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Building energy resilient communities in an Australian distribution network

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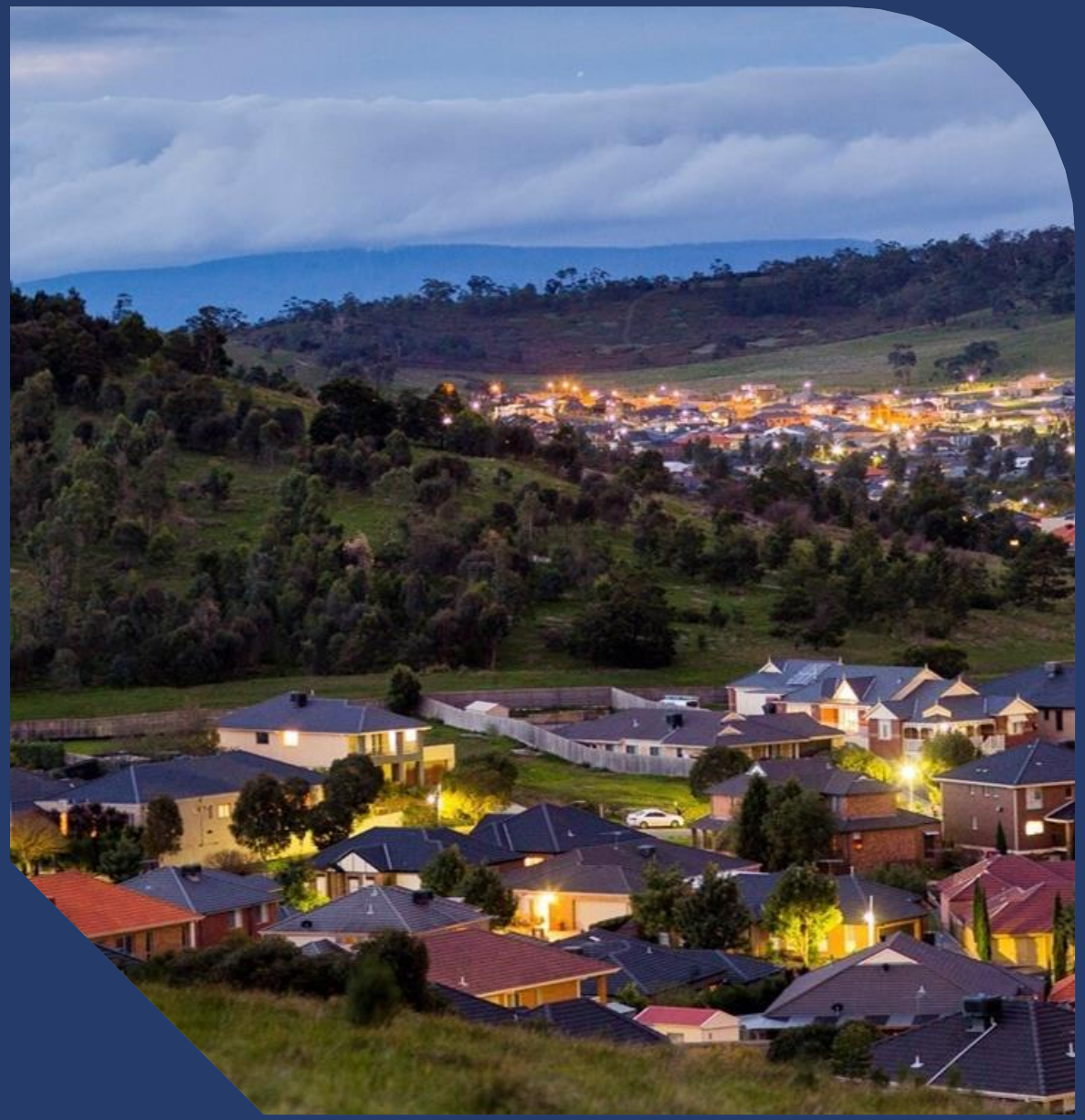
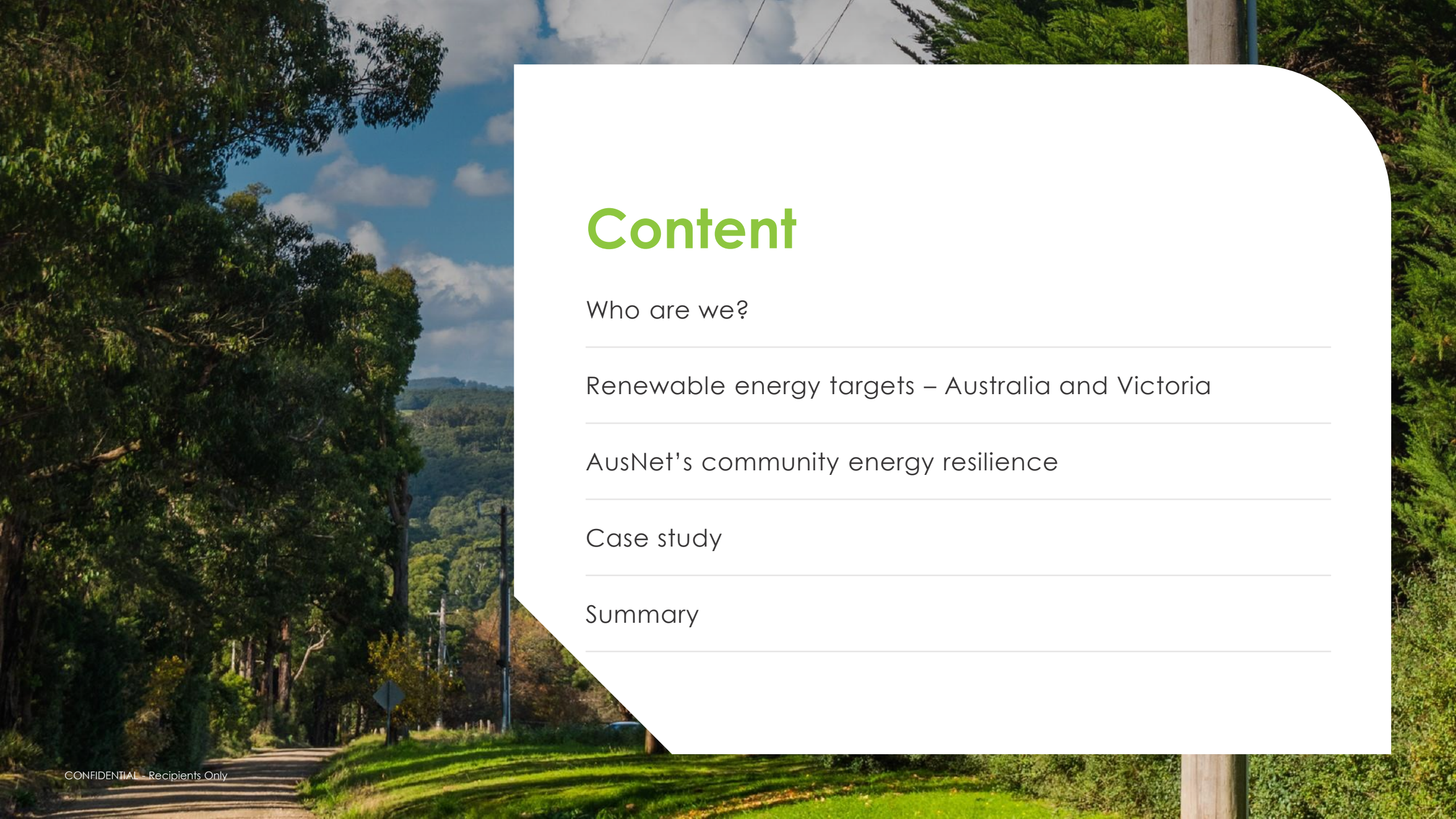
November 2022





Content

Who are we?
And what we do…

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We move energy

Electricity transmission

- 6,852 km of transmission lines
- ~227,600 sq km
- ~5.9m people or 2.1m households and businesses

