Integrating DER and EV monitoring

By Oleg Gulich
Agenda

- Current trends for DER and EVs in the UK
- UK Power Networks’ DSO and EV strategy
- LV SCADA and real-time EV/DER control
- Active Network Management system design
- Active Response innovation project
### About UK Power Networks

We own and operate 3 of 14 networks in the UK:
- Eastern
- London
- South east

<table>
<thead>
<tr>
<th>Measure</th>
<th>Data</th>
<th>% of industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>End customers</td>
<td>8.3m</td>
<td>28%</td>
</tr>
<tr>
<td>Population served</td>
<td>c. 20m</td>
<td>28%</td>
</tr>
<tr>
<td>New metered connections</td>
<td>46,000</td>
<td>32%</td>
</tr>
<tr>
<td>Distributed generation connected</td>
<td>9.1GW</td>
<td>32%</td>
</tr>
<tr>
<td>Energy distributed</td>
<td>85TWh</td>
<td>29%</td>
</tr>
<tr>
<td>Peak demand</td>
<td>16GW</td>
<td>28%</td>
</tr>
<tr>
<td>Number of substations</td>
<td>147,000</td>
<td>-</td>
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</table>
Current trends in the UK

DG Growth
- 9.1GW of DG connected, doubled since 2011
- Over 160,000 distribution connected generators

Energy Storage
- 28GW formal enquiries since July 2015
- 1.4GW accepted offers
- 177MW connected storage

EV Growth
- 200,000 Plug-in vehicles sold in the UK, 32% on our networks, 55% ahead of our forecast
- 18,000 charge points across UKPN

Heat Electrification
- One to watch - slower than expected
- Large flexible load
- A mix of solutions will be key

Pace and scale of change continues to increase
EVs are coming. Are we ready?

200k plug-in cars in the UK as of Jan 2019

Now 60k vs. 2030 4.1m

amount of plug-in cars in UKPN licence areas

UKPN is undertaking efficient network investment to support EV growth
DSO and flexibility

DSO role
- Keeping the lights on
- Providing great customer service
- Lowering our costs
- Support whole system optimisation
- Enabling markets

Flexibility services
- Reinforcement deferral
- Managing planned maintenance
- Dealing with unplanned interruptions

Locational awareness
- Solve DER connection constraints
  (geographic, voltage)
Flexibility is core to our DSO strategy

- Facilitate cheaper and quicker connections using proven innovation
- Use customer flexibility as an alternative to network reinforcement
- Develop enhanced System Operator capabilities
- Collaborate with industry to enable GB wide benefits
- Prepare and facilitate the update of Electric Vehicles
What is Flexibility?

Distributed energy resources (DSR, generation, storage) that can increase generation or reduce consumption in return for payment to support the local electricity network.

New network capacity

Investment trigger

Flexibility Services

Service Window

Load profile

MW

Network limit

Time of day

Piclo Flex Platform

https://picloflex.com/
Enabling the Market: Visibility

Publish heat maps showing areas of potential flexibility needs

Enable existing and new DER to register on a flexibility platform

Enable interested DER to enter into framework contracts with us
UK Power Networks’ EV Strategy

Enabling the decarbonisation of transport and improving air quality

**Appropriate investments**
- Improve planning and scenario analysis
- Develop policies and standards

**Customer experience**
- Expand choice and facilitate convenience
- Engage and educate / learn

**Network readiness**
- Develop an evidence base for investment
- Develop smart toolbox of offering in response to uptake scenarios

**01** FORECASTING

**02** MONITORING

**03** DEPLOY SMART

Enabling the decarbonisation of transport and improving air quality
LV visibility and monitoring

We are investing £30m on strategically targeted LV monitoring:
6,000 distribution substations driven by LCT constraints

Today

2020
PowerOn
- EHV & HV ADMS
- Fully functional
- Tracing
- Safety Logic
- Connectivity
- Work Package Manager
- Equipment Explorer
- SCADA
- Automation

GeoView
- Old interim solution
- LV Operational Viewer
- Limited functionality
- No connectivity
- Just a Picture
- Unable to trace
- Geographic diagram
- Simple dressing
- Limited reporting
- End of life

vs
LV add-on for SCADA: a fully interactive LV model
UK Power Networks’ ANMS Solution

First-of-a-kind BAU Active Network Management system rollout in the UK
Real-time DER monitoring and balancing
Active Response innovation project

Active Response is an network innovation competition project run by Ofgem

Participants:

- UK Power Networks
- SP Energy Networks
- CGI
- tps
- RICARDO

Duration: 2018-2021

Budget: £14M

- 4 trials
- 4 work packages
Active Response innovation project

Objectives

Demonstrate 2 optimisation methods in 4 separate trials:

- **Network Optimise** – optimisation and automatic reconfiguration of HV & LV networks, using tele-controlled switches and Soft Open Points.
- **Primary Connect** – controlled power transfers between primary substations using a Soft Power Bridge.

Benefits

A cost effective solution to facilitate the connection DER/EVs, improved fault level control, voltage control and asset protection in the LV network.

- Saves £9 per customer (NPV to 2030)
- UKPN-wide benefits by 2030: £60M savings, 928 MVA released capacity.
- Break even 2 years after trial
Network Optimise method

Legend:
- Ring Main Unit
- Normally open point
- Transformer
- Soft Open Point
- LV load
- LV Linkbox switches
- LV Circuit breakers

Move 11 kV NOPs
Install SOP device
Reconfigure LV network

Primary Substation
11kV busbar

Cluster of LCTs

Feeder A
Feeder B
Feeder C

Low voltage network
Primary Connect method

Legend:
- Ring Main Unit
- Normally open point
- Transformer
- Soft Open Point
- Soft Power Bridge
- LV load
- LV Linkbox switches
- LV Circuit breakers

Cluster of LCTs

Network boundary

Primary Substation A
11kV busbar

Primary Substation B
11kV busbar

Feeder A

Feeder B

Feeder C

SPB
Active Response combined method
## Network Hardware

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft Power Bridge</td>
<td>2</td>
</tr>
<tr>
<td>Soft Open Point</td>
<td>6 two-port devices 4 three-port devices</td>
</tr>
<tr>
<td>LV Circuit Breakers</td>
<td>200 (3-phase sets)</td>
</tr>
<tr>
<td>LV Link Box Switches</td>
<td>100 link box sets</td>
</tr>
</tbody>
</table>

### Diagrams

- **Soft Power Bridge**
- **3-port Soft Open Point**
- **2-port Soft Open Point**
- **LV Circuit Breakers**
- **LV Linkbox Switch**
Soft Open Point

Deferring reinforcement whilst enabling Electric Vehicles and Renewable Generation

- Voltage Correction
- Power Balancing
- Power Factor Correction
Active Response: conceptual design

**Active Network Management**
- Forecasting
- State estimation
- Contingency analysis
- Power flow
- Optimisation

**SCADA / ADMS**
- EHV+HV network model
- LV network model

**Key:**
- New AR: Smart Solution
- Smart Device
- Information
- Control

**Network planning tools**
- SAP

**GIS database**
- Data historian
- SAP

**New AR**
- EHV+HV network model
- LV network model

**Smart Solution**
- Control
- Information

**Smart Device**
- SOP
- LV CB
- SPB
- Smart Link Box
Conclusions

- Investing time and money to ensure EV readiness
- Collaborating across industry to address EV challenges
- Innovation plays a key role in energy transition
- ANM is a key system for delivering Flexibility Services
Thank you