Storing Electricity
Technology in a UK/EU Context

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Fully engaged in public debate
Talk overview

- Energy landscape and policy context
- Overview for storage
- Policy needs
- Energiewende
- Conclusions
UK energy landscape

• Stable demand profile for past three decades
• Need to replace ageing plant and infrastructure
• North Sea gas depleting (by 2020, 80% of gas demand will need to be met through imports)
• Increasing global competition for limited primary energy resources, particularly oil and gas
• Decarbonisation aspirations and obligations (targets)
Supply and demand

• UK primary energy sources
  - Oil: 45%
  - Gas: 32%
  - Electricity (nuclear, wind, hydro): 19%
  - Coal: 1.5%
  - Other renewables: 2.5%

• UK energy consumption
  - Transport: 39%
  - Domestic: 30%
  - Industry: 18.5%
  - Services: 12.5%
  - Heat 49%, Electricity 20%, Transport 31%
## UK Energy policy

### Sustainability
- EU 20 / 20 /20 targets
- Climate Change Act 2008
- Increased renewables
- Decarbonisation of electricity
- Decarbonisation of other sectors
- Increased use of electricity as a clean energy vector
- Energy conservation
- Energy efficiency
- Distributed generation

### Economy
- Open markets deliver competitive prices
- Interconnections link markets
- Avoid price uncertainty for consumers
- Political intervention and regulation to protect consumers
- Community and domestic stakeholder participation in ownership, production and trading
- Asset optimisation

### Security of supply
- Licence conditions provide requirements for supply
- Invest in storage
- Ensure sufficient peak capacity (Winter)
- Maintain margin with adequate reserves
- Increase renewables and nuclear to reduce reliance on imported gas and other fuels
- Develop system flexibility and community level resilience
- Adopt smart grids
Future generation mix

Generation under ‘Gone Green’ scenario
Source: National Grid
Renewables and power system

- Large scale and small scale
- Variability and location
- Surplus and shortfall
- Short and long term reserves
- Markets/subsidies
UK power network

Today’s network

• Large scale competitive generation, regulated transmission and distribution
• Limited embedded generation (at distribution level)
• Wholesale market supplies retail customers
• Limited number of self suppliers
• System planned to meet peak demand plus reserves – spare (or under utilised assets)
• Low level of interconnections to other networks
• Regulated wires businesses
• Facing substantial change

The future

• Significant shift from dispatchable generation to time variable generation
• Peaky demands from digital society, switch to heat pumps, uncertain effect of electric vehicles
• Distributed community and domestic level generation and trading
• Average and peak domestic demand likely to increase
• Balancing the system requires more flexibility
• Higher level on continental interconnection
Tools for system balancing

Flexible generation (reserve)

Storage (absorbs and rejects power)

Demand response

Connectors (import or export)
Storage – enabling technology

• Intermittent renewable energy sources
  ▪ ‘Wrong time’ electricity generation – too much or too little
  ▪ Optimises return on investment (ROI) in renewables plant
  ▪ Reduces need for idle spare capacity (reduces investment costs in asset base) and avoids (volatile) fuel costs

• Large base-load electricity generation
  ▪ Sweats assets for improved ROI – e.g nuclear and biomass

• Flexibility of scale and location
  ▪ Mix of storage technologies analogous to generation mix
  ▪ Defers network investments and lowers system costs
  ▪ Reduces SMART grid and interconnection risks
Enablers - storage

- Pumped hydro
- Compressed-air
- Power to gas
- Flywheels
- Thermo processes
- Batteries
- Stockpiling
## Storage application matrix

### Application scales and potential users

<table>
<thead>
<tr>
<th></th>
<th>Small Under 1 MW</th>
<th>Medium 1–10 MW</th>
<th>Large 10 MW–100 MW</th>
<th>Very large 100 MW +</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power producers</strong></td>
<td>Standalone systems for self-generation and renewables</td>
<td>Energy trading</td>
<td>Supply of ancillary services</td>
<td>Network constraint management</td>
</tr>
<tr>
<td><strong>Network operators</strong></td>
<td>Deferral of network reinforcement</td>
<td>Local network management</td>
<td>Deferral of system reinforcement</td>
<td>Peak shaving</td>
</tr>
<tr>
<td><strong>Consumers of power</strong></td>
<td>Small commercial, domestic users for local load management and tariff reduction</td>
<td>Local load management, smart grid support and external ancillary services</td>
<td>Peak shaving for energy cost reduction and ancillary services</td>
<td>Peak shaving for energy cost reduction</td>
</tr>
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Barriers and challenges

• Classification of storage solutions
  - Electricity “consumer” and electricity “generator”

• Electricity market structure
  - Competitive generation and highly regulated transmission and distribution – disincentive for investment
  - Lack of income certainty increases financial risk - need to be allowed to access multiple income streams
  - No clear business model

• Government policy
  - No current UK Government policy for widespread deployment/adoption of storage capability
Policy needs

• Recognise the value of storage
  ▪ Strongly dependent on network generating mix and local market rules

• Separate classification for storage
  ▪ Recognise unique roll as both ‘consumer’ and ‘provider’

• Create competitive incentivised environment
  ▪ Needs to ensure inclusion and access to multiple streams

• Support demonstration at commercial scale
Germany’s Energiewende

- Biggest renewable transition experiment in the world
  - Legally binding (Renewable Energy Act 2000) with cross-party support and strengthened by recent no nuclear policy
  - Nuclear provided 25% primary power in 2011 when 8 stations were closed with immediate effect, remaining 9 by 2022
  - Total power generation capacity 155GW
  - Aspiration is 35% of electricity generation from renewable sources by 2035, 80% by 2050 (2012 figure was 20%)
Energiewende plan

• Transition
  - 45% to be achieved by demand reduction and increase in imports
  - Plan a 42GW connection with Norway
  - Focus is wind and solar resources

• Issues
  - Dumping of power on neighbours (Poland and Czech)
  - 2011 experienced 200,000 blackouts of more than 3 mins
Energy storage focus

• Current
  - Pump storage (30 sites in operation; 7.6GW, 4.9% total power generation) but few available for future

• Future
  - Government spending €200 million in period 2011-2014 on energy storage R&D
  - Focus is on power-to-gas capability (methane, hydrogen)
  - 250 kW pilot plant in Stuttgart largest in world; €3.5 million
    - Methane from water and CO₂ (50% efficient)
    - CO₂ from sewage and agricultural sludge
  - Early stage in thinking about energy storage potential
UK conclusions

• Support action to identify true system benefit of electricity storage

• Develop policy frameworks that reward value of electricity storage in UK power markets

• Encourage/support UK companies and research organisations that are developing storage technologies
Thank you