- AusNet is the network operator and AEMO is responsible for network planning

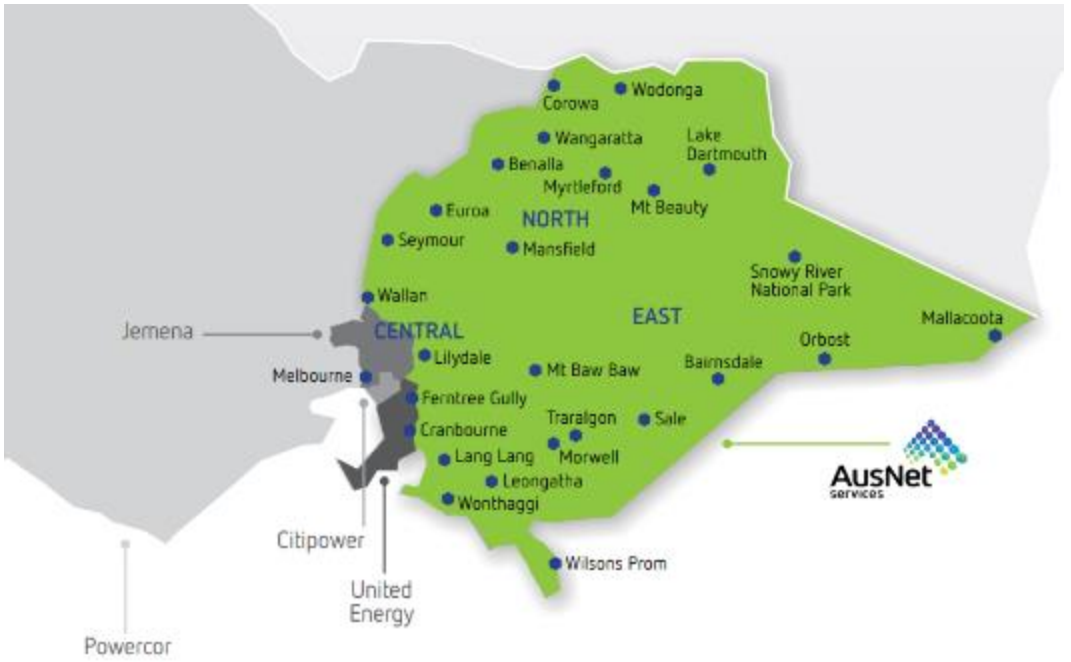
Electricity distribution

- 53,990 km of electricity distribution network
- ~80,000 sq km in eastern Victoria
- ~770,000 residential and business customers

- Primarily consists of overhead lines traversing rural areas

Gas distribution

- 12,384 km of gas distribution network
- 752,882 customers



768,460
Customers served

53,990km
Network line length

7,426GWh
Energy transmitted

333,725
Distribution poles

46,352km
Overhead conductors

7,585
Underground cables

62,049
Substation transformers

The energy supply chain

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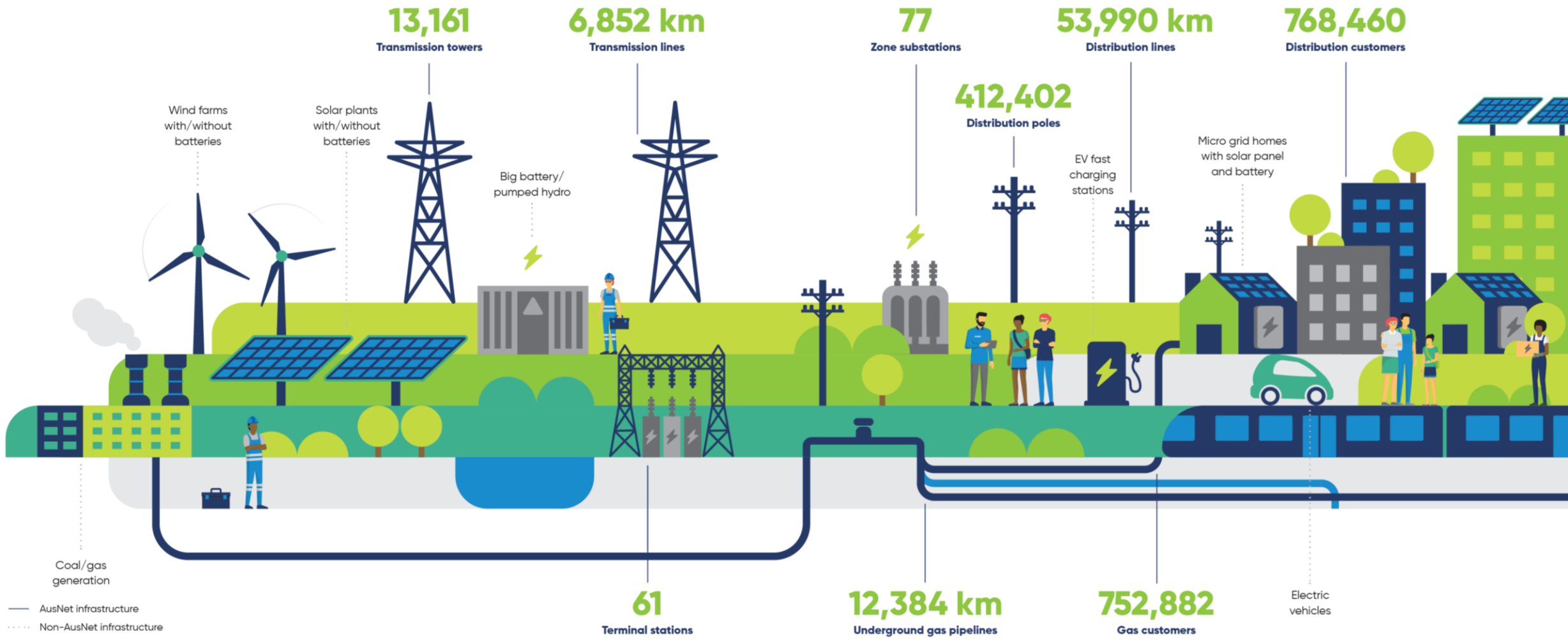


Note: Network data as at 31 March 2021

To reach net zero by 2050, we will need to rebuild the NEM

Magnitude of change is unprecedented

5x increase in distributed solar PV

NOW	2030	2050
15 GW	35 GW	69 GW

9x increase in grid-scale wind and solar

NOW	2030	2050
16 GW	44 GW	141 GW

2x increase in NEM electricity usage

NOW	2030	2050
180 TWh	184 TWh	320 TWh

Coal generation to be withdrawn

2030		2043
60%	→	100%

Gas-fired peaking plants to increase

NOW		2050
7 GW	→	10 GW

Storage capacity to increase by ~30x

NOW	2030	2050
2 GW	15 GW	61 GW

Source: AEMO 2022 ISP Step Change Scenario to 2050

Momentum is unstoppable behind net zero by 2050

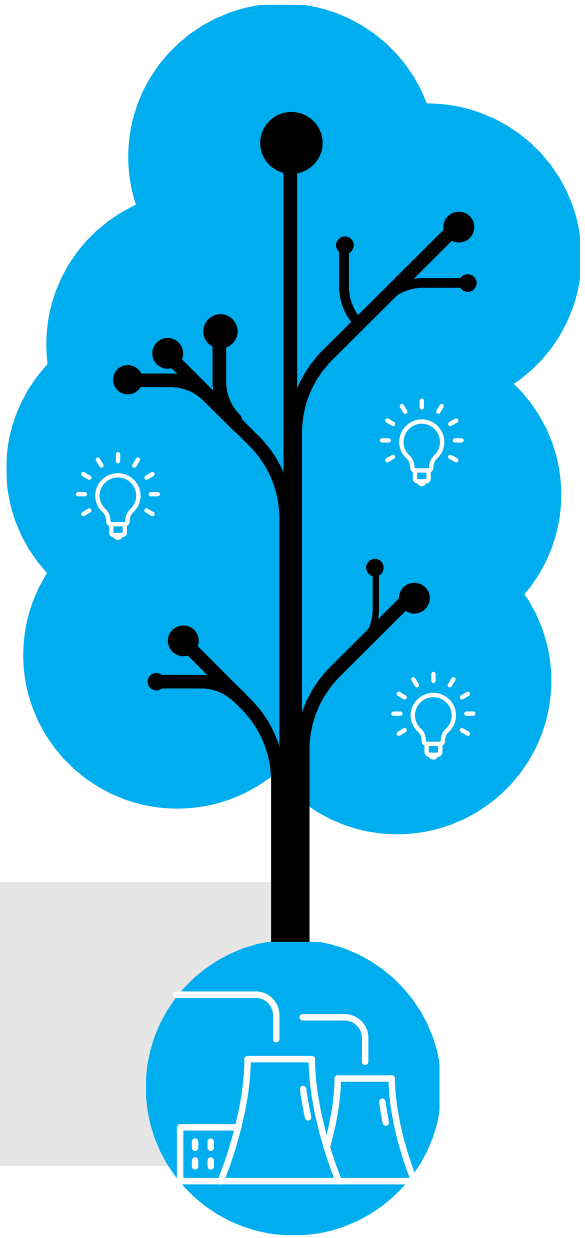
- Greater policy certainty is improving investor confidence
- Our networks will continue to play a critical role

Significant challenges remain

- Challenging operating environment expected to continue
- Recent market crisis highlights the need for an orderly transition
- High cost of living environment increasing scrutiny and regulatory oversight

The challenge

The existing Victorian network was built in and for another era.
Designed to support the one-way flow of energy.



