or voltage step changes outside of prescribed limits in the Technical Rules due to network topology changes (load growth, new generator, DER etc)	Dependent on the location / type of load supplied. Can occur during peak and low load conditions	Technical Rules non-compliance Equipment failure System stability issues	Installation of primary plant e.g. STATCOM, reactors, capacitor banks
Transmission Thermal Overload	Substation transformer, transmission line or other equipment exceeding their rated capacity	Dependent on the location / type of load supplied. Typically, most common during evening peak load period	Equipment failure System stability issues Increased safety risk due to clearance issues caused by excessive overhead conductor sag etc	Uprating or installing a new transformer or transmission lines to increase the rated capacity
MV Network Thermal Overload	Load growth (new connections or increased demand) causing load to exceed the rated MV network capacity	Typically, during peak load (5-8pm). Season can vary depending on location (Winter / Summer peak)	Equipment failure Increased safety risk due to clearance issues caused by excessive overhead conductor sag etc	Installation of new MV feeders or feeder interconnections Transfer of load to adjacent networks Conversion of existing OH conductor to UG cable
MV Network Over-Voltage	Localised excess generation from high DER penetration causing voltages to exceed acceptable limits	Typically, during periods where the load levels are relatively low, and the solar resource is high	Technical Rules non-compliance Curtailed DER generation under inverter autonomous response	Installation of reactive power compensation equipment
MV Network Under-Voltage	Voltage levels below acceptable levels due to voltage drop as a result of high loading	Most common during peak load periods but can vary depending on network topology and feeder length	Technical Rules non-compliance May cause network and/or customer equipment or appliances to malfunction	Installation of voltage regulators, capacitor banks, or other reactive power compensation equipment Installation of additional feeder interconnections

Investment Trigger	What is the issue?	When does it occur?	Potential impact if not addressed	Traditional network solution?
LV Thermal overload	Load growth (new connections or increased demand) causing load levels to exceed the rated capacity of the LV network and/ or the distribution transformer	Typically, during peak load (5-8pm). Season depends on location	Network apparatus failure Safety issues due to excessive overhead conductor sag (clearance issues)	Upgrading or installing additional distribution transformers LV network re-configuration Replacement of overhead conductor with underground cable
LV Over-Voltage	Excess or DER generation causing voltage to be above the prescribed LV network voltage range	Typically, during periods when the load is relatively low and solar resource is high	Technical non-compliance Damage to network apparatus and Customer equipment Disconnection of Customer DER	Distribution transformer fixed tap setting changes. LV network re-configuration Converting OH conductor to UG cable. Upgrading or installing additional distribution transformers
LV Under-Voltage	Excess load causing voltage to be below the prescribed LV network voltage range	Typically, during peak load periods	Technical non-compliance Inability to supply customer loads and/ or equipment	Distribution transformer fixed tap setting changes LV network re-configuration Converting OH conductor to UG cable Upgrading or installing additional distribution transformers
Network Reliability	A fault event 'upstream' of a customer or group of customers causing an outage and loss of supply	Events can be random however they most commonly occur during periods of extreme weather, or at locations which are susceptible to inherent environmental conditions (i.e. saline or dust pollution etc)	Customers suffer loss of network supply until it can be restored. Reliability impact – financial penalties and reputational damage	Distribution network re-configuration, OH to UG conversion. Installation of additional feeder interconnections Additional distribution automation Improved condition monitoring and diagnostics for proactive identification of problems MV or LV Emergency response generators

Table 3. Typical Network Investment Triggers

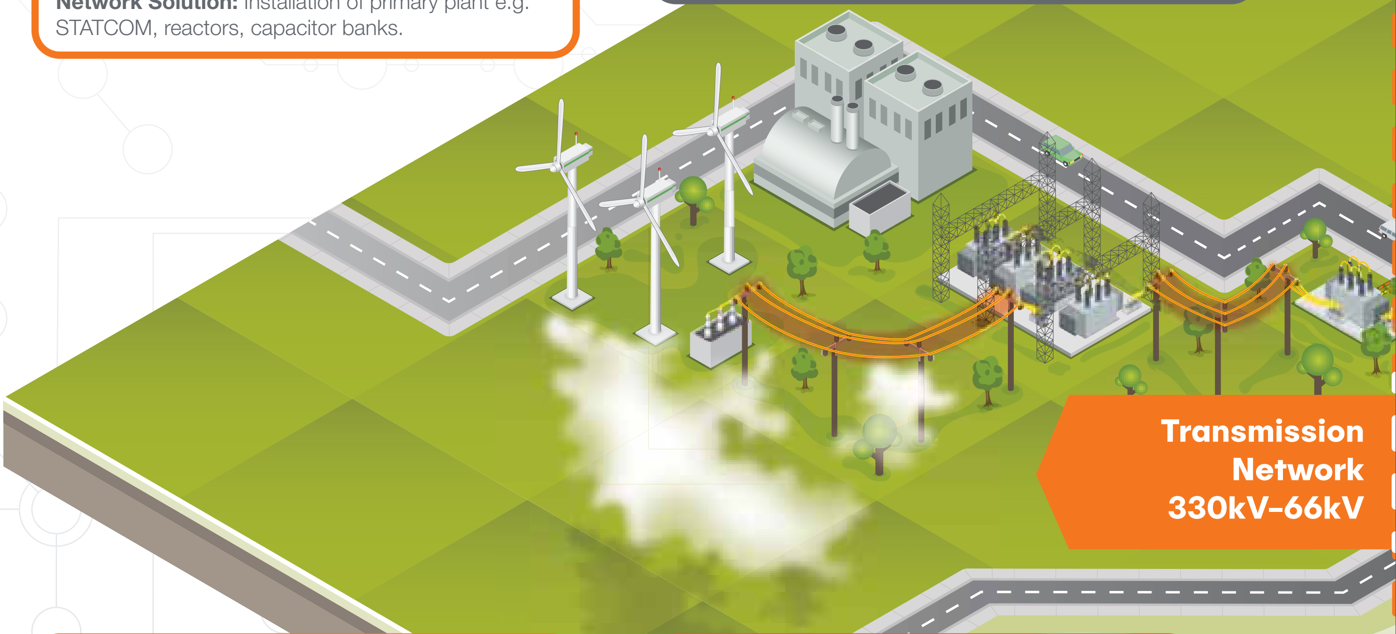
Typical Network Investment Triggers

Transmission Voltage

Issue: Voltage levels or voltage step changes outside of prescribed limits in the Technical Rules due to network topology changes
Where: Transmission network
When: Site dependent. Most common during a contingent event during peak or low load periods
Potential Impact: Non-compliance - could lead to equipment failure and system security issues if not addressed
Network Solution: Installation of primary plant e.g. STATCOM, reactors, capacitor banks.

