What We Do

100% own, operate and control critical energy delivery infrastructure in Victoria

Electricity Transmission
- 6,600 km of transmission lines
- 13,000 towers

Electricity distribution
- 52,000 km of electricity distribution network
- 720,000 customers

Gas distribution
- 11,400 km of gas distribution network
- 690,000 customers

* All figures are approximate as at 31 March 2017
**Our electricity distribution network**

AusNet Services’ electricity distribution network is highly diverse, from suburbs to mountains, farmland to forests

- 80,000 km² service area
- 52,000 km lines & cables
- 400,000 poles
- 720,000 customers
- 18% solar customers (residential)
1. Integrating Distributed Energy Resources
   Mooroolbark Mini Grid Innovation Project
Network trends and smart grid drivers

- Electricity sector undergoing exciting and unprecedented change
  - Shift towards Distributed Energy Resources (DER)
  - Shift to low carbon and renewable energy sources
  - Customers moving from literacy to empowerment
  - Digital platforms & big data analytics

- Our Network Innovation program seeks to test and leverage this future environment with smart grid technologies
Electricity networks need to transform

- More customers using DER to control of their energy needs
- Networks expected to evolve through progressive stages of sophistication

Reference: De Martini, NREL, as represented by ENA/CSIRO
Case study: Mooroolbark Mini Grid Project
Decentralised microgrid

2016: Australia’s first 100% renewable microgrid in an established community

Objectives
› Creating a snapshot of the future energy network
› Understanding the impacts and benefits of a high-DER network
› Prepare for a future “Distribution System Operator’ model

Modes of operation:
1. Grid connected
2. Home island (backup supply)
3. Minigrid island
The Mooroolbark Mini Grid Project
Creating a snapshot of the future energy network

HOUSEHOLD DER (14 Participants)
- Battery system, 5kW/10kWh
- Solar PV system, 3kW+
- GreenSync PRU control unit

CENTRAL DER
- LV Switching cabinet & relay
- Stabiliser unit, 18kVA inverter, 10kWh battery storage
Control system architecture
Designed for realistic testing of future DSO model at manageable scale

Three levels of control:

1. **Local household system control:**
   Inverter native functions + local control unit (GreenSync PRU, PowerTec PaDECS) – Fast response

2. **‘Microgrid’ control system:**
   Aggregated fleet control software (GreenSync EM) – 1 min control cycle

3. **Network optimisation:**
   AusNet Services Distributed Energy Network Optimisation Platform (DENOP) – 1+ min control cycle
Use cases and value streams
The Mooroolbark Mini Grid is a test bed for DER uses cases that can return customer and network value, when orchestrated

A series of operational tests were conducted to understand the real-world challenges, implications and benefits of DER orchestration under a potential DSO construct

- **Peak demand management**
  *Coordinate distributed energy to provide network peak demand reduction*

- **Supply reliability and resilience**
  *Provide islanded supply to customers during network outages*

- **Solar uptake management**
  *Facilitate higher penetration of distributed generation*

- **Power quality improvement**
  *Regulate supply voltage and power factor*

- **Customer bill savings**
  *Reduce energy costs by reducing net consumption and tariff arbitrage*

- **New options for customers to share & trade energy**
  *Enable community energy models and access for customers to market*
**Use case example: Demand Management**

**Peak Lopping:** Allows maximum demand on a network element to be capped to a defined value, with automated response from DER customers.