Centralised energy flows in one direction from a small number of large generators to large number of consumers.

By 2032[1]

0%

of Victoria's coal fired generators will be operating.

1. Draft ISP 2022 – Step Change Scenario

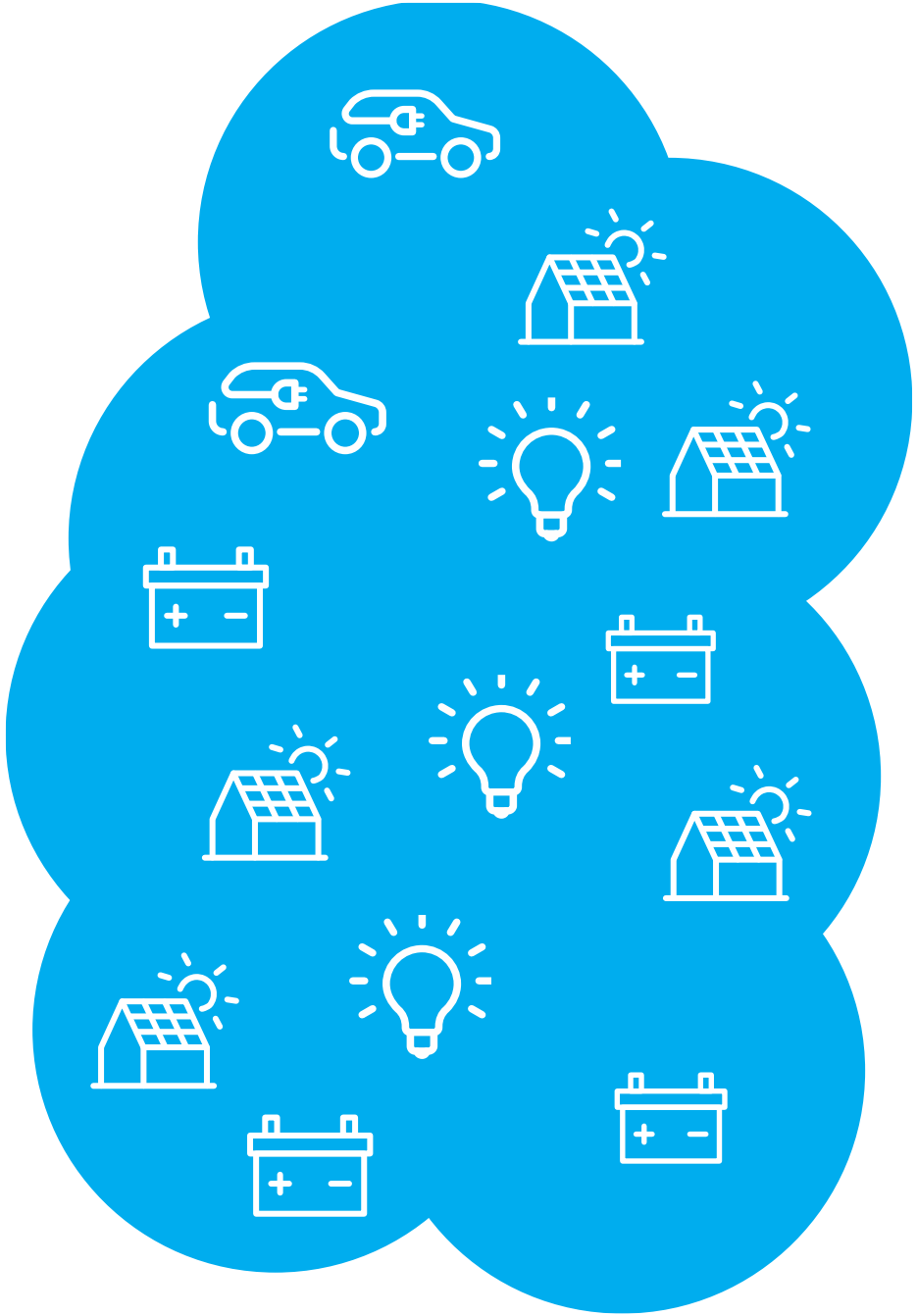
Changing demand

By 2050

Replacing gas and petrol consumed in transport, industry, offices and homes.

x2

Double the current demand levels.



x3

The amount of Distributed PV.

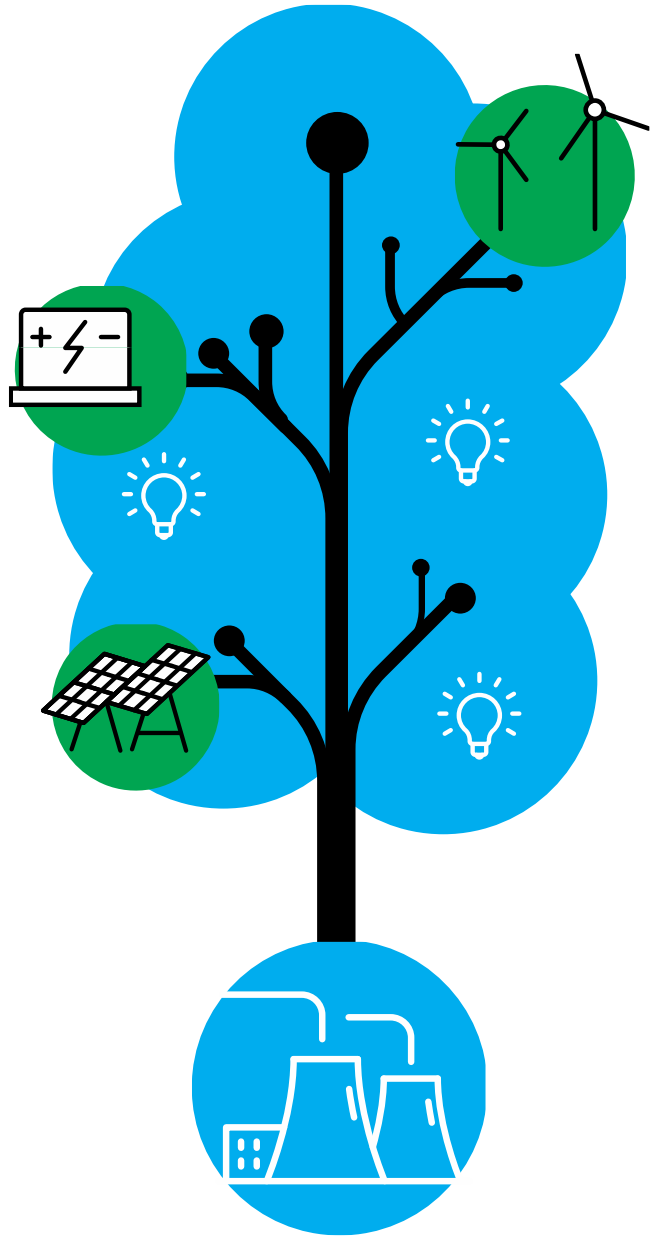
x10

The amount of Distributed storage.

Today

70% coal

~70% of Victoria's energy supply is from coal-fired generation.



The growth of large-scale renewable energy projects are already challenging the capacity of the existing Victorian network.

