Energy Storage: The Holy Grail

All Energy, 19th May 2010

Dr Graham Cooley, CEO

ITM POWER
Energy Storage | Clean Fuel

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Contents

The Holy Grail

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Production & consumption are dynamically coupled:

- Supply matches demand in sub-second timescale
- The system has no scalable cost effective energy storage solution
- How can we use unpredictable generation?

'The Attainment, the Vision of the Holy Grail to Sir Galahad, Sir Bors and Sir Percival'.
Part of the 'Quest for the Holy Grail' tapestries by Edward Burne-Jones, produced in 1896.
Tapestry in wool and silk © Collection Lord Lloyd-Webber

Dynamic Coupling

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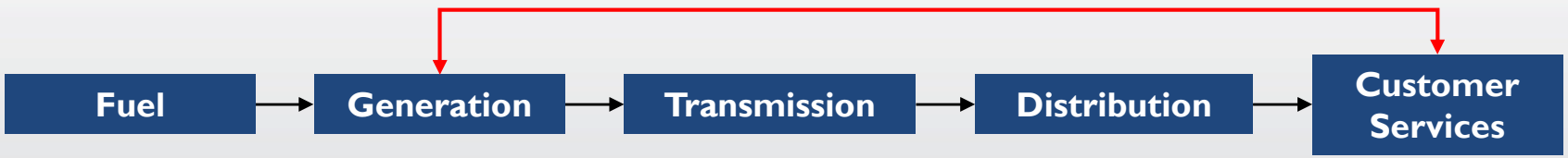
Production & consumption are dynamically coupled:

- Supply matches demand in sub-second timescale
- The system has no energy storage solution
- How can we use unpredictable generation?



Supply Chain Logistics

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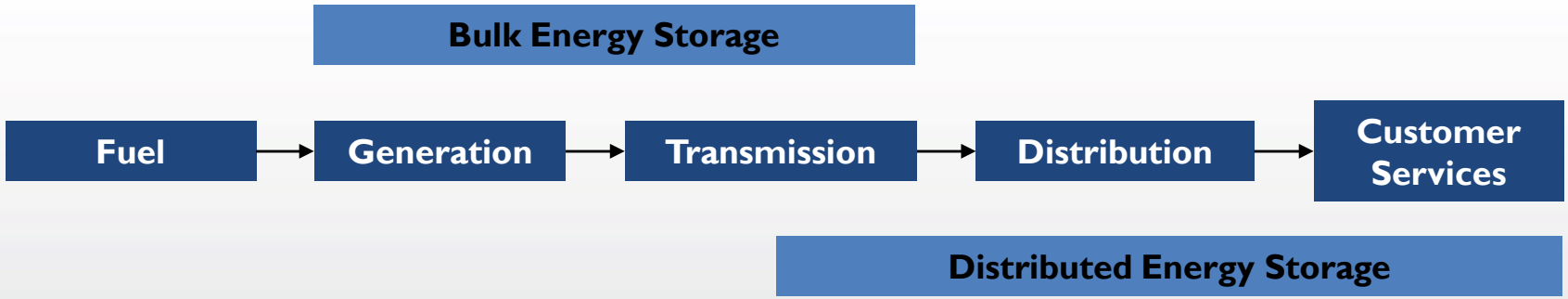
Adding energy storage to the logistics:

- Five elements are dynamically balanced
- Adding energy storage would lead to:
  - New business models
  - New service strategies
  - New pricing structures



Industry Snapshot

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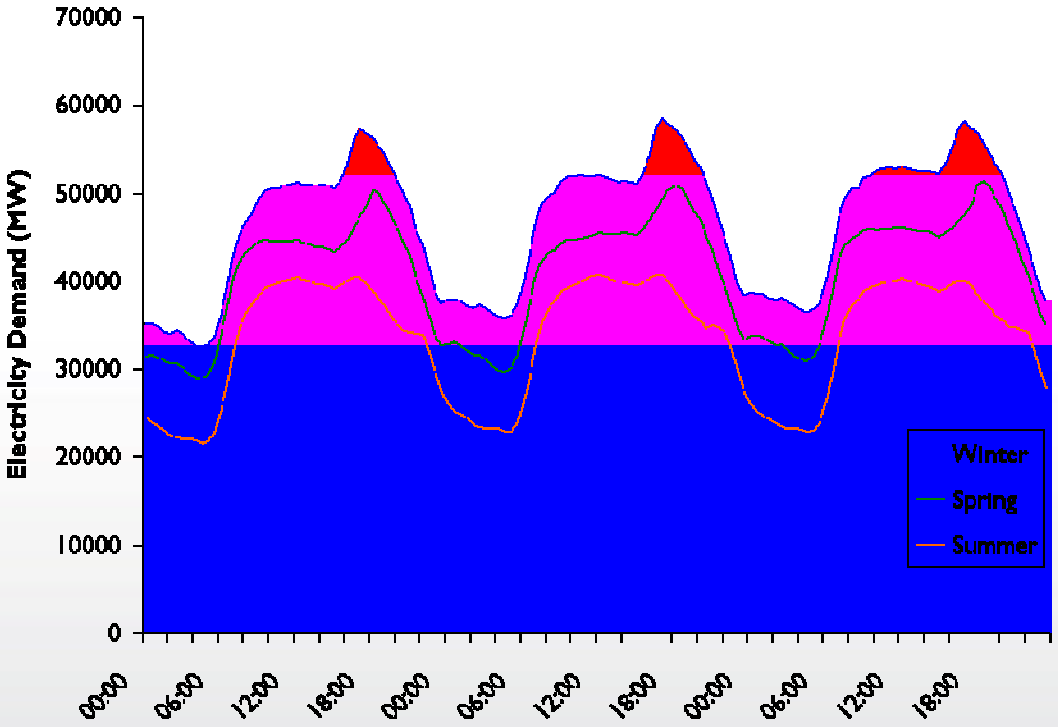
UK Electricity Demand

