



www.eti.co.uk

Future challenges for UK electricity storage

Laura Morris - Energy Policy Analyst

Energy Technologies Institute

Laura.morris@eti.co.uk



Overview

- Technologies and applications
- UK electricity markets, policy and regulation
- Key future challenges



ETI technology programme areas



ETI Members



ETI programme associate





The ETI works with:





Current technology costs

- “Over the next 10 years, innovation could lower costs by around 13%, with further savings after 2020 capable of lowering costs by around 44% by 2050 compared with 2010 costs” (LCICG, 2012)

		£/kWh ¹¹	£/kW
Pumped hydro	Traditional onshore reservoir	150	1500
	Offshore 'energy islands'	200	2000
CAES	Underground/geological	150	1500
	Aboveground	200	2000
Sodium-based batteries		250	1250
Redox flow batteries	kWh or kW	400	2000
Lithium-based batteries		1000	5000
Flywheels		4000	1000
Supercapacitors		6000	1500
Thermal-to-electric storage		200	2000
Average		1255	1975

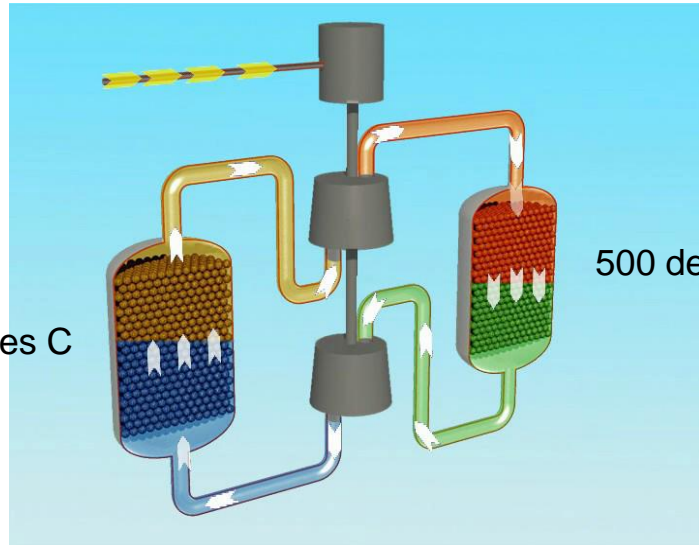
Technology Innovation Needs Assessment (TINA) Electricity Networks & Storage (EN&S), LCICG (2012)



Iisentropic

- Electrical energy to heat and cold in reversible process
- System range 700kW – 6MW
- Multiple storage services capability
- £400/kW, £45/kWh

Motor/Generator