Distribution MV Thermal Overload

Issue: Load growth (new connections or increased demand) causing load to exceed the rated mv network capacity
Where: MV distribution network
When: Typically, during peak load (5-8pm).
Potential Impact: Load shedding - could lead to equipment failure, and increased safety risk due to clearance issues etc
Network Solution: Installation of new mv feeders or feeder interconnections transfer of load to adjacent networks conversion of existing OH conductor to UG cable.



Transmission Thermal Overload

Issue: Load exceeds equipment rated capacity
Where: Transmission network
When: Dependent on the location / type of load supplied. Most common is during evening peak load period.
Potential Impact: Equipment failure. System stability issues. Increased safety risk due to clearance issues caused by excessive overhead conductor sag etc.
Network Solution: Uprating or installing a new transformer or transmission lines to increase the rated capacity.

Network Reliability

Issue: Customers loss of supply due to fault event
Where: Can occur anywhere in the SWIS
When: Most common during period of extreme weather or seasonal environmental factors
Potential Impact: Customer experience loss of supply. Reliability impact, financial penalties and reputational damage
Network Solution: Distribution network re-configuration. OH to UG conversion. Installation of additional feeder interconnections MV or LV Emergency response generators.

Figure 4. Typical Network Investment Triggers

Distribution MV Under-Voltage

Issue: Voltage levels below acceptable levels.
Where: Typically, long MV feeders where load is significant distance from the substation
When: Most common during peak load periods
Potential Impact: Non-compliance - may cause network and/or customer equipment or appliances to malfunction and result in damage. Customer complaints and reputational damage
Network Solution: Installation of voltage regulators, capacitor banks, or other reactive power compensation equipment. Installation of additional feeder interconnections.

Distribution LV Voltage

Issue: Excess load or generation causing voltage to be outside the prescribed range
Where: LV network
When: Can occur during peak load (under-voltage) and low load (over-voltage) periods
Potential Impact: Non-compliance. Disconnection of customer DER connections. Damage to customer equipment / network apparatus.
Network Solution: Distribution transformer fixed tap setting changes LV network re-configuration. Converting OH conductor to UG cable. Upgrading or installing additional distribution transformers.

Distribution MV Over-Voltage

Issue: Localised excess generation from high DER penetration causing voltages to exceed acceptable limits.
Where: MV distribution network
When: Typically, during periods where the load levels are relatively low, and the solar resource is high.
Potential Impact: Technical Rules non-compliance. Curtailed DER generation under inverter autonomous response
Network Solution: Installation of reactive power compensation equipment

Distribution LV Thermal

Issue: Load growth (new connections or increased demand) causing load levels to exceed the rated capacity of the lv network and/or the distribution transformer.
Where: LV transformer and/or LV network
When: Typically, during peak load. Season depends on location.
Potential Impact: Network apparatus failure.
Network Solution: Upgrading or installing additional distribution transformers. LV network re-configuration Replacement of overhead conductor with underground cable.

3. The role of Distribution Storage

As the technology has matured and costs have reduced, distribution storage has become an increasingly viable option when compared to traditional network investments due to the potential benefits and value streams listed in section 1.5. This chapter will consider how distribution storage could address each of the network investment triggers identified in chapter 2.

3.1 Addressing Thermal Overload

Thermal overload can occur on the transmission and distribution networks, most commonly in the evening (between 5pm-8pm) on peak load days. The number of days and timing this occurs is location specific, but typically only occurs for a few days per year during an extended period of hot or cold weather.

Figure 5 shows an example peak day load profile as seen by a MV feeder exit cable on the MV distribution network. The area shaded orange indicates that the load is above the required rating of the cable and a response is required to maintain load within acceptable levels. The traditional network response often seeks to address an issue which occurs for a small percentage of the time.

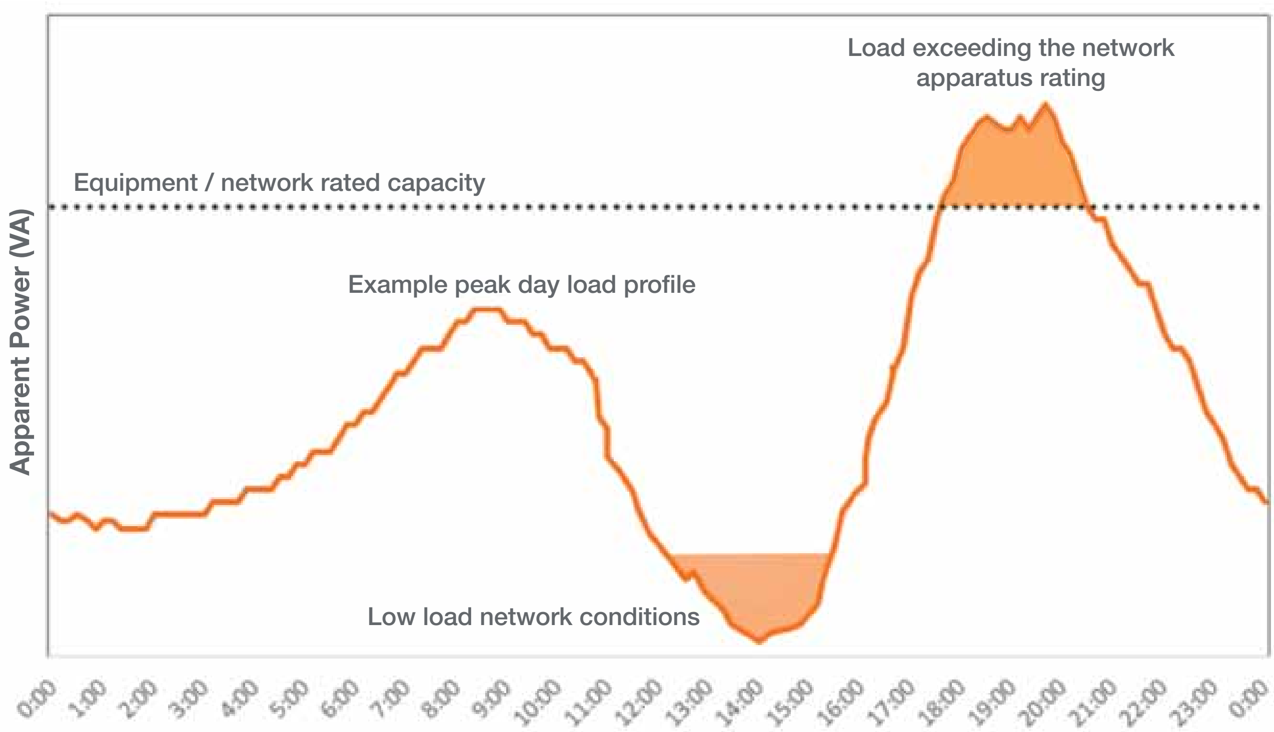


Figure 5. Example Peak Day Load profile

In the example above, distribution storage located downstream of this constraint could discharge power onto the network between 17:00-20:00 to reduce the load below the exit cable's rated capacity to give the effect as shown in Figure 6.