Demand varies daily, weekly, seasonally:

- Winter peak is 60 GW
- Base load plant
- Mid merit plant
- Peaking plant

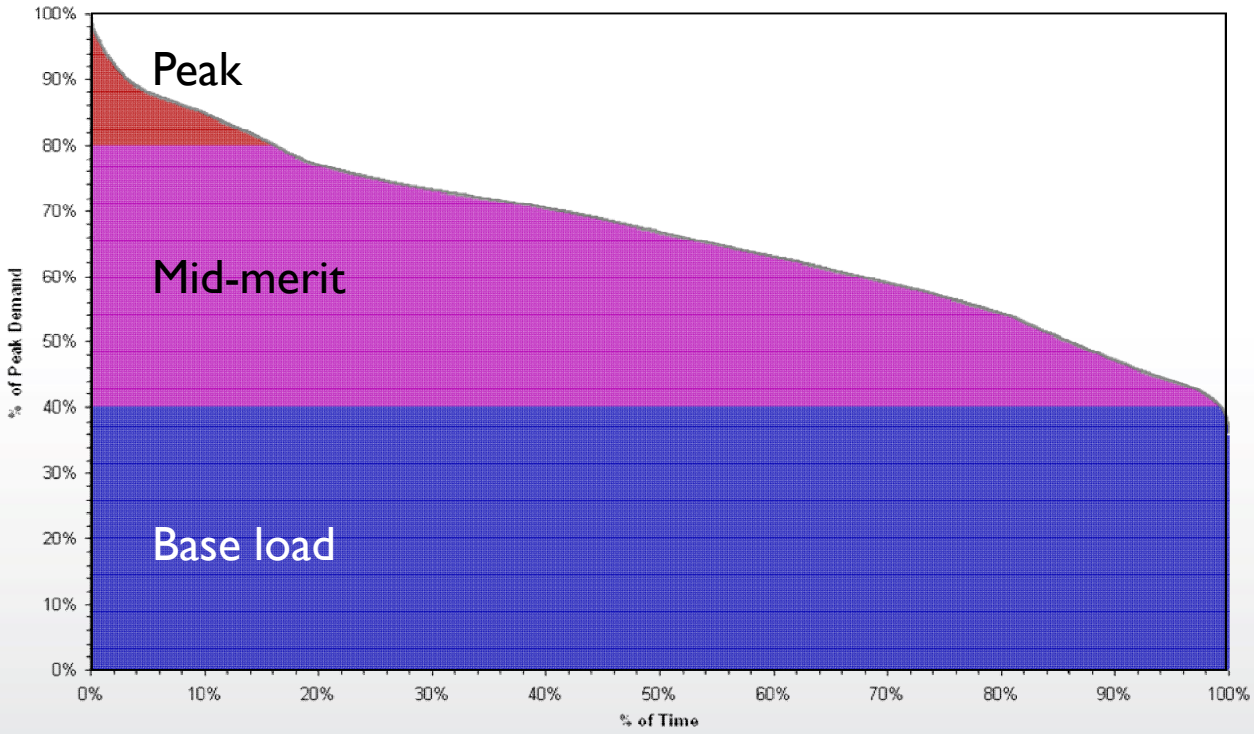


Data from National Grid

UK Load Duration Curve

Plant utilisation over time:

- Huge utilisation of inefficient plant
- 40% fully utilised



Data from National Grid

Bulk Commodity Storage

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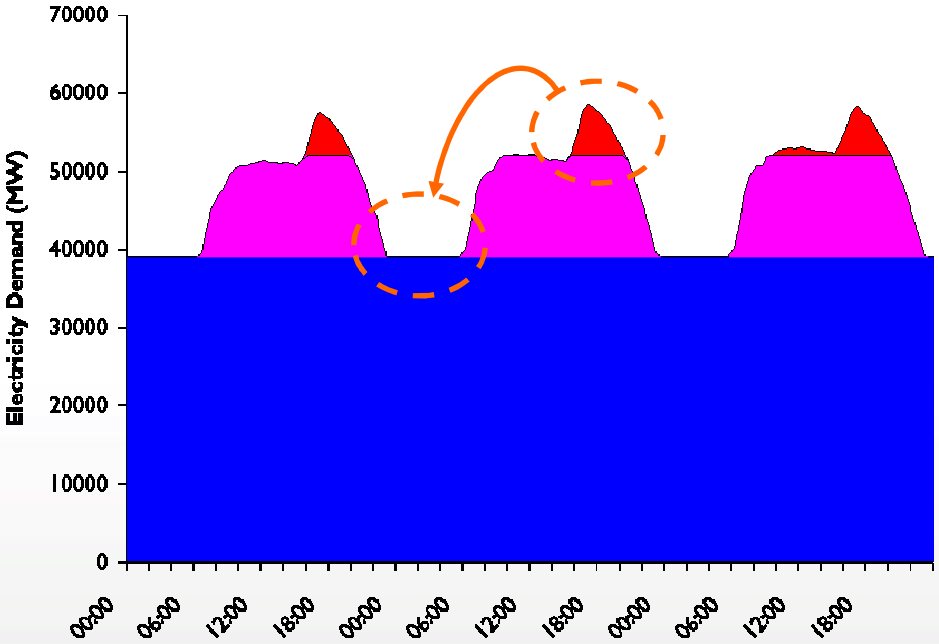
Shifting the peaks to fill the troughs:

- Turns mid merit in base load
- Reduces the need for peaking
- Increases system efficiency
- Day night arbitrage!