30%

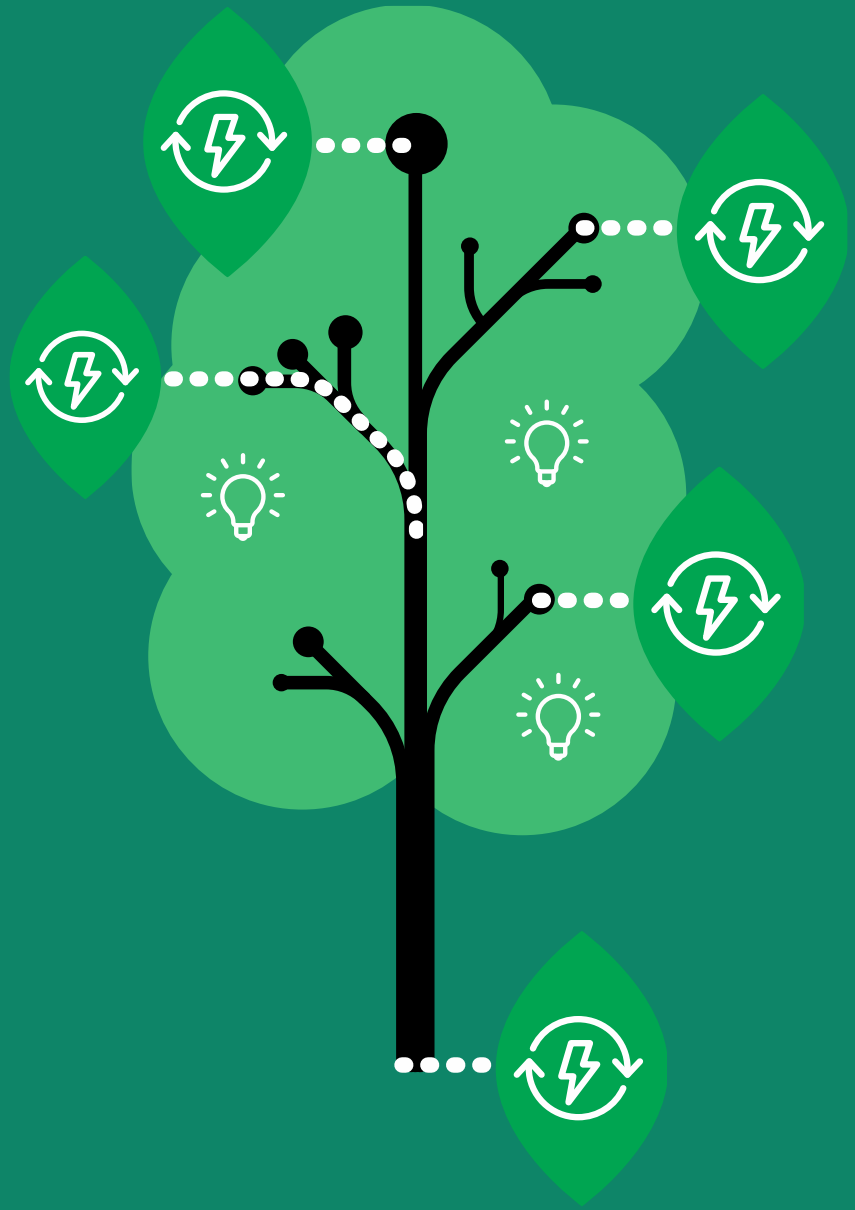
~27% of Victoria's current energy supply is renewable generation and 3% gas.

By 2032

100%

Renewable, gas or storage.

Victoria's energy ecosystem will comprise of complex integration in dispersed renewable generation, network and storage.



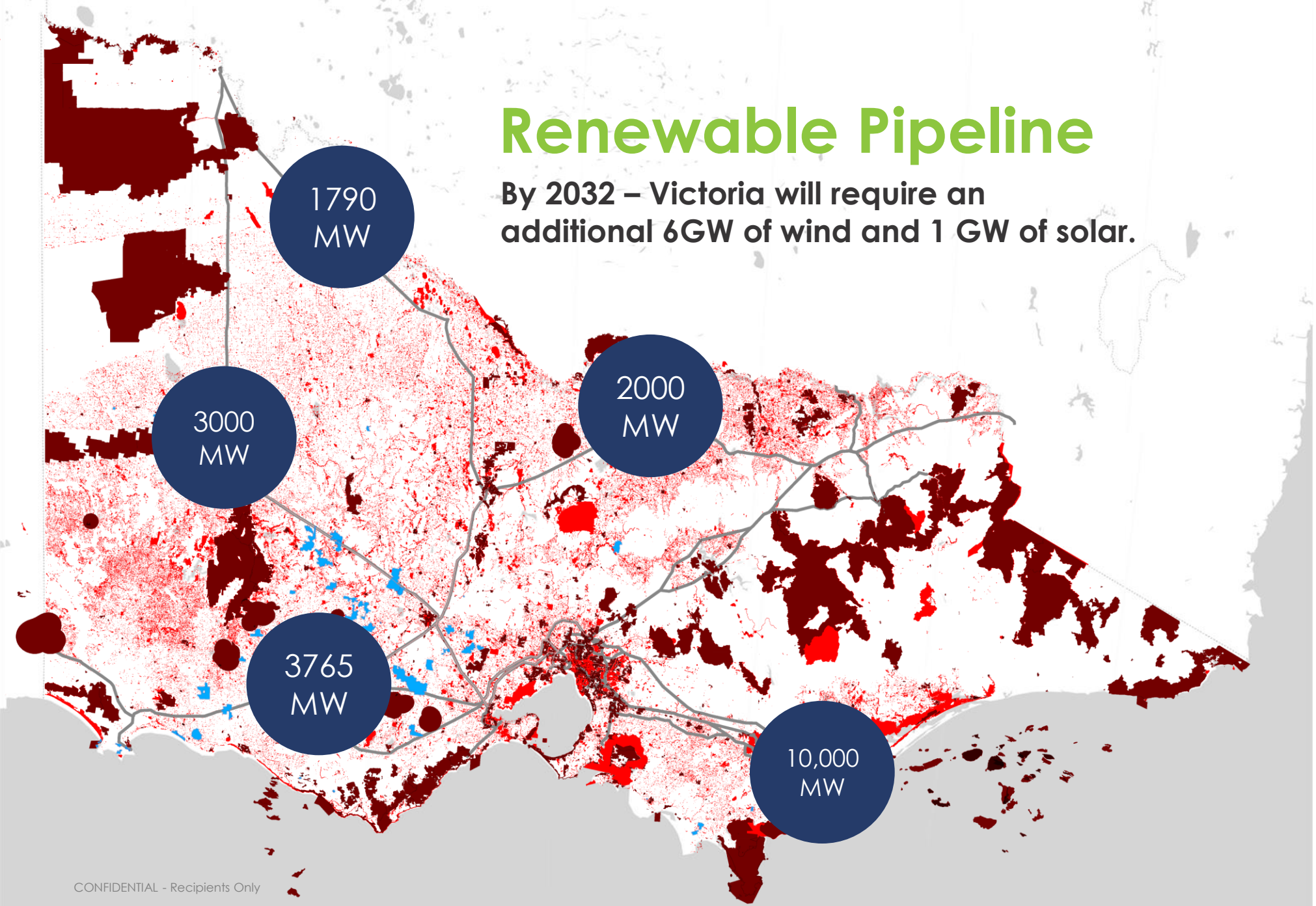
Renewable Energy Zones

Transmission connections

Energy demand

Renewable Pipeline

By 2032 – Victoria will require an additional 6GW of wind and 1 GW of solar.