This principle can be also applied to address transmission and LV network thermal overload issues. To this effect, Western Power's community storage trials have been undertaken to defer costs associated with upgrading existing Distribution transformers which are in otherwise in good working condition. These battery storage solutions, which are connected on the LV network downstream of the transformer, operate on a daily cycle where they charge (import) Real Power during low load periods and discharge (export) during peak conditions.

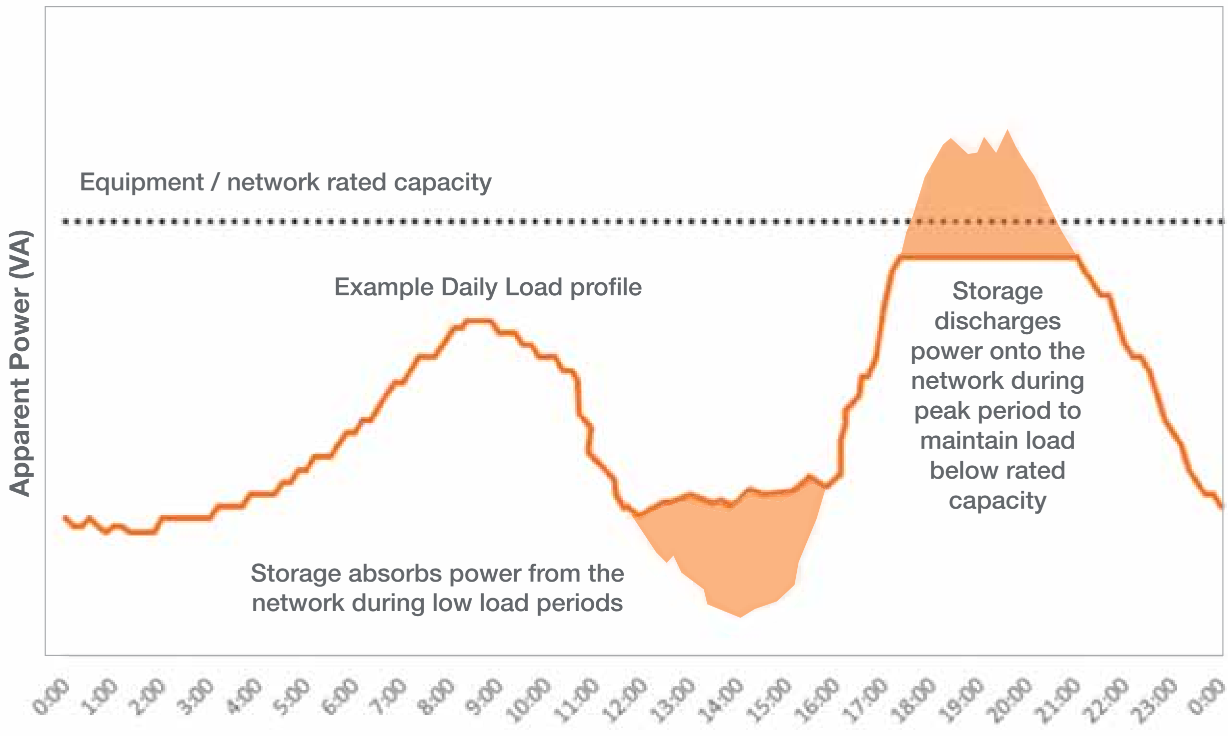


Figure 6. Example peak load day with downstream Distribution Storage

3.2 Assisting with Network Voltage Constraints

3.2.1 Transmission Voltage Issues

Western Power is obligated to manage the network to maintain Transmission network voltages (including voltage step changes resulting from switching) within limits prescribed in the Technical Rules. Abnormal network configurations (due to planned or unplanned outages) and/or changes to the network topology (new connections, load growth, DER connections etc) over time can result in the voltage for that area exceeding the prescribed limits and requiring augmentation. This can occur during both low-load and peak load conditions.

The traditional network response to rectify these issues (like the thermal overload issues) only addresses issues which occur for a very small percentage of the year. Storage located on the local distribution network has the potential to alter the load profile, provide Real and/or Reactive Power support to assist in maintaining voltage within prescribed limits.

3.2.2 Distribution MV Voltage Issues

3.2.2.1 MV Over-Voltage

Over-voltage on the MV network is becoming increasingly common during periods of low load due to excess local generation from DER connections, predominately Customer's rooftop solar. This issue is most common in the Perth metropolitan region due to higher levels of PV penetration, however it can also occur in regional areas.

Substation and distribution transformers tap settings can be adjusted to cater for ranges of voltages but when the tap options are exhausted, an additional response is required. This may involve installing Reactors to absorb excess reactive power and reduce the voltage levels. Distribution storage installed on MV networks with high DER penetration and charged at the appropriate time could be used to absorb the excess generation, reduce reverse active and reactive power flow and maintain voltages within acceptable limits.

3.2.2.2 MV Under-Voltage

Maintaining the voltage within the prescribed limits at both the substation and load end can prove challenging on long MV feeders. A MV feeder may need to be "boosted" several times via multiple voltage regulators in series to maintain the supply within the designated range as illustrated in Figure 7.