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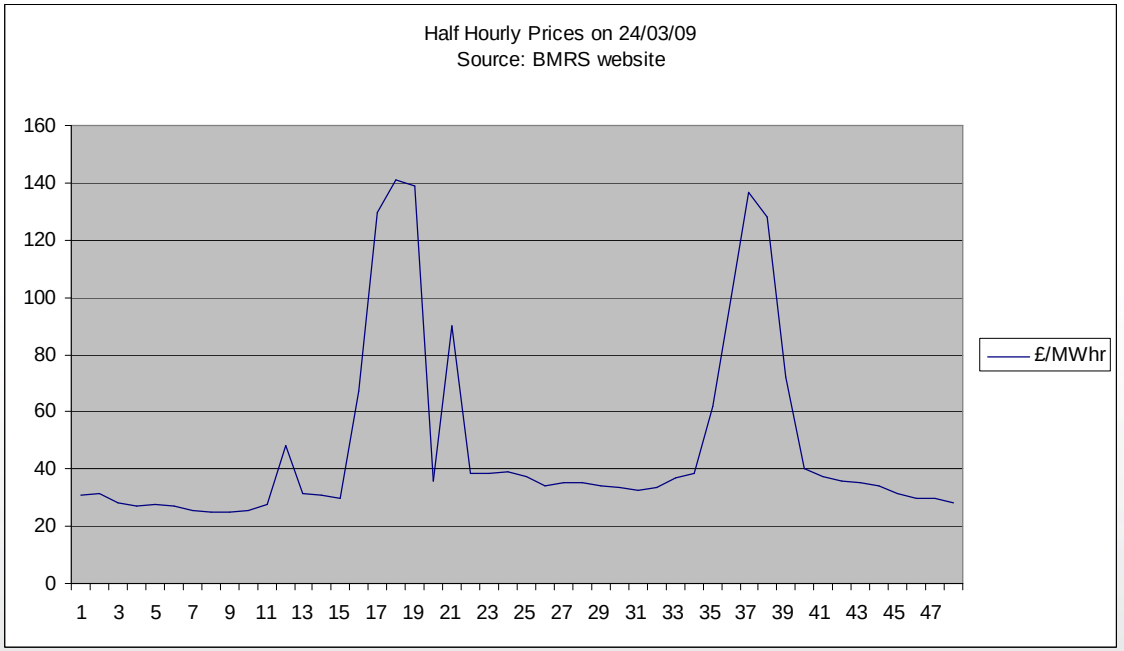

The Balancing Mechanism Reporting System (BMRS)
The BMRS website provides near real time and historic data about the Balancing Mechanism which is used by the National Grid (System Operator) as a means of balancing power flows on to and off the electricity Transmission System in the UK.

Energy Storage Applications

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Energy Storage Applications

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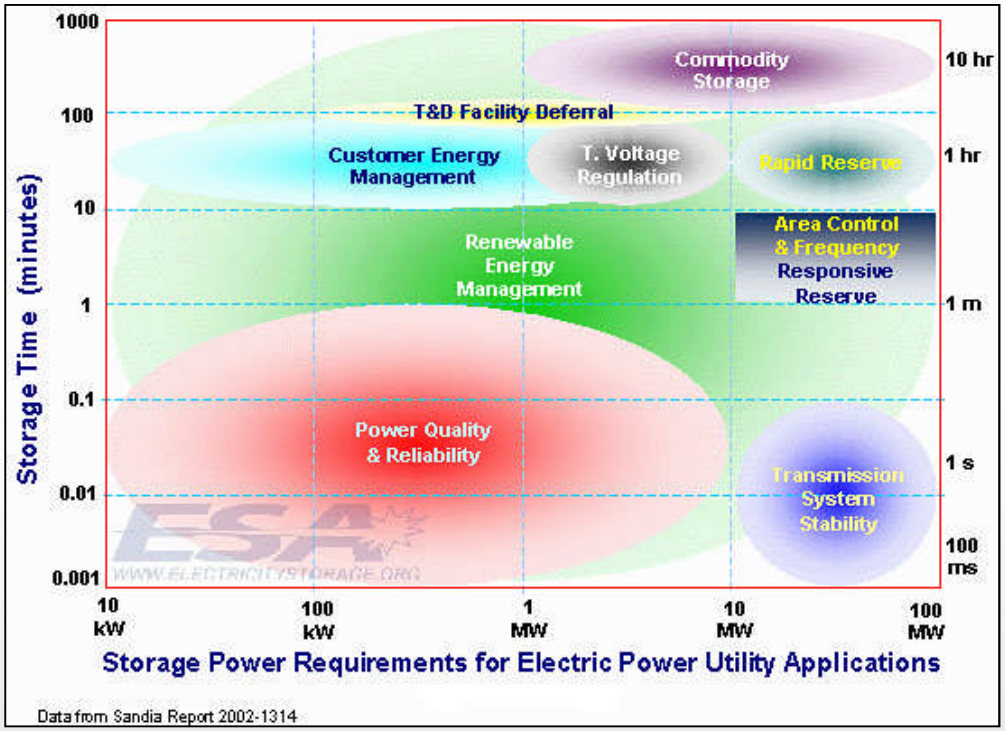
Segmented by size and storage time:

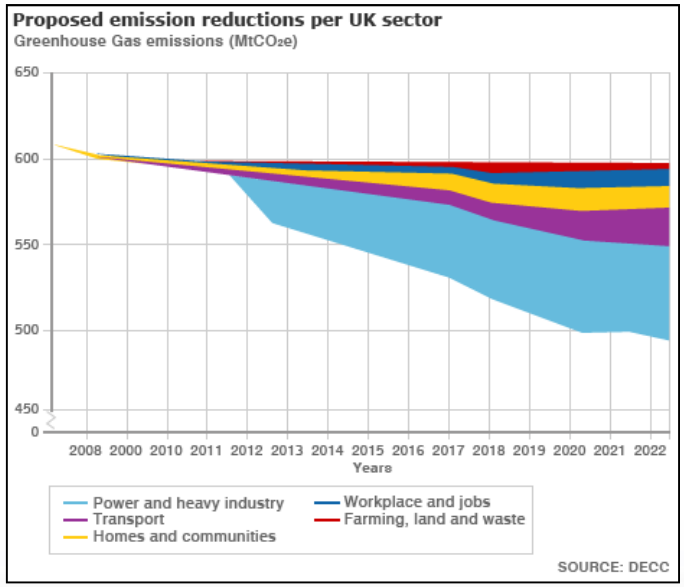
- Commodity storage (already discussed)
- Renewable energy management
- Power Quality
- Customer Energy Management

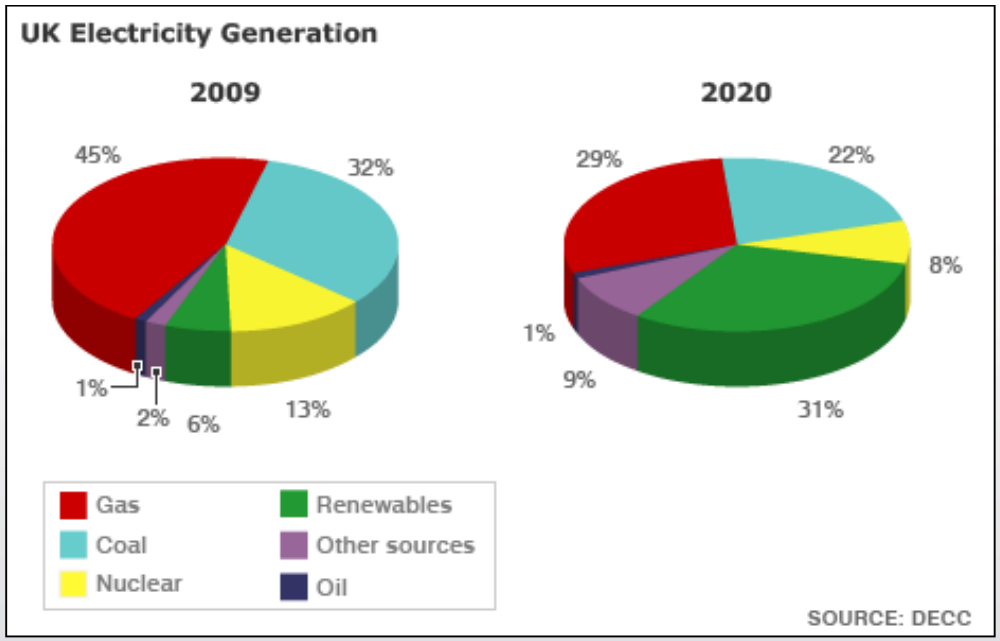


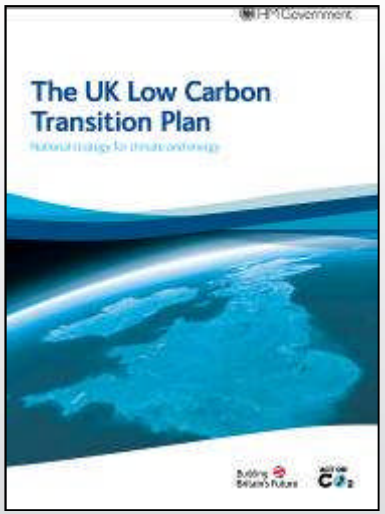
UK Generation

CO_2 targets to be met by power & heavy industry:

- 16% reduction in GG emissions by 2020
- 31% renewable generation by 2020
- This cannot be achieved without energy storage!