Constraints

- Existing Wind Farms
- No-go zones
- Very high constraint

Opportunities

- Proposed projects

Our Vision

Building Energy Resilience in Regional and Remote Communities

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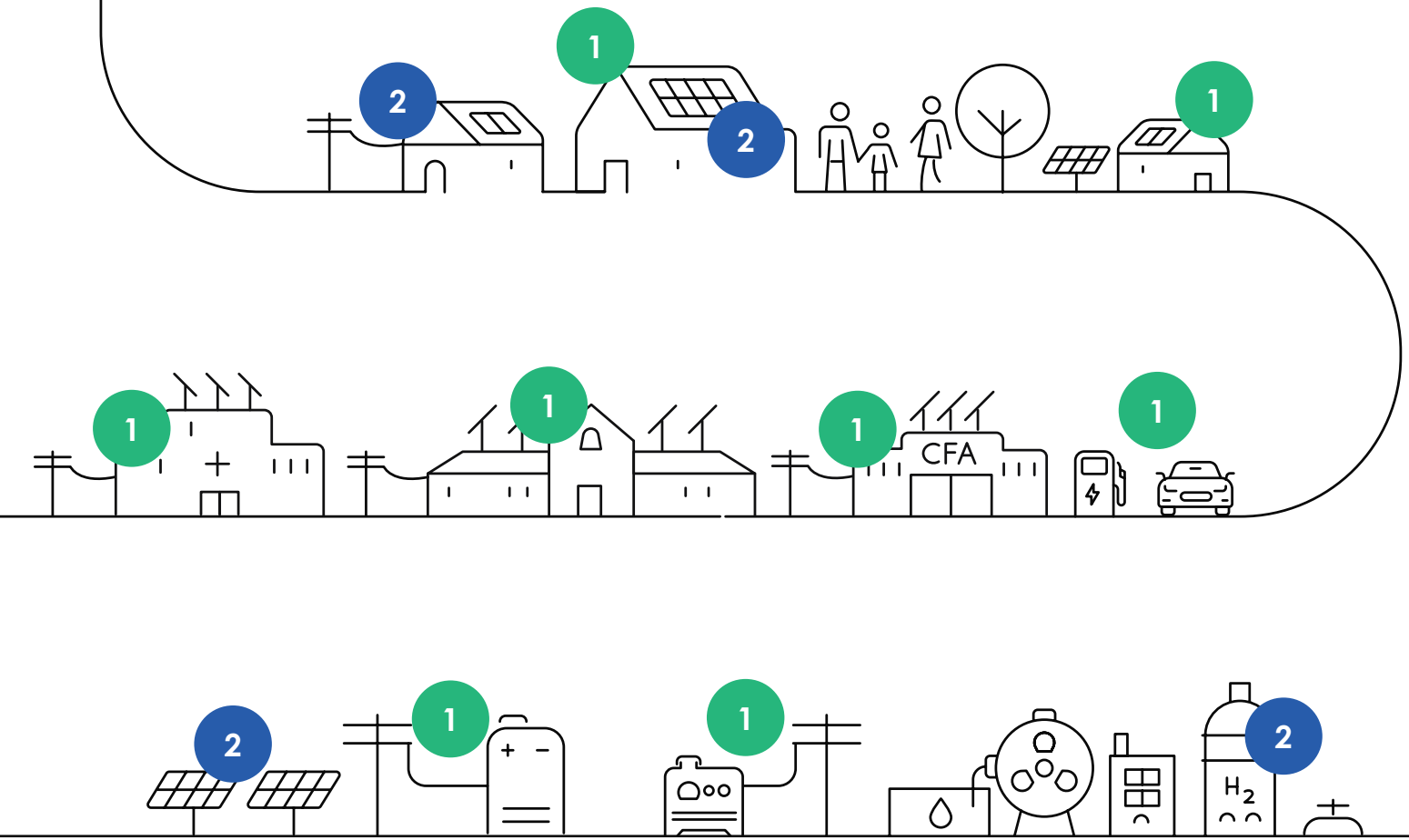


Phase 1 – Modernise Local Energy Grid

Build the energy infrastructure foundation and local capabilities to enable the transition and acceleration to energy self-sufficient communities through deploying:

- **Microgrid technology**
- **Stand-alone power systems**
- **Solar generation**
- **Battery Storage**
- **Electric Vehicle charging**

Phase 2 – Accelerate Local Generation

Incentivise investments in local generation and circular economy to accelerate journey towards 100% local generation

- **Alternative generation and storage options**
- **Energy Efficiency**
- **Integrate Energy and Transport infrastructure**

***Ultimate Goal**: Modernise energy systems using microgrid technology to create future "Smarthoods" within communities where circular flows of water, food and energy enable communities to be entirely self-sufficient, recycling water, materials and waste wherever viable.*

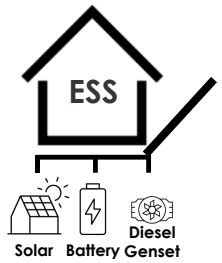
Community energy solutions

single to small hubs

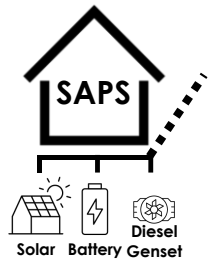
serving single homes or community facilities, or in small or isolated rural/urban fringe

Behind meter PV and battery

Individual households to commercial and industrial premises



Systems for LV customers comprised of solar &/ battery &/ diesel generators



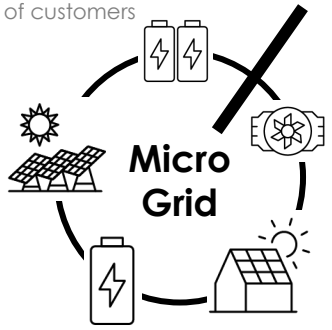
Stand Alone Power Systems (SAPS) Infront of the meter Off grid systems for LV customers

medium to large hubs

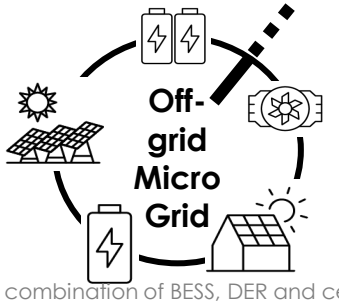
Town-scale solutions integrating single to small hubs with grid scale infrastructure

Grid Scale Storage (BESS)

Battery Storage supporting large clusters of customers



A combination of BESS, DER and central generators supporting large clusters of grid connected customers



A combination of BESS, DER and central generators supporting large clusters of off grid customers

A new approach

Benefits

- Reduced outage duration and frequency
- Potential to offer network support and wholesale market services (where orchestration or aggregation enabled)

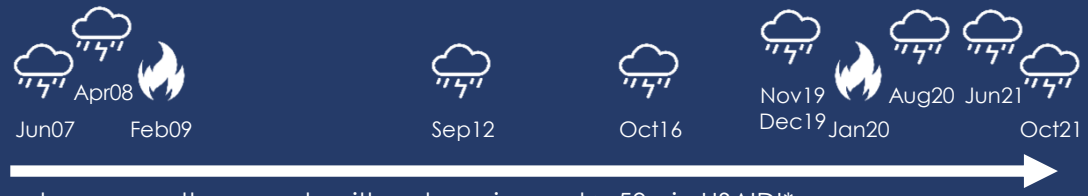
- Higher resilience to extended outages from extreme weather events
- Potential to offer network support and wholesale market services

- Higher resilience to extended outages from extreme weather events
- Reduce safety risk
- Potential to remove networks with high cost to serve

Extreme weather events are not new…

Responding to storms and bushfires is not new.

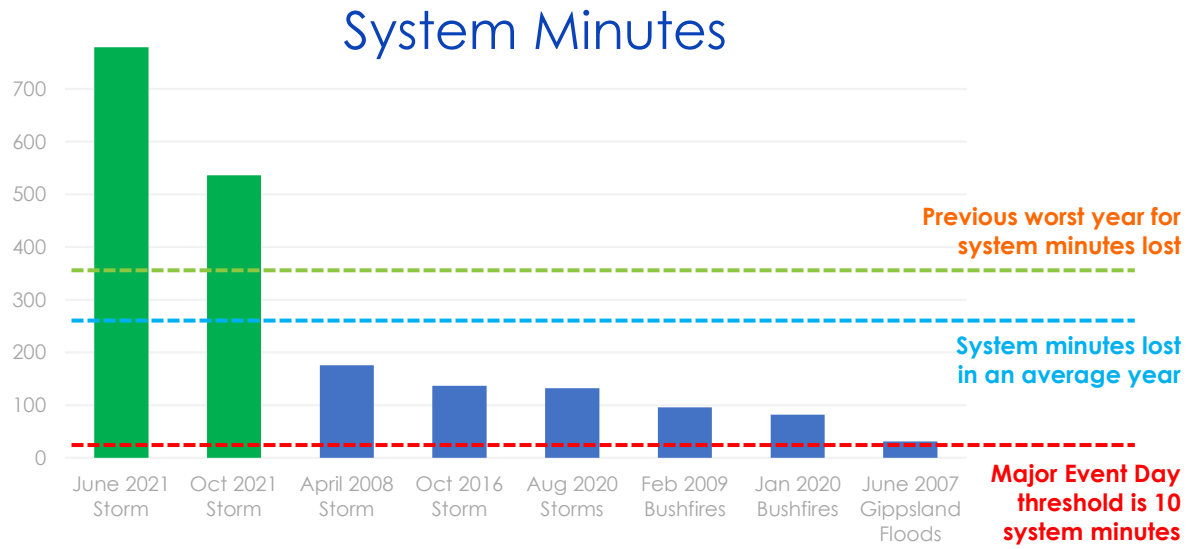
However, increased frequency and severity of recent weather events are leading to a review of whether new approaches can provide more resilience in energy supply.



extreme weather events with outage impact > 50min USAIDI* on AusNet network

* USAIDI = unplanned system average interruption duration index, or average interruption minutes that a customer is off-supply during a reporting period