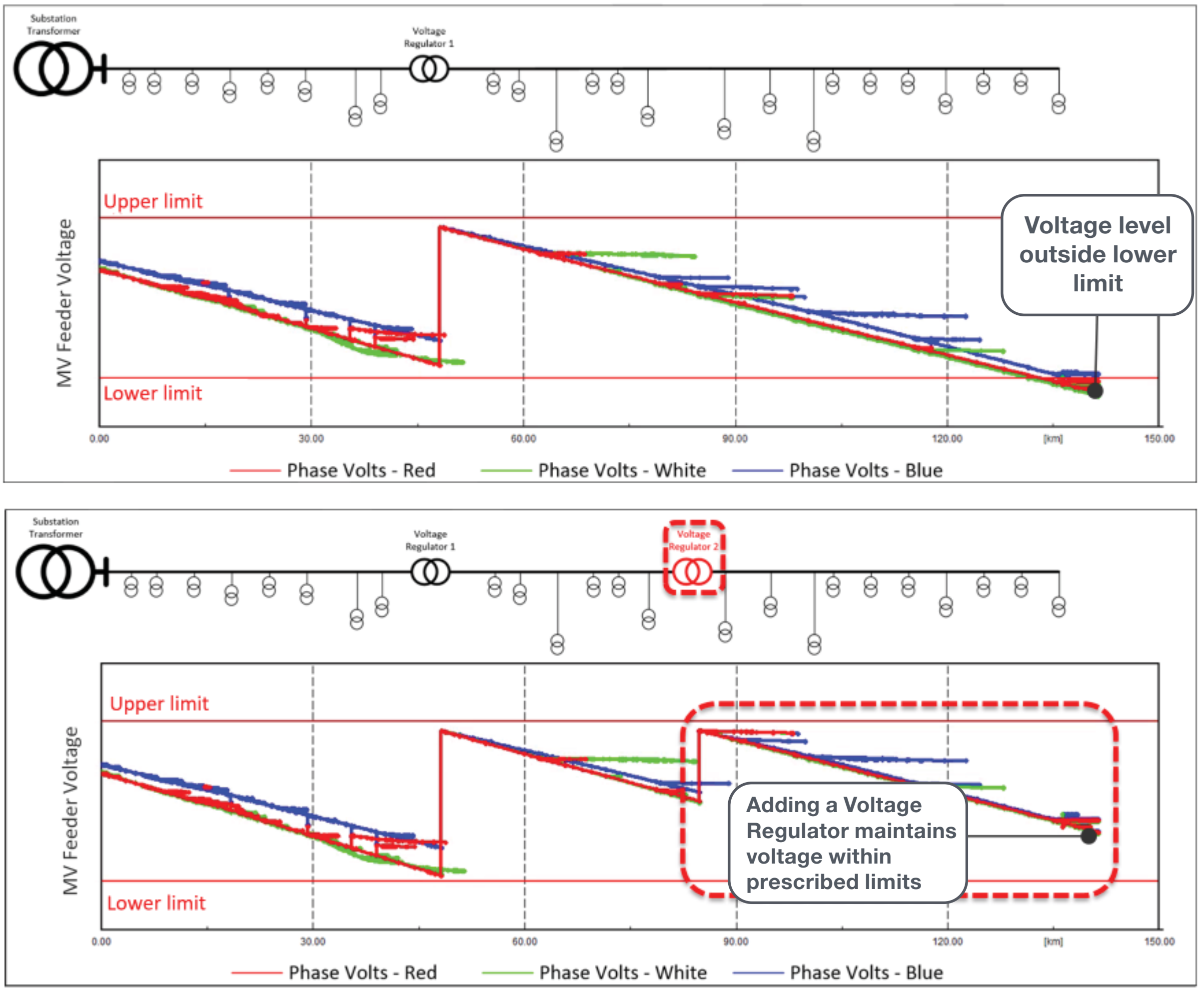


Figure 7. Example Voltage Profile of a Long MV Feeder

Failure to address this issue may cause Customer's electrical equipment or appliances to malfunction resulting in an inability to supply their loads, leading to a poor Customer experience and reputational damage.

Distribution storage located along the feeder and discharged at the appropriate time could reduce the amount of forward active and reactive power flow along the feeder, reducing line losses and maintaining acceptable voltage levels.

3.2.3 LV Voltage

LV networks were historically designed to facilitate one-way power flows from the source (network) and the load (customer). In recent times, they have been exposed to high degree of voltage fluctuations as DER connections have changed the way power flows on the SWIS.

LV voltage issues can occur during peak load periods (under-voltage caused by peak demand) and low load periods (over-voltage caused by high penetration of PV) on the same LV network. Storage located on the LV network has the capability to balance the local load and DER generation to ensure a compliant voltage can be delivered to customers and avoid the autonomous curtailment of solar generation due to localised voltage conditions.

3.3 Using Storage to Improve Network Reliability

When a fault event occurs on the network, Western Power crews will rectify the event as safely and efficiently as possible. In some cases, however, the power cannot be restored for an extended period. In these instances, and if affected customers cannot be restored via an alternative supply, they will experience an outage.

This issue can be magnified in remote rural towns on the SWIS which are often supplied via long radial powerlines which are exposed to inherent environmental factors (such as dust or saline pollution) or extreme weather conditions and contain no alternative supply. Traditional network investments such as installing new interconnections or replacing overhead network with underground cable can be costly.

Distribution Storage installed in these towns can provide an alternative supply to improve reliability performance and in turn, the improve service provided to our Community. An example of this is the 1MW, 1MWh BESS installed at the town of Perenjori, see figure 8 below. When a fault occurs upstream of the town on the incoming MV feeder, automatic protection devices isolate the township and the BESS supplies power until either the network can be restored or the BESS runs out of capacity.

Figure 8. Network Reliability Battery installed at Perenjori, WA

3.4 Using storage to enable Asset Rationalisation

Another potential application of distribution storage is enabling asset rationalisation. This concept involves rationalising end of life (EoL) assets (typically transmission assets which are more costly to replace and maintain) to ensure they meet the forecast requirements whilst minimising life-cycle costs.

For example, a substation containing multiple power transformers may require one to be replaced due to it approaching EoL. Removing the transformer from service without replacing it would reduce the substation capacity beneath the peak demand forecast, leading to thermal overload issues on the remaining transformers.

However, if the peak demand forecast for the substation is flat or declining replacing the transformer may result in a rated capacity well above the forecast peak demand and may not be the optimal investment decision. An alternative option may be to utilise distribution storage to reduce and maintain the peak demand below the reduced substation capacity.

This example is demonstrated in Figure 9. In Option A, the EOL asset is replaced with an asset of identical capacity thereby maintaining substation capacity despite the declining peak demand forecasts. In Option B, distribution storage is deployed to reduce the peak demand beneath the rated capacity and the replacement is avoided. In this scenario, distribution storage avoids the replacement and maintenance costs of a new power transformer by discharging power at peak times.

