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Scottish and Southern Energy Power Distribution owns:

- One electricity transmission network
- Two electricity distribution networks
- 106,000 substations
- 130,000 km of overhead lines and underground cables
- 100+ submarine cable links

The company serves 3.5 million customers across one third of the UK’s landmass
The Question

Energy storage solutions for electrical Distribution networks, what are they, why do we need them, what can they do, what are we doing and what’s hindering further deployments?
What is Energy Storage?

- **In a networks context:**
  - A means of separating the time of Generation and time of energy Consumption.
Energy Storage Continuum

Demand Side Response

Enhanced Demand side Management

Bi-directional storage

Fuel Manufacture

Domestic
Commercial
Industrial
New entries (cars)......

Small scale thermal Mass
Manufacture process management
District Heating......

Batteries
Flow Batteries
Thermal conversion
Pump storage
Flywheels......

Sabatier process (Methane)
Electrolysis (Hydrogen)
Haber Process (Ammonia)
Inter sector energy exchange...

Short Time Constant..................................................Long Time Constant

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Electrical Energy Storage Drivers

- Increase in Variable Output Generation
- Avoided Generation CAPEX/OPEX
- Avoided Transmission, Distribution and Interconnector CAPEX
- Balancing services
- Undefined business case
What solutions can energy storage provide?
Building on the proven.

- **Storage Heaters and Radio Tele-switch (LW)**
  - In use for 30 years
  - National balancing
  - Managing network constraints in “Managed Zones”
  - Currently deferring £161M of network investment on mainland connected islands alone, can be extrapolated to £700M benefit across our North network alone.
Northern Isles New Energy Solutions (NINES) Overview

- New Large Tidal
- New Large Wind
- New Small Wind
- Existing Generation

- Cullivoe Tidal Array
- Shetland Tidal Array

- Garth (4.25 MW)
- North Hoop (0.5 MW)
- Gremista (6.09 MW)

- LIC

- Active Network Management System

- Leirwick Power Station
- SVT Power Station
- Burradale Wind Farm
- Ollaberry

- DDSM
- Thermal Store
- 3MWh Battery
Water Cylinders

Default water temperature

Water Temperature = 60 °C
Energy Stored = 9 kWh
Available Energy storage = 4 kWh

Maximum water temperature

Water temperature = 80 °C
Energy Stored = 13 kWh
Available Energy Storage = 0 kWh

If all water tanks on Shetland converted then 2.5MW of control on island 25% of summer demand

If all domestic tanks in UK 6GW
## Economics

<table>
<thead>
<tr>
<th>DDSM 750 homes (3MW / 31MWh)</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications</td>
<td>750 x £250 every 10 years (Assuming Smart Metering infrastructure)</td>
</tr>
<tr>
<td>Customer Ancillary Service Payment</td>
<td>750 x £200 per annum</td>
</tr>
<tr>
<td>NPV</td>
<td>£2.3M (£4M with full costs of a dedicated comms solution)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Single Battery Solution (1 MW / 6 MWh)</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>£4,000,000 every 15 years</td>
</tr>
<tr>
<td>Losses</td>
<td>£200k per annum</td>
</tr>
<tr>
<td>NPV</td>
<td>£8.6M</td>
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</tbody>
</table>
Community Energy Storage

CES Operation 4th September - Peak Shaving on Phase A (5 minute averages)

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Mobile Generation Optimisation

Generator Section

Battery/Inverter Section

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Not just technology.

COMMERCIAL APPROACHES
Potential Revenues Streams

- **STOR**
  - Committed
  - Flexible
- **TNUoS avoidance**
- **DUoS avoidance**
- **Capacity payments**
- **Arbitrage**
Orkney Energy Storage Park

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Today’s Orkney Business Case Results

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Generic ESS Business Case Results

- Annual Revenue Target: £184,641
- DNO - ESP Constraint Management Contract: £14,235
- STOR - Committed: £934
- STOR - Flexible: £33,066
- TNUoS Avoidance: £12,138
- DUoS Avoidance: £1,516
- Electricity Arbitrage
- Capacity Payment: £34,000
- Revenue Gap: £88,751

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Tomorrows Orkney Business Case Results

The ESP would have a revenue shortfall

The annuitised fair value cost of the asset to the ESP

The ESP’s revenue shortfall is greater than the amount that the DNO would be willing to pay it

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Other Commercial Solutions

- Electrolysers
  - Aberdeen installation
  - Transport usage
- Automated Demand Response
  - Bracknell
  - Honeywell
Challenges

• Codes & standards
• Technology prices
• Business case
• Regulatory Environment
Constraint Managed Zones

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Interim Conclusion

- Energy storage is already proven.

- Big synergies to be had cross traditional market boundaries.

- DSM should be the first choice but keep it simple.

- Energy storage will, without doubt play a role in networks, question is to what extent.
Thank you

• More information at:

http://www.ssepd.co.uk