… but they are increasing in frequency and severity

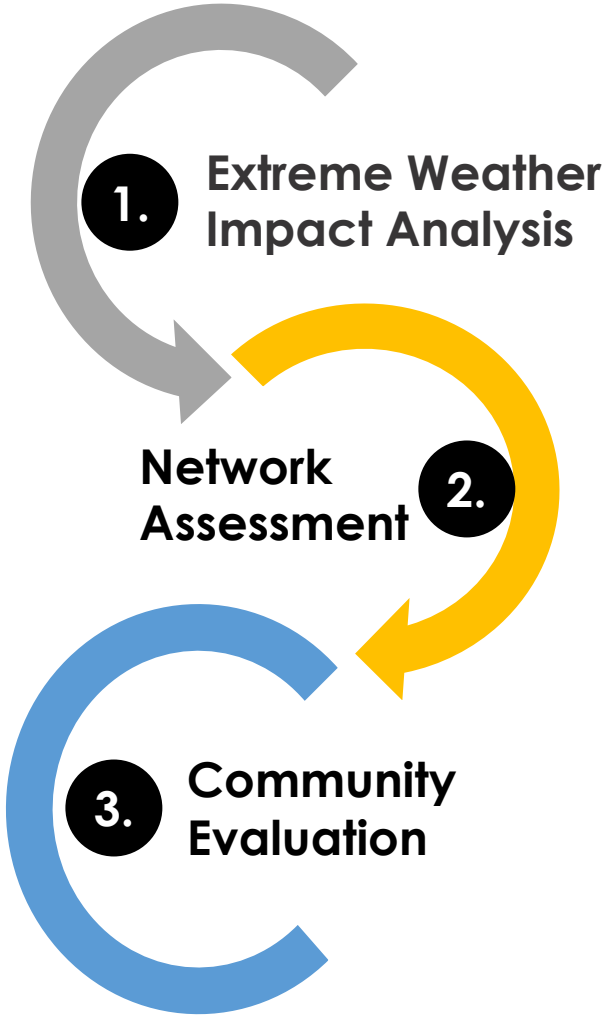


The June and Oct 2021 storms have been the two largest interruptions to our distribution network since privatisation in 1995.

The June 2021 storm was five times bigger in impact than next largest storm in previous years, with nearly double number of customers impacted.

Our approach

Identifying potential locations



- Impact from recent extreme weather events
- Frequent Power Outages

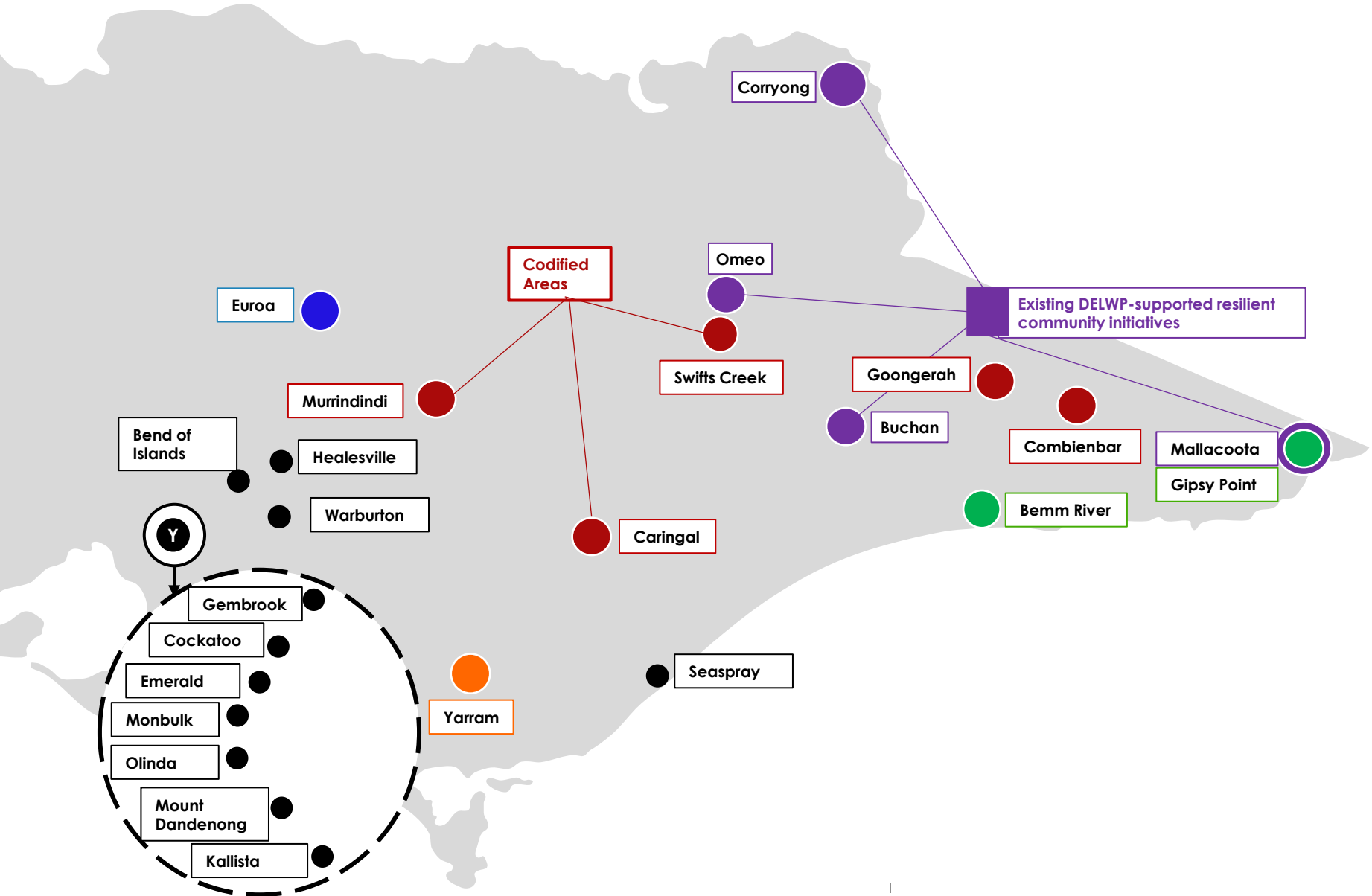
- High Network OPEX
- Customer load demand
- Vegetation assessment
- Low Power Quality
- Favourable network topology
- Site locations to deploy equipment

- Communities with a desire for a net-zero resilient future
- Communities with a capacity to act as hubs of essential services
- Retaining and developing local jobs and growth

What we considered

- Securing Essential Services:
  Futureproofing at-risk critical services (communications, fire services, etc)
- Enabling Residential Basic Needs:
  Ensuring access to clean water, refrigeration, cooling and cooking
- Supporting Network Infrastructure:
  Implementing fail safe solutions within network segments
- Addressing Network Issues:
  Solving ongoing Network problems with long term renewable solutions
- Community Advocacy:
  Understanding community needs and aspirations
- Enabling a Net Zero Future:
  Creating a platform for future community energy projects

Identified key resilience opportunities across the AusNet network



Solutions	Location
Storm Response Areas Microgrid, Front of the meter SAPS and ESS	Y. Sites Healesville Warburton Bend of Islands Seaspray
Battery Energy Storage Solutions (BESS)	Euroa
Off-Grid Microgrids (including SAPs, load reduction, demand mgmt.)	Gipsy Point Bemm River
Grid-connected Microgrid (incl community battery)	Yarram
SAPS (single customers only)	Combienbar Goongerah Codified Areas
DELWP Projects (multiple combined solutions)	Mallacoota Buchan Omeo Corryong