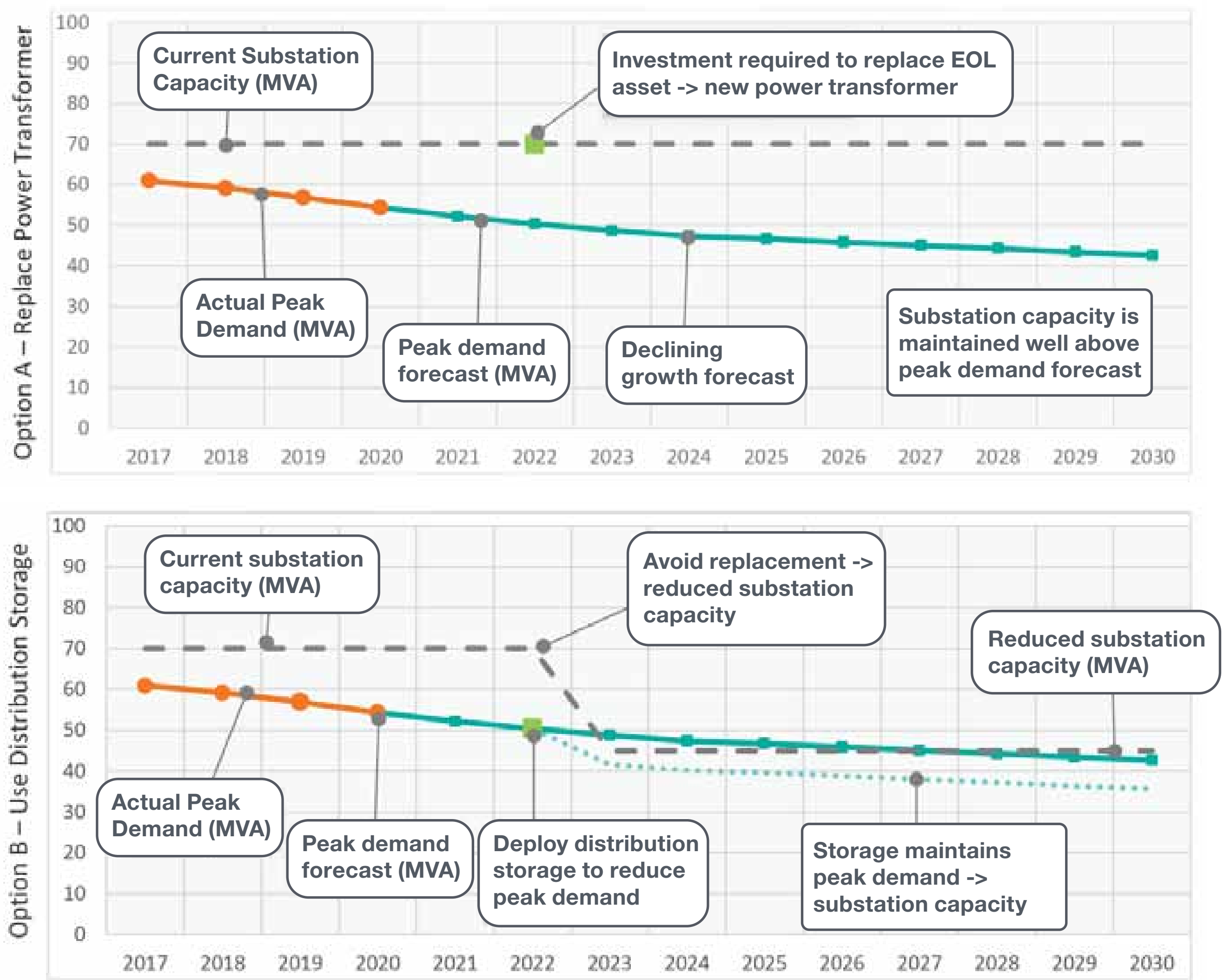


Figure 9. Using Storage to enable asset rationalisation

2. brighterenergyfuture.wa.gov.au/whole-of-system-plan/

3. westernpower.com.au/community/news-opinion/the-tool-changing-our-energy-future/

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3.5 Use of distribution storage to address multiple network drivers

A key advantage of distribution storage as compared to traditional network investments is the ability for a single installation or service to potentially provide multiple network benefits. For example, a number of LV connected storage facilities on a single MV feeder could not only overcome thermal distribution transformer constraints, but also assist in mitigating thermal constraints on the MV feeder.

This concept could potentially be extended to address transmission constraints too. This layering of network benefits makes distribution connected storage a very attractive proposition from a network perspective, however in reality these co-incident constraints do not materialise at the same instant.

To identify where these value stack opportunities may occur in the future, Western Power is seeking to use its Grid Transformation Engine (GTEng). GTEng is a cutting-edge planning tool that allows for multiple scenarios around future power needs and use over the longer term.

It processes complex and wide-ranging data including population and demographic predictions, economic forecasts, customer needs and profiles, and energy generation to create views and forecasts of different scenarios, and then assess what infrastructure is needed to transition to that scenario.

The four scenarios utilised for the inaugural Whole of System Plan (Double Bubble, Techtopia, Groundhog Day and Castaway) are those developed by Western Power from GTEng. For a given scenario, GTEng can identify where and when a network constraint will arise. Using this information, we can strategically place storage where it will address a localised constraint (e.g LV voltage or overloaded DSTR), and when grouped with multiple installations or services, also potentially alleviate a current or future constraint on the MV and/or transmission network. Further information on GTEng can be found on the Western Power website.

Figure 10 illustrates how the value stack can be realised. In this example, multiple LV connected storage units are connected on the same MV feeder. Each unit can address the local LV constraint (defer the DSTR upgrade and rectify LV voltage issues) while simultaneously addressing the upstream MV and transmission network thermal overload and voltage constraints. A similar concept also applies for MV connected storage, though due to its location, is not able to claim the LV benefits.

Distribution Storage Network Support Value Stack

- Transmission Voltage (HV)
- Transmission Thermal Overload (HV)
- Medium Voltage (MV) Network Thermal Overload
- Medium Voltage (MV) Network Over Voltage
- Medium Voltage (MV) Network Under Voltage
- Low Voltage (LV) Network Thermal Overload
- Low Voltage (LV) Network Voltage