Unpredictable Generation

- Low load factors
- Supply and demand mismatch
- Low return on capital
- Prices passed onto the customers

Table 1: Regional capacity factors

	1998	1999	2000	2001	2002	2003	2004	Average 1998-2004
East of England	0.23	..	..	..	..	0.23	0.26	**0.24**
North East	..	..	..	..	0.23	0.19	0.22	**0.21**
North West	0.30	0.29	0.27	0.23	0.27	0.24	0.26	**0.27**
Yorkshire and The Humber	0.32	..	..	..	..	0.28	0.27	**0.29**
South West	0.30	..	..	..	..	0.24	0.24	**0.26**
England	0.30	0.28	0.27	0.23	0.27	0.24	0.25	**0.26**
Northern Ireland	0.40	0.39	0.37	0.32	0.35	0.34	0.36	**0.36**
Scotland	0.34	0.29	0.29	0.27	0.29	0.28	0.34	**0.30**
Wales	0.29	0.29	0.26	0.23	0.26	0.25	0.26	**0.26**
UK average	**0.31**	**0.31**	**0.29**	**0.26**	**0.28**	**0.26**	**0.29**	**0.29**
UK aggregate load factor	***0.31***	***0.28***	***0.28***	***0.26***	***0.30***	***0.24***	***0.27***	***0.28***

DTI, 'Energy Trends', March 2006 p. 29

5MW offshore wind turbine

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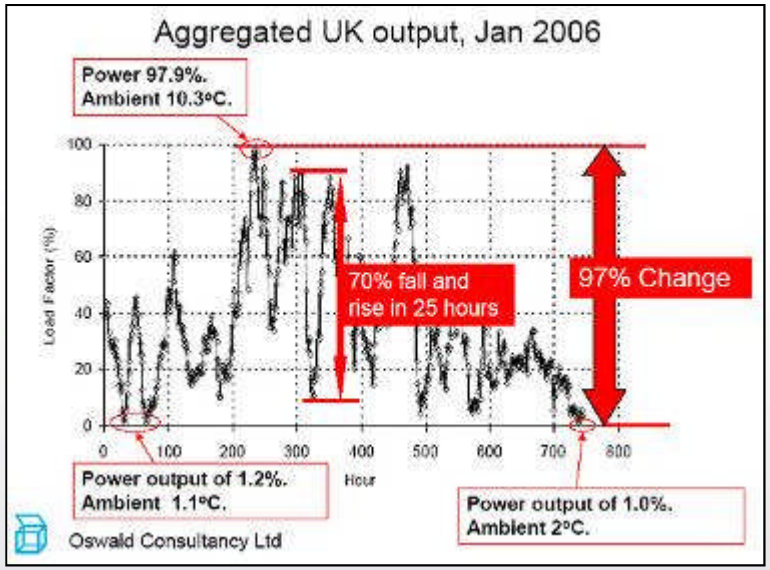