Case study - Mallacoota

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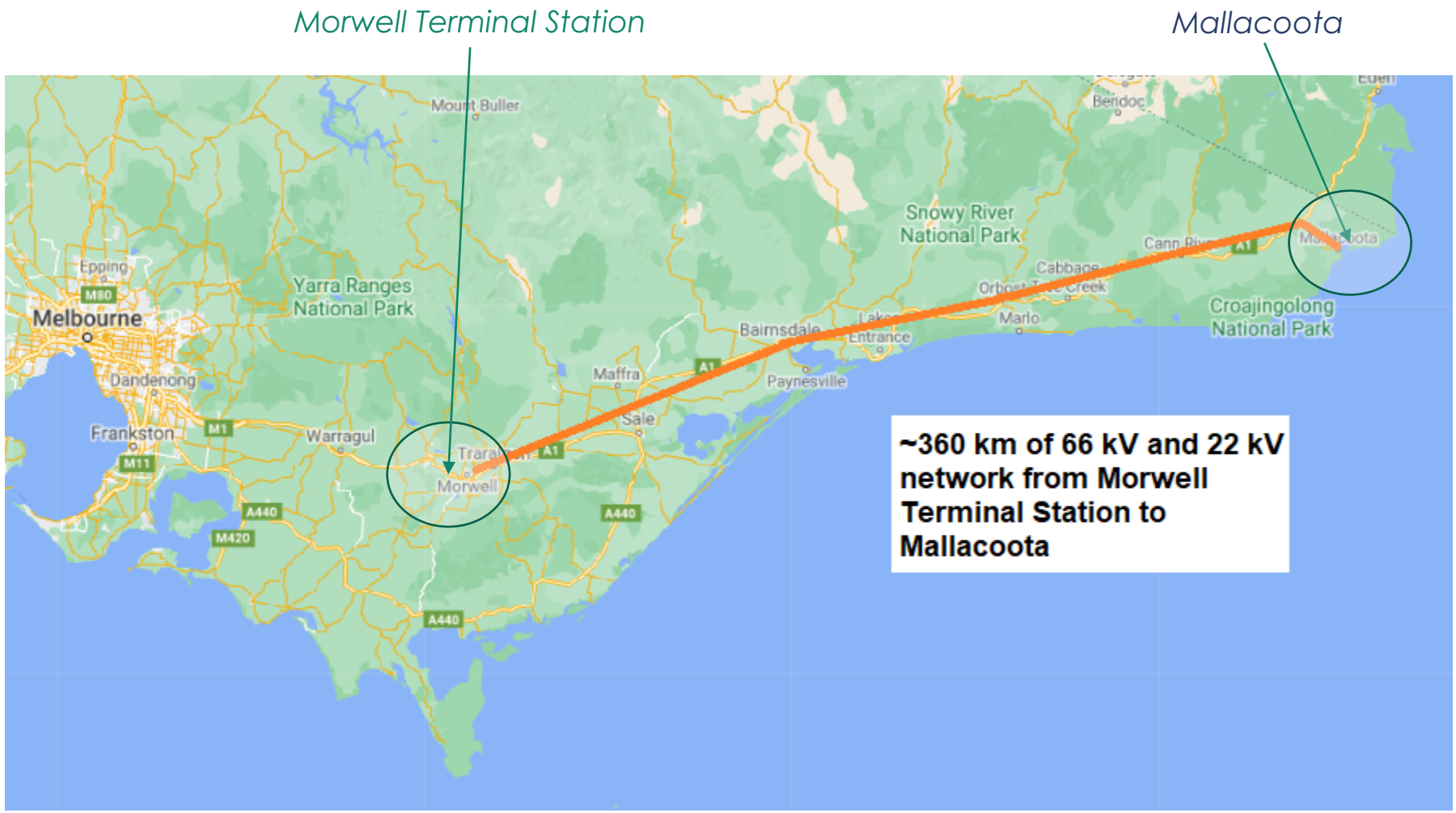
- Mallacoota is located ~515 km from Melbourne, at the eastern tip of Victoria.
- 66 kV line from Morwell to Cann River zone substation ~290 km
- 22 kV feeder from Cann River to Mallacoota ~70 km
- Line travels through a highly vegetated region of East Gippsland.
- Mallacoota has experienced frequent and long duration outages due to bark, animal interference and bushfires affecting the line.

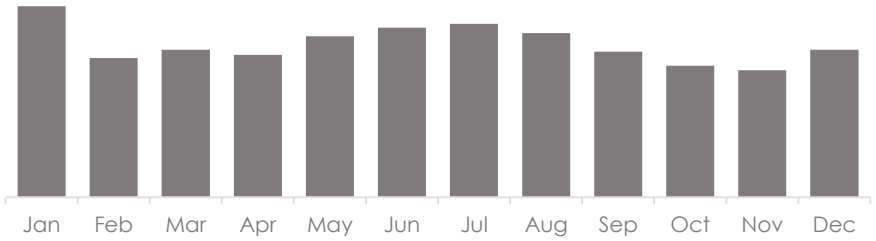


Mallacoota

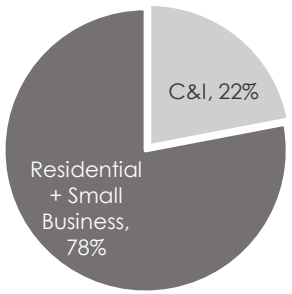
Mallacoota Energy Statistics

Town Profile	
Annual Consumption - 2018	~7 GWh
Peak Demand - 2019	~2.6 MW

Monthly Consumption - 2018



Consumption Breakdown



The Mallacoota Challenge…

- ❑ High cost to serve
- ❑ Supply reliability due to high bushfire risk zone

The Mallacoota Opportunity…

By taking Mallacoota off-grid, we are able to realise the following benefits:

- ❑ **Enterprise Benefits:**
  - ❑ Reduction in cost to serve
  - ❑ Reduced fire risk
  - ❑ Facilitating network decarbonisation & decentralised network
  - ❑ Hazard reduction
- ❑ **Community Benefits:**
  - ❑ Increased power reliability & power quality
  - ❑ Accelerated transition to renewable energy and a low carbon future
  - ❑ Additional revenue from PV export & opportunities for job creation
  - ❑ Bushfire resilience

Mallacoota – consideration to going off-grid in stages

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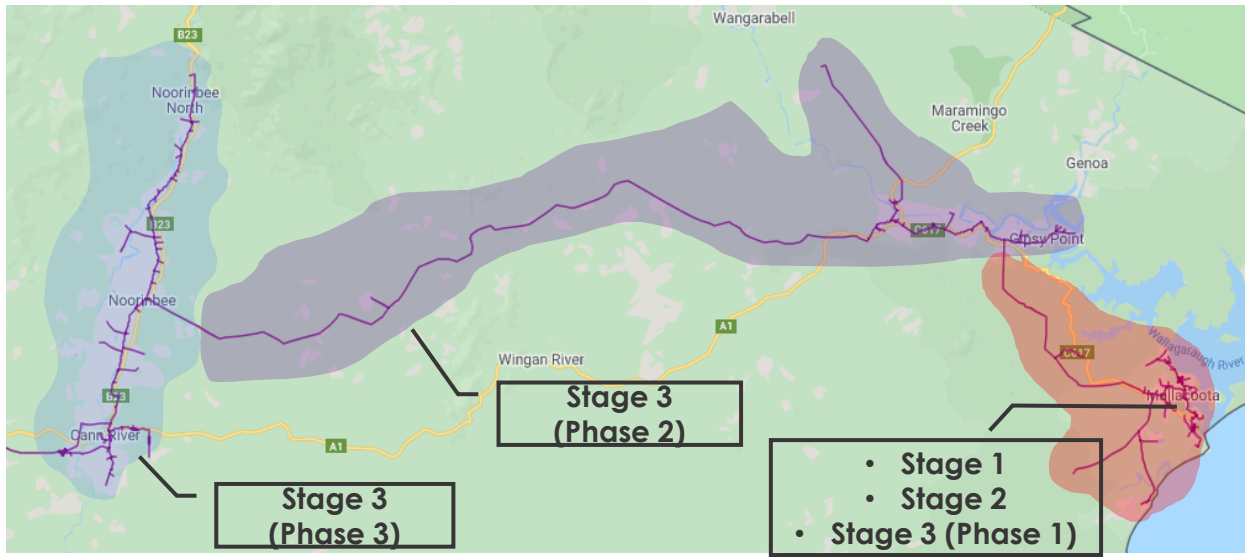


Stage 2 – Bushfire Resilience initiative in partnership with DELWP

– Planned completion in 2022

Up to 7

Essential Services and Businesses

Powers Businesses for up to 5 days

- Mallacoota Fire Station
- Mallacoota Police station
- Caltex Service Station
- 3MGB Radio
- Mallacoota P-12 College
- Mallacoota DH & Mallacoota MC

Up to 220

Residential Demand Management

Stage 1 – Mallacoota Area Grid Storage (MAGS)

– AusNet network improvement initiative (2021)