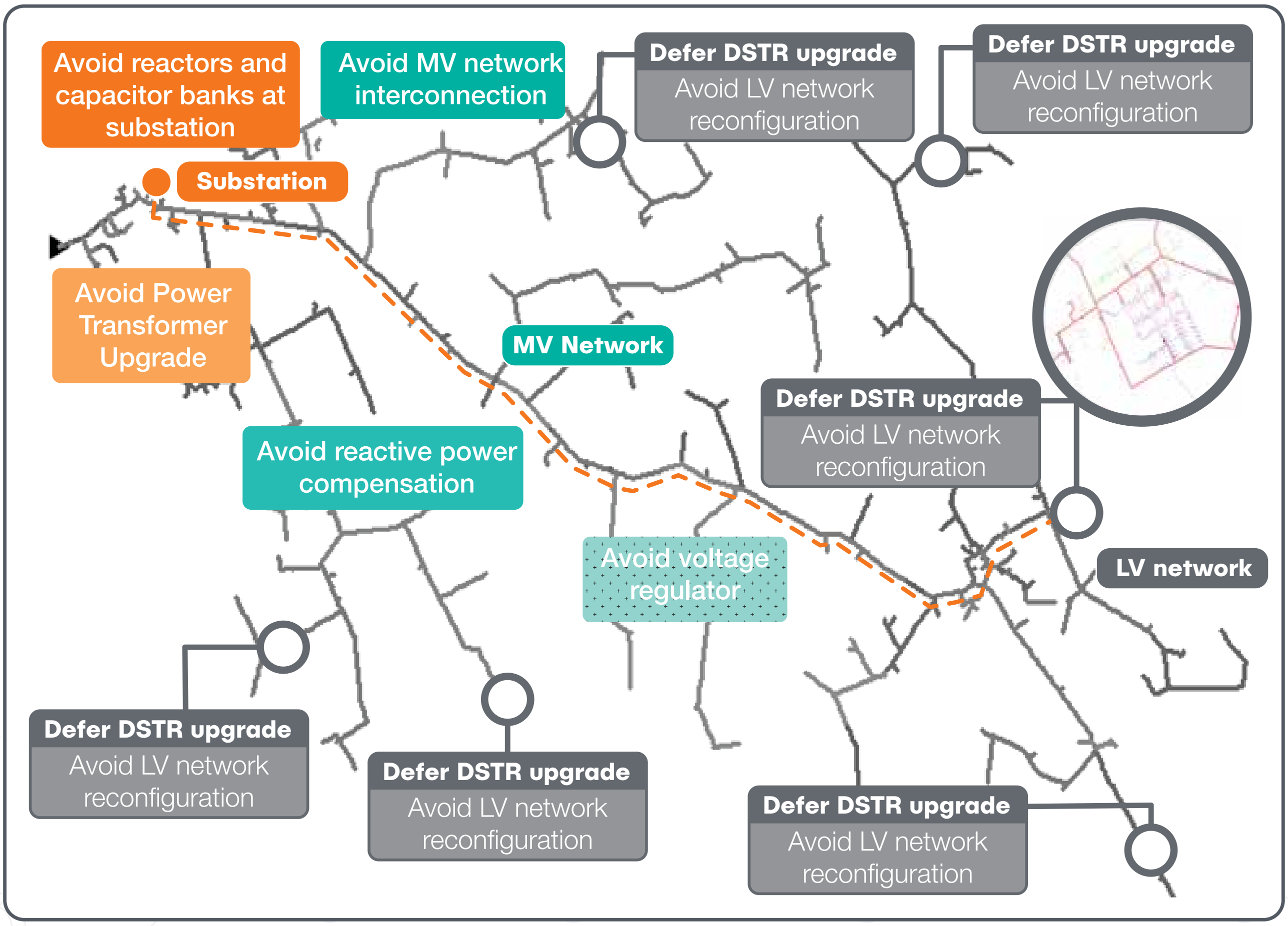


Figure 10. Example Distribution Storage Network Support Value Stack

4. Distribution Storage Opportunities

4.1 Basis of Identification and Potential Opportunities

Opportunities for storage as an alternative to network augmentation will be identified by understanding the ability of existing network apparatus to support load forecasts. The preferred solution (distribution storage or traditional network investment) will be determined through detailed cost-benefit assessment.

Indicative locations of possible future network constraints where storage could be an alternative to conventional network augmentation are shown in Figure 11 and Appendix A. When the need to address a constraint is confirmed by Western Power, identified distribution storage opportunities will be released to registered Vendors through a commercial process (via Western Power website) in the form of an expression of interest (**EOI**), Request for Proposal (**RFP**), or Request for Tender (**RFT**).

4.2 Changes to the Access Code

The Energy Transformation Strategy highlighted required changes to the Electricity Networks Access Code (Access Code) to support the delivery of the Distributed Energy Resources workstream. Two of the key changes recently gazetted related to distribution storage are the Alternative Options Strategy and the Network Opportunity Map.

4.2.1 The Network Opportunity Map

Changes to the Access Code require Western Power to publish an annual Network Opportunity Map (**NOM**) as part of its non-network solution obligations. This map will provide greater transparency and opportunity for 'alternative options' service providers to provide a contracted service with their equipment to address network capacity constraints. The NOM will provide greater detail on the locational opportunities for alternative options (including storage) over both the short term and longer term.

The first iteration of the NOM is expected to be released 1st October 2021.

4.2.2 Alternative Options Strategy & Vendor Register

The alternative options strategy will set out how Western Power will engage with alternative solutions providers and consider non-network options for addressing system limitations. A vendor register is an engagement facility by which parties can register their interest in being notified of developments related to distribution network planning and expansion, and associated opportunities to provide a network support service (defined as Alternative Options Service in the Access Code).

Western Power will seek and record vendor interest via establishment of a vendor register for future storage opportunities. The first alternative options strategy is expected to be released 1st October 2021.

4.3 The Community Battery Preferred Vendor Panel

In 2019, Western Power invited parties to provide storage solutions as part of the Community Battery Preferred Vendor Panel. The aim of the panel was to streamline the process for where Western Power procures and installs storage when deemed the optimal investment decision. The panel has been structured such that it can be reviewed annually to enable additional product or service providers can become involved. For more information about how to be considered for the panel in the future, please keep an eye on the Western Power website.