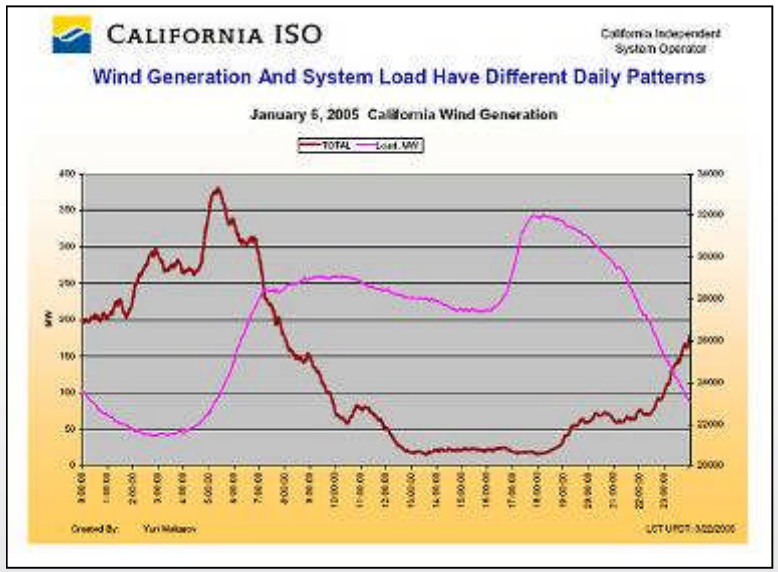

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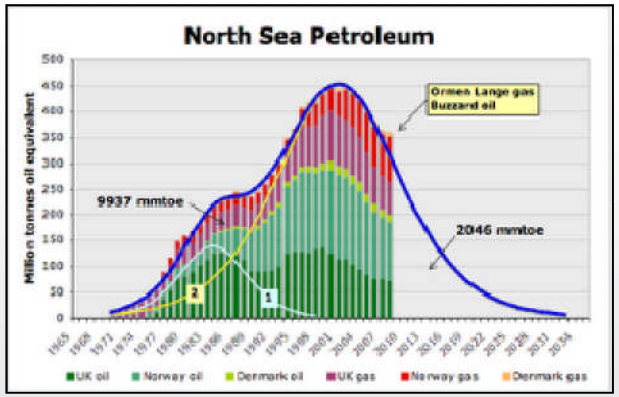
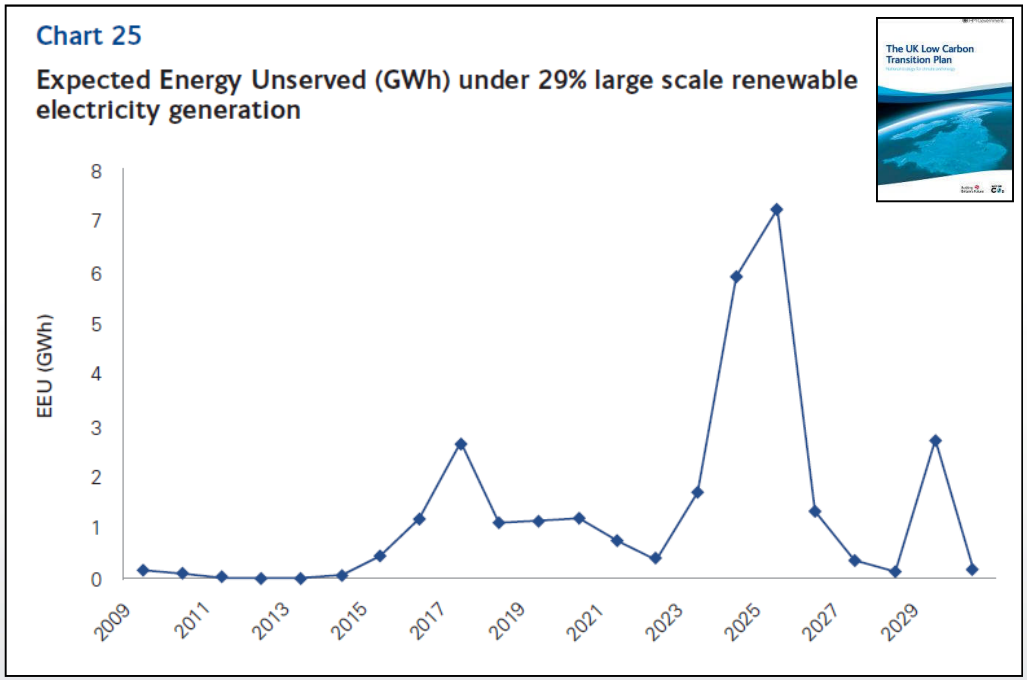
Transition plan predicts 7GWh unserved demand in 2025

- Short fall starts in 6yrs
- 7GWh is 50% of UK out for 1hr
- Based on optimistic projections
- Energy storage is a key solution





Energy Management:

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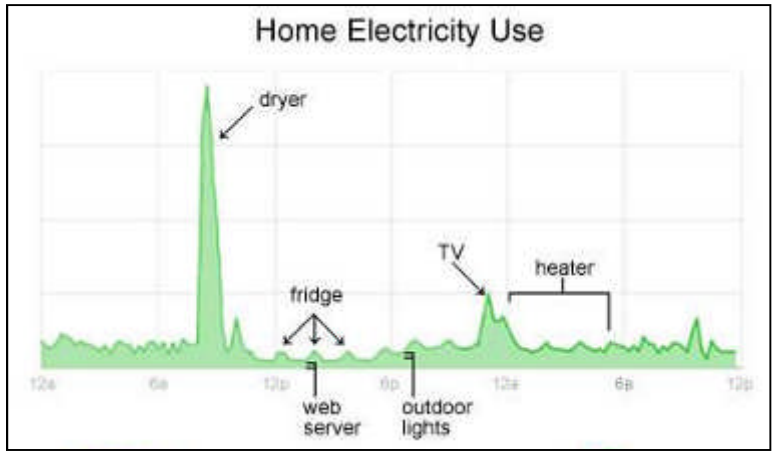
Customers are the most extreme peaks:

- Local peak management
- Energy storage
- Embedded generation
- Demand side management




Smart meters will work with real-time energy displays showing energy use around the home. Photograph: Energy Retailers Association/PA

Energy Storage Technologies

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Energy Storage Applications:

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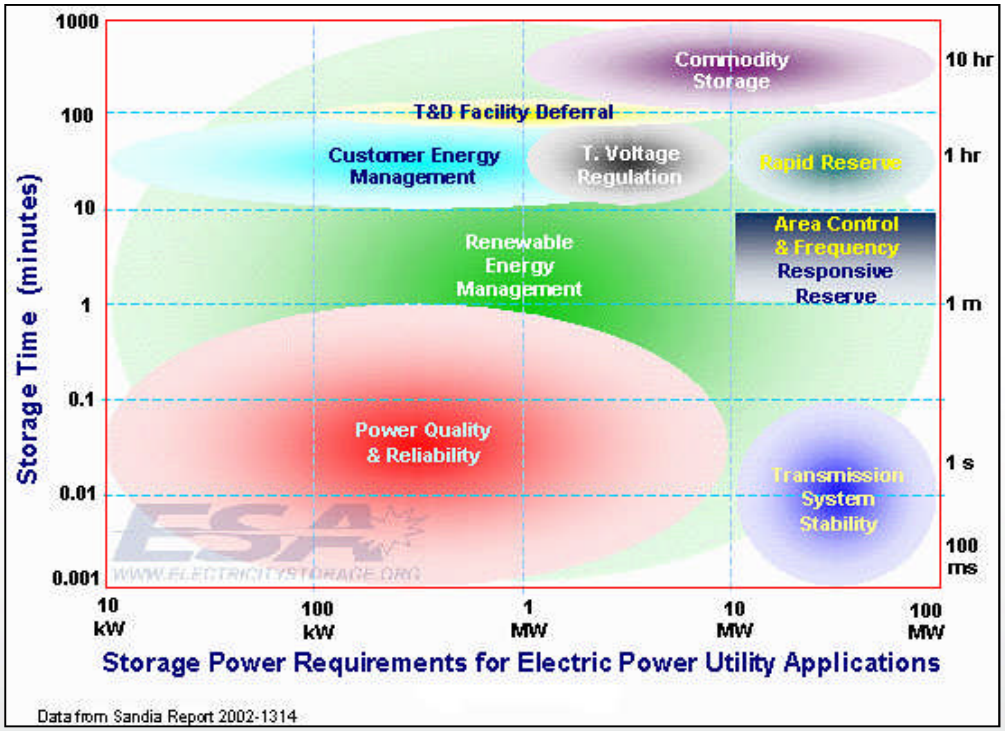