1 MWh

Battery Storage

Powers Town for 60 mins

1 MW

Diesel Generator

Powers Town up to ~20 hours

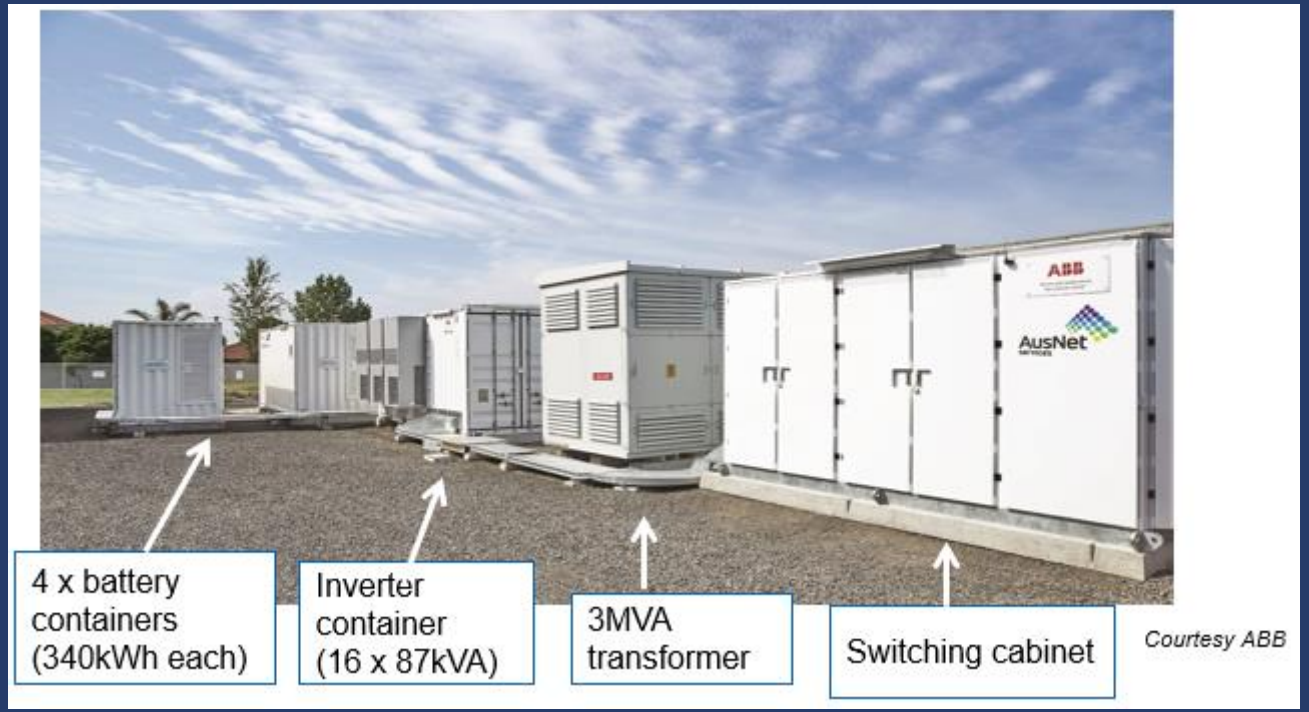
Stage 3 – Mallacoota Off-Grid (planning in progress)

– Planning in progress

- **Phase 1** – Off Grid Solution + decommissioning of 24km line
- **Phase 2** – SAPS for all rural residences off the line + decommissioning of 70km line
- **Phase 3** – SAPS for all rural residences off the line + decommissioning of remaining line

Technical Solution

- 1 MW / 1 MWh battery energy storage system coupled with 1 MW diesel generator.
- System initially constructed in 2014 and underwent operational trials in a Melbourne suburb.
- Mallacoota selected in 2017 as the preferred town for relocation, to provide an improvement in supply reliability for the community.
- System installed in Mallacoota in late 2020 and commissioned in early 2021.



Courtesy ABB

MaGS site near the gateway to Mallacoota

Challenges Along the Way

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- **Design**
  - Excess solar during island
  - Protection scheme complexity
  - Long relatively weak line compared to strong urban test site
  - Seamless transition to and from island

- **Delivery**
  - Supplier availability (limited support in Aus)
  - Transport challenges with containers loaded with batteries
  - Bushfires caused delays
  - COVID caused delays
  - Internal knowledge transfer

Mallacoota – off-grid solution (Stage 3 – Phase 1)

What would it take?

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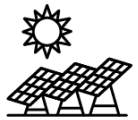
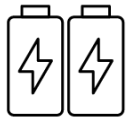
Central



Ground Mount Solar

10.4 MW

~70 Acres



Grid Scale Storage

14 MWh

Co-located with solar farm

Backup Generator

2 MW

~14 days of usage

Community

BTM Solar

2.1 MW

Primarily Residential
70% Uptake

Community Storage

500 kWh

Installed part of community interest

Hot Water Heat Pumps

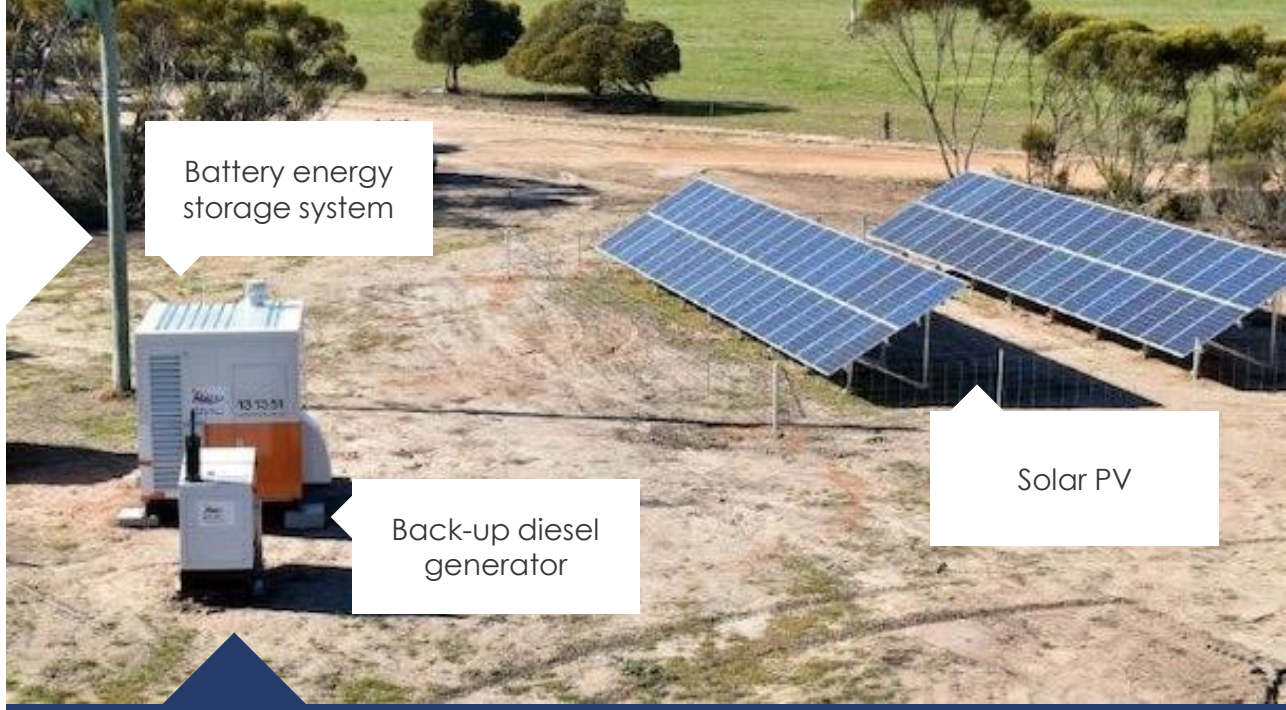
~180 Storage HW

~180 Instantaneous HW

Standalone Power Systems - SAPS

SAPS-as-a-service arrangement - Solar PV, battery energy storage system (BESS), and a back-up diesel generator will supply customers as an off-grid in front of the meter solution

AusNet aims provide improvements and resilience in service to customers in Rural Victoria in addition to reduce the overall cost of the grid network.



Standalone Power Systems (SAPS) will:

- Increase reliability to customer
- Improve community resilience
- Reduce cost to serve
- Supporting the transition into renewable generation technologies

Summary

- Significant challenges to achieve net zero target by 2032 and 2050

- Building energy resilience in rural and regional areas of Victoria using various solutions, including:
  - Grid-connected microgrids
  - Off-grid microgrids
  - Stand-alone power systems (SAPS)

- Suitability of solutions for identified locations depends on multiple factors, including:
  - Network reliability
  - Network OPEX
  - Power quality
  - Network topology
  - Community desire for net-zero resilient future