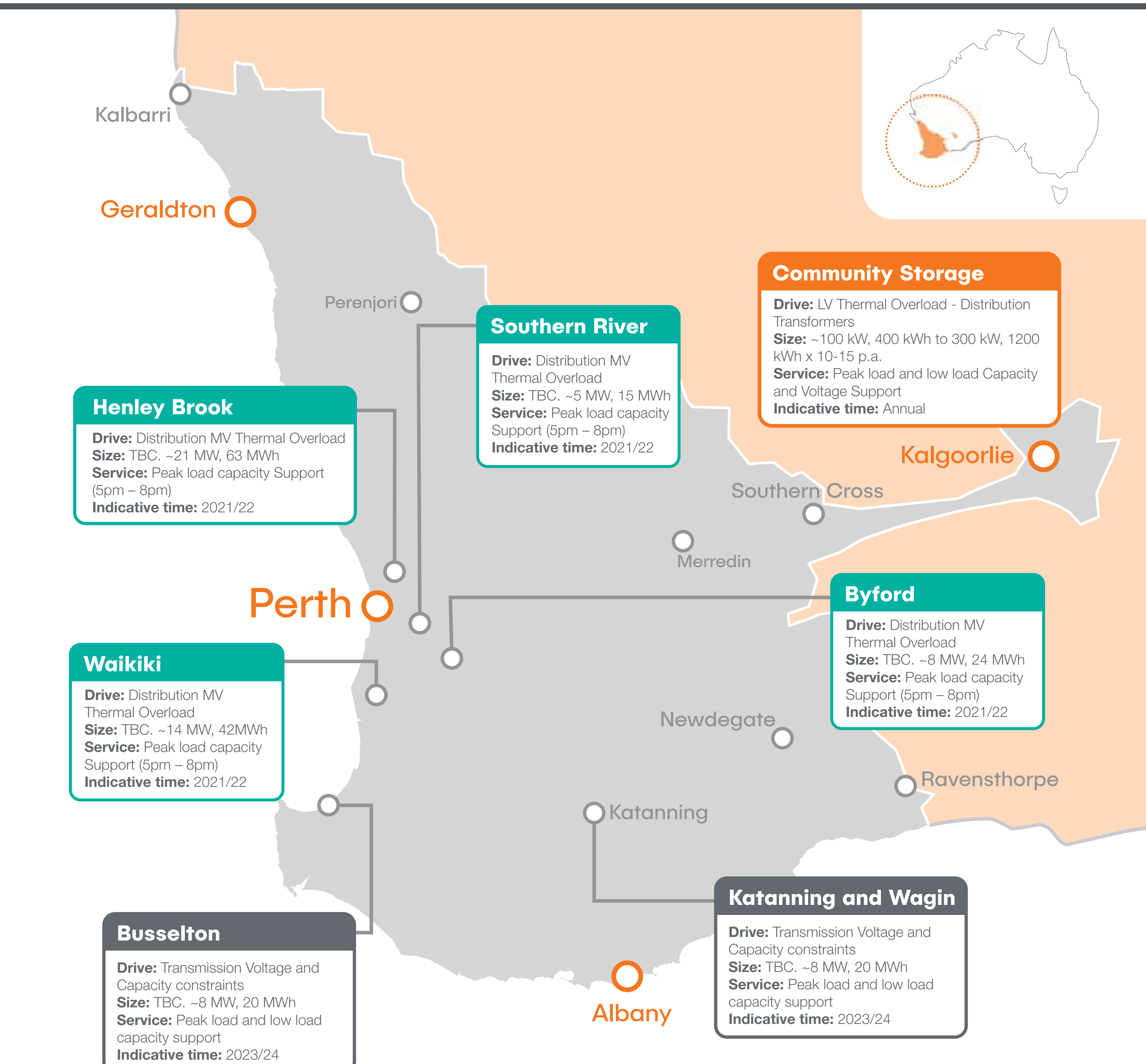


Figure 11. Indicative Distribution Storage Opportunities Map

5. Other considerations

When each storage opportunity is released to market, so too will the detailed requirements and parameters for that specific service or installation. This section will highlight some of the key considerations a product or service provider should consider when connecting to the SWIS.

5.1 Load Forecasts

Load forecasts which underpin Western Power's investment plans are revised on an annual basis. In some situations, forecast growth does not materialise at the rate previously expected; in a similar manner we could forecast zero or negative growth and it accelerates. Though Western Power is continually endeavouring to forecast where network constraints may emerge well in advance, unforeseen growth may necessitate response by Western Power outside of this process.

5.2 Safety & Environmental

At Western Power we pride ourselves on the way we respect and take care of each other and our community; key to this is our Safety First value. It's non-negotiable - put simply, if it's not safe we don't do it.

Western Power will only engage in products and services which have been subjected to robust risk management processes and can demonstrate risks are managed to ALARP. We expect product design to ensure inherent safety and apply human factor considerations to the associated installation and maintenance requirements. As a minimum, the delivery of services must be in accordance with Western Powers Safety, Health and Environmental requirements for Contractors and the related Health and Safety management procedures.

In addition to site specific environmental management measures, general environmental considerations for distribution storage include asset placement and retrofitting within established urban areas and communities, management of soil and groundwater impacts, noise emittance and associated abatement measures, fire risk management including hazard separation, visual amenity land impact, noise emittance, fire risk, and end of life recycling are all crucial components in the design and planning of distribution storage options across the network.

Western Power's environmental management procedures and guidance notes, including the Safety, health and environment requirements for contractors guideline outline Western Power's expectations when planning a distribution storage project. With an emphasis on sustainable delivery of whole system optimisation, it is an expectation that the aforementioned considerations will accompany distribution storage proposals presented to Western Power.

5.3 Technical Requirements

The technical requirements of each opportunity will be specific to the site and the service / product being offered. The items listed in this section are generic and may not be relevant to all applications.

5.3.1 Connection to the Network

The documents listed in Table 4 will form the foundation for any connection to the distribution network:

Document Title	Document Description
Distribution Construction Standards Handbook (DCSH)	The Distribution construction standards handbook is for both HV and LV of the overhead and underground system, including the street-lights.
Distribution Customer Connection Requirements (DCCR)	The Distribution customer connection requirements details network arrangements for both customer connections and the interconnection of substations to Western Power's LV/HV distribution network within the South West Interconnected Network (SWIN)
Distribution substation plant manual (DSPM)	The Distribution substation plant manual contains a suite of standard diagrammatic representation designs of Western Power plant and equipment within a specified land area (the distribution substation site)
Network Integration Guideline (NIG)	The Network Integration Guidelines details requirements for AS/NZS 4777 compliant Inverter Embedded Generator (IEG) systems based on the customer's connection arrangement from the Western Power network. It provides guidance on: • identifying the customer's network supply arrangement; • determining maximum IEG able to be connected to that current supply arrangement; • understanding what types of systems can be connected (PV, energy storage, other energy sources); and • identifying the correct requirements to be met
Safety, health and environment requirements for contractors	The Safety, health and environment requirements for contractors outlines our expectations of contractors.
Technical Rules	The Technical Rules are the technical requirements to be met by Western Power on the transmission and distribution systems and by users who connect facilities to the transmission and distribution systems.
Underground Cable Installation Manual (UCIM)	The Underground cable installation manual sets out the requirements for the safe and efficient installation of underground cables that are to be connected to our public distribution system.
Underground Distribution Schemes Manual (UDS)	The Underground distribution schemes manual (UDS) contains the information required by developers and their electrical consultants to allow them the undertake the electrical reticulation of new subdivisions.
Western Australian Distribution Connections Manual (WADCM)	The WA distribution connections manual is a comprehensive reference for industry and the community when seeking an electrical connection of a customer's installation to the distribution network of the SWIS.
Western Australian Electrical Requirements (WAER)	The WAER applies to all electrical installations, whether connected to distribution networks, transmission networks or stand-alone ('off-grid'), with operating voltages up to 330kV. The WAER sets out minimum requirements for all electrical installations in WA.

Table 4. Network Connection Documents

5.3.2 Battery degradation, lifecycle & state of charge

The required storage (instantaneous power and energy) will be for a specified location or point of connection. The product or service provider will need to determine how to best meet that requirement whilst considering the degradation of storage capacity over time, along with state of charge considerations to address each constraint

5.3.3 Emergency Conditions Requirement

Any product or service will need to comply with Emergency Conditions Requirements as prescribed by our Network Operations function. Western Power would likely require the ability to actively control the deployment of procured service via appropriate communications.

5.4 Procurement

Western Power is committed to working to ensure the highest integrity in relation to human rights. The manufacturing process of batteries is well known to include areas of high risk for modern slavery practices such as forced labour and the worst forms of child labour. So, as part of our procurement processes Western Power is committed to continually reviewing the suppliers partnering with us to provide community batteries and stand-alone power systems, to actively monitor and mitigate our shared risks.