Energy Storage Technologies:

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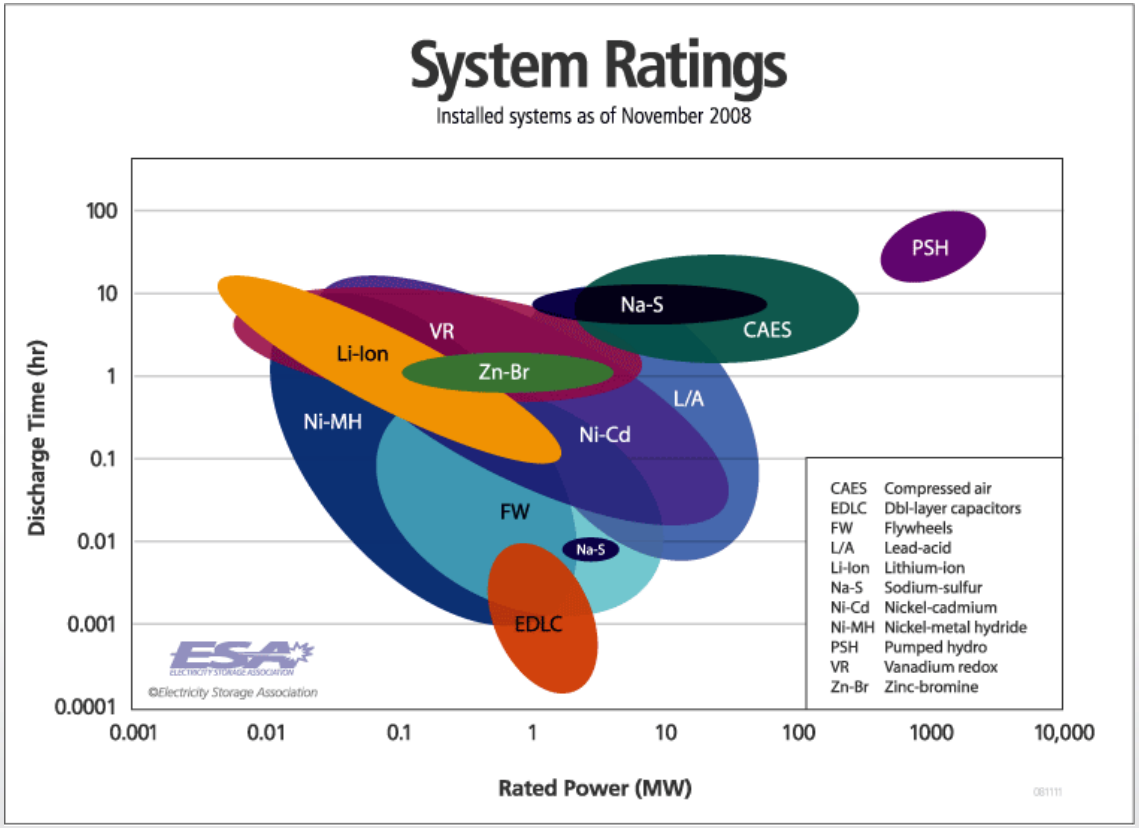
Segmented by size and storage time:

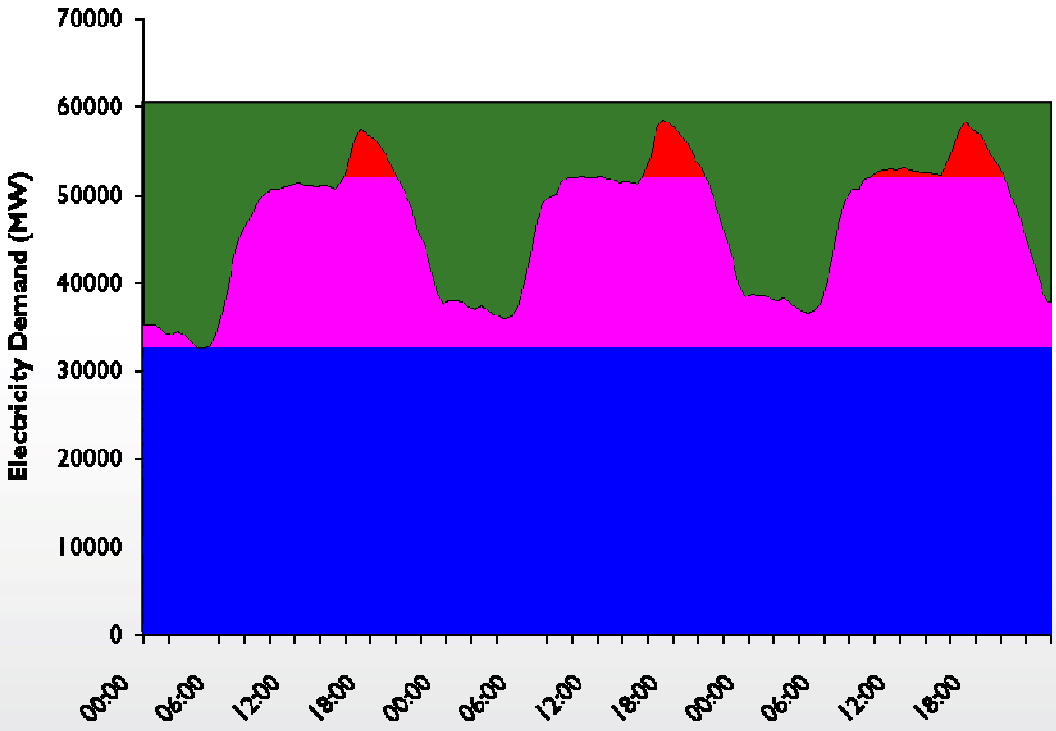
- Pumped hydro
- Compressed Air
- Flywheels
- Batteries
- Flow cells
- Hydrogen



