ENERGY STORAGE
Can Li Ion Batteries meet grid requirements?

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UK TRANSMISSION & DISTRIBUTION SYSTEMS

Transmission System
the extremely high voltages
(275kV and 400kV for England)

Distribution System
lower, but still high, voltages
(e.g. 132kV, 33kV, 11kV and 400V)

www.energynetworks.org/info/faqs/electricity-transmission-map.html

www.energynetworks.org/info/faqs/electricity-distribution-map.html
HISTORIC UK POWER SYSTEM

- Network designed for power flow in one direction only
- Active transmission network
- Passive distribution networks
- “Fit & Forget” approach to designing distribution networks
DRIVERS FOR CHANGE

Renewable Targets

Performance Targets

Distributed Generation

Existing Power System

Ageing Assets

New Technology

[Images and charts related to renewable targets, performance targets, distributed generation, existing power system, ageing assets, and new technology]
POWER SYSTEM CHANGING
TECHNICAL CHALLENGES FOR NETWORKS INCLUDE:

- Need for increased capacity
  - Growth in demand, reaching thermal limits
  - Seasonal variations in demand changing
  - Uncertainty
- Increased difficulty getting overhead line routes
  - Need to optimise existing capacity
- Need to balance the system
  - High volumes of variable generation
  - System inertia reducing, frequency more volatile

→ http://www.smarternetworks.org/
EXAMPLE – THE DNO

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<tr>
<th>Peak Demand Reduction</th>
<th>Infrastructure Investment</th>
<th>Others</th>
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<tr>
<td>- Increase in distributed generation and peak demand</td>
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<td>- Network limits being reached</td>
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<td>- Uncertainty over future demand and generation (investment risk)</td>
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MANAGING THE SYSTEM FREQUENCY

- When generation equals demand, the system is balanced and the frequency is 50Hz (or really close)
- If demand increases or generation is lost, the scales tip to the left and system frequency reduces
- If demand reduces or generation increases, the scales tip to the right and system frequency goes up
- The larger the system, the larger its inertia, the smaller the fluctuations of the system frequency under contingencies

\[ \uparrow 50\text{Hz} \quad \text{demand reduces / generation increases} \]
\[ \downarrow 50\text{Hz} \quad \text{demand increases / generation reduces} \]
Enhanced Frequency Response achieves 100% active power output at 1 second (or less) of registering a frequency deviation.
NATIONAL GRID TENDER FOR ENHANCED FREQUENCY RESPONSE (EFR) SERVICES

→ Key requirements

- Enhanced Frequency Response (EFR): Facility achieves 100% active power output at 1 second (or less) of registering a frequency deviation.
- Response proportional to frequency deviation.
- Operation within a frequency envelope and specific ramp rates.
  - Deadband where providers don’t need to respond to deviations and can manage state of charge
  - Providers cannot offer other services that would affect the EFR service
- Minimum sustained delivery of 15 min
- Availability of >95%
What do providers need to consider?

- Meet technical requirements
  - NG EFR requirements
  - Desired performance requirements (lifetime, frequency of operation, efficiency, duration of discharge, etc)
  - Size of installation
  - Testing requirements

- Location
  - Location e.g. existing site, green field, co-located with other assets, etc
  - Purpose built building or containerised units
  - Environmental Impact
  - Flood Risk
  - Accessibility
What do providers need to consider?

- Access to the Grid
- Health and Safety
  - In particular fire and for Li-Ion the phenomena of “thermal runaway”
- Planning permission
- Operation e.g. remote
- Maintenance
- Cost
EFR – 200MW REQUIRED FOR 2017

Pre-qualified parties

- Tenders from 37 providers across 64 sites.
- 888 MW for battery projects.
- Max 50MW per provider
EFR – RESULTS (AUGUST 2016)

- 8 tenders accepted – Average price of £9.44/MW of EFR/h

- Some of these projects are in the range of 40MW, that's a significantly larger project than ever before → Currently biggest battery installation in the UK are 10 MW (phase 1) at Kilroot Power Station in NI and 6MW at Leighton Buzzard.

- Few technical details available → for batteries the market is moving to Li-Ion

- Winners predominantly renewables EPCs and developers → Strengthens the link between the renewable industry and the battery industry

→ http://www2.nationalgrid.com/Enhanced-Frequency-Response.aspx
OTHER BATTERY STORAGE APPLICATIONS

→ Reduction of generation curtailment and increased utilisation of low carbon generation assets.
→ Short Term Operating Reserve (STOR) provision.
→ Black start.
→ Isolated grid support.
→ Voltage control on voltage-constrained networks (high voltages associated with generation (DG) or low voltages associated with demand).*
→ Dynamic Reactive Response*
→ Power factor control to reduce network losses.*

*with power electronics
Thank you for your attention
BARRIERS/AREAS FOR CHANGE – IN THE UK

- High-profile Government support and clarity of policy to provide investor confidence.
- Formation of a new asset class and/or class exemption.
- Inappropriate use of network charges for storage.
- Operation across different markets to provide multiple services is currently complex or not allowed.
- The development of technical standards for installing, testing and using energy storage technologies.
- Contract length e.g. EFR is 4 years.
- Revenue cannibalisation risk – services from storage are finite.
- Market education and information.
- Improved access to finance.
- Developing the case for joint renewable energy / storage deployment.
- Encouragement of collaborative working – integrated planning.
- Brexit? Change in government?

Sources:
- Can storage help reduce the cost of a future UK electricity system, Carbon Trust