6. Industry feedback questions

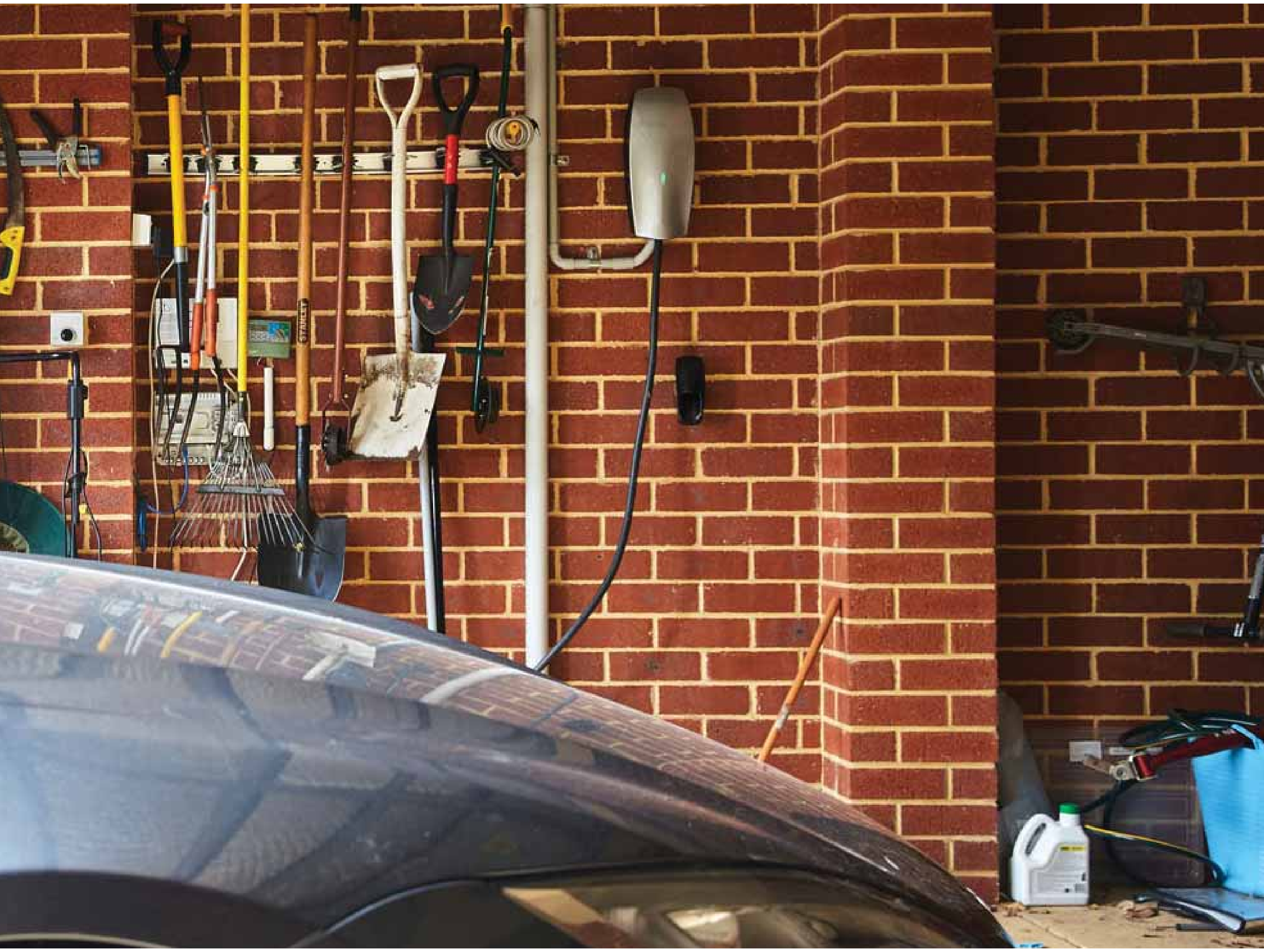
Western Power welcomes feedback on this information paper, in particular response to the following consultation questions. Please respond to the below email address prior to **15th January 2021**:
distributionstorage.infopaper@westernpower.com.au

Q1. What storage technologies do you have that could meet Western Power's needs? Which of the network needs outlined in this information paper can be met?

Q2. Of the value streams other than network benefits identified in section 1.5, would any service you provide to Western Power be dependent on accessing them and when?

Q3. What other information would you like to see from Western Power to help in enabling you to provide a storage offering for network support services indicated?

Q4. In what prospective time-frame can your business deploy storage solutions to Western Power?



Appendix A

Indicative Distribution Storage Opportunities 2021–2024

Opportunity	Network Investment Trigger	Proposed Traditional Network Investment	Targeted Benefit	
Community Storage	Overloaded Distribution Transformer (DSTR)	Upgrading the distribution transformer to higher capacity	Deferral of network augmentation	
Byford MV Feeder utilisation	MV Thermal overload	TBC work in progress – Typically, installation of new MV feeders or feeder interconnections	Avoid network augmentation	
Henley Brook MV Feeder utilisation	MV Thermal overload	TBC work in progress – Typically, installation of new MV feeders or feeder interconnections	Avoid network augmentation	
Southern River MV Feeder utilisation	MV Thermal overload	TBC work in progress – Typically, installation of new MV feeders or feeder interconnections	Avoid network augmentation	
Waikiki MV Feeder utilisation	MV Thermal overload	TBC work in progress – Typically, installation of new MV feeders or feeder interconnections	Avoid network augmentation	
Katanning and Wagin Load Area	Transmission Voltage and Thermal Overload constraint	6MVAr capacitor bank installed at Narrogin Substation	Avoid network augmentation	
Busselton Load Area	Transmission Voltage and Capacity constraint	Reactive compensation equipment at Busselton Substation	Avoid network augmentation	

	Estimated Storage Required	Required service	Storage Location	Expected Timing
	Estimated 10-15 locations per annum, ranging between: 100kW, 400kWh and 300kW, 1200 kWh	Full discharge capacity required for evening load during peak load days – typically 20 days per year	Various Locations identified annually based on previous utilisation and load forecasts	Annual program
	8MW, 24MWh	Capacity support required for evening load during peak load days – typically 10 days per year	Byford Distribution network	2021-2022
	21MW, 63MWh	Capacity support required for evening load during peak load days – typically 10 days per year	Henley Brook Distribution network	2021-2022
	5MW, 15MWh	Capacity support required for evening load during peak load days – typically 10 days per year	Southern River Distribution network	2021-2022
	14MW, 42MWh	Capacity support required for evening load during peak load days – typically 10 days per year	Waikiki Distribution network	2021-2022
	TBC – Indicatively: 8MW, 20MWh	Capacity support required for evening load during peak load days – typically 20 days per year	Katanning and Wagin transmission or distribution networks	2021-2022
	TBC - Indicatively: 8MW, 20MWh	Capacity support required for peak load days between 5-8pm. Typically 50 days per year (peak occurs during summer and Winter) Full charge capacity required for minimum load days to assist with voltage	Busselton and Margaret River transmission or distribution network	2022-2023

Notes

Notes

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