- **Scenario:** Peak lopping of upstream network element (22kV feeder ACR)
- **DENOP** reads in SCADA data and dispatches the required level of support every 10mins
- **DER** is successfully orchestrated to bring down peak from 210kVA to 140kVA
- Each colour represents the contribution of each customer
- Relative customer contributions optimised (in this case according to battery SoC)
- Vastly improved response compared to traditional “simple” demand management
2. Large Scale Energy Storage
Grid Energy Storage System, Thomastown
**Case study: Grid Energy Storage System (GESS) Trial**

*Centralised microgrid*

- **2013**: The first ‘large scale’ network support battery system in Australia

- **Objectives**
  - Understand and evaluate the network value of grid-scale battery storage
  - Gain experience and build organisational capacity
  - Prepare for lower storage system prices in future

- **Network value streams**
  - Peak demand management
  - Voltage & power factor support
  - Operation in islanded mini-grid mode, with smooth transition to and from grid

[Courtesy ABB]
GESS facility and hardware

› 1MW / 1MWh lithium-ion battery + 1MW diesel get set
› EPC contract awarded to ABB after tender process
› Located in an industrial zone in Thomastown, Melbourne, 22kV feeder
Islanded operation testing
Reducing customer outage time

GESS in Islanded Operation

- Before Outage
- Grid Outage
- Sync back to Grid
- After Outage

Power (kW)

0 100 200 300 400 500 600 700 800 900 1000

Time (h:mm)

06:00 09:00 12:00 15:00 18:00 21:00 00:00

Customer Load (kW)
GESS Support (kW)

GESS Islanded Power restored to 104 customers
GESS established at remote township
Mallacoota islanded supply system

Mallacoota Project stats:
• Population: 1030, swelling >3000 during holiday periods
• Supplied via 250km radial network through national park
• 9 sustained outages p.a.
• Restoration time of 3.5 hours
• Occasional multi-day outage
• Aiming for sub 1-min islanding
3. Data analytics
Transmission asset inspection using aerial survey techniques and digital image capture/processing

- GPS/GIS/Laser Enabled Digital Image Capture
- Advanced Digital Image Processing Techniques
- Automatic Detection of Defects, Abnormalities
- Rapid Inspection of Specific Asset Categories (spacers, dampers, joints etc.)
Smart meter data visualisation

Explore tool - Substation View

- Smart meter data:
  - 30min interval data (accumulated data for billing purposes)
  - 5min Power Quality data (instantaneous readings for network status)

- Communications are currently a hybrid of:
  - Wimax (base station)
  - Silverspring (mesh)
  - 3G in rare occasions

- Many different visualisation & analytics tools developed
Smart meter data visualisation

*Explore tool - Network Voltage by Feeder Distance*

Network Voltage By Distance

- **Minimum**
- **Min-trend**
- **Maximum**
- **Max-trend**
- **Mode**
- **Mode-trend**

![Network Voltage By Distance Chart]

- **Voltage Band (V):**
  - 207 - 216
  - 216 - 220
  - 220 - 224
  - 224 - 228
  - 228 - 232
  - 232 - 236
  - 236 - 244
  - 244 - 248
  - 248 - 253
  - 253 - 262
  - 262 - 280

- **Distance from ZSS (km):**
  - 0.0
  - 0.5
  - 1.0
  - 1.5
  - 2.0
  - 2.5
  - 3.0
  - 3.5
  - 4.0
  - 4.5

**Data Range:** 22 October 2017 - 28 October 2017
AusNet Services has developed analytics – using Smart Meter Data – that detects when a customer solar systems may have stopped working.

- Using voltage data collected from AMI Meters we detect when a solar system has not exported for over 7 days.
- Customers are notified by an SMS message of the issue, and the Solar Alert Analytics continue to monitor the customer’s meter until an export is detected again.
- Since implementation >4,000 alerts have been provided to customers.
- Customer response to this service has been very positive with most customer rating 10/10.
4. Network Automation
Distribution Feeder Automation
Distribution feeder automation based on data analytics

**System Normal**

- Automation Controller
- CB
- Switch
- Switch
- N/O
- Switch
- CB
- FDR1
- FDR2

**During Fault Sequence**

- Automation Controller
- CB
- Switch
- Switch
- FDR1
- FDR2
- N/O
- Switch

**After Automation Action**

- Automation Controller
- CB
- Switch
- Switch
- N/O
- Switch
- CB
- FDR1
- FDR2

**Customer Supply Interruptions**

- After Feeder Loop Automation

- Time (minutes)
  - Urban
  - Rural
Thank you