Fuel and Power:

Sector Export:

- Demand side management
- Energy storage
- Energy security
- Clean fuel



Data from National Grid

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Supply Chain Logistics:

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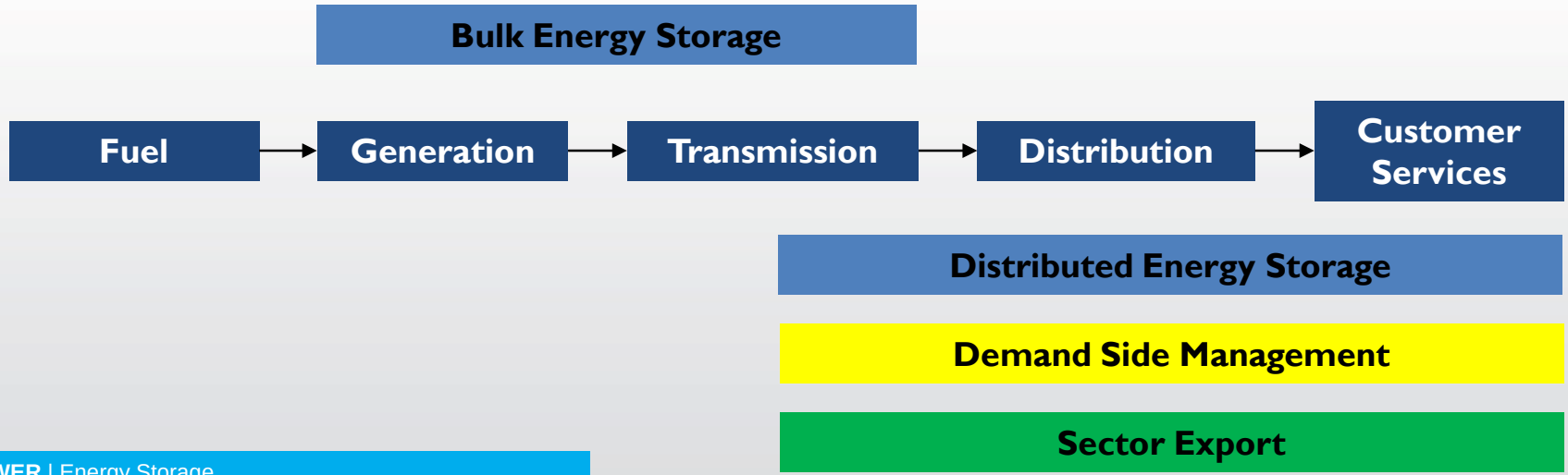


Summary:

Energy storage offers:

Improve operational efficiency

Integrate intermittent renewables

Support base load nuclear

Join the dots between power & energy

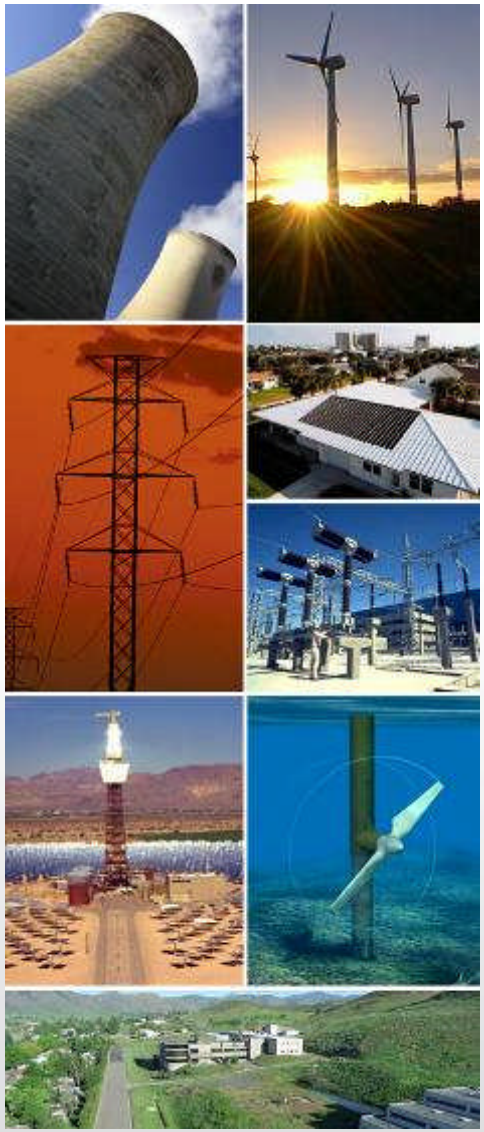
Decarbonisation

However:

Many technologies are unproven

Cost targets are difficult to define

Engineering scale poses a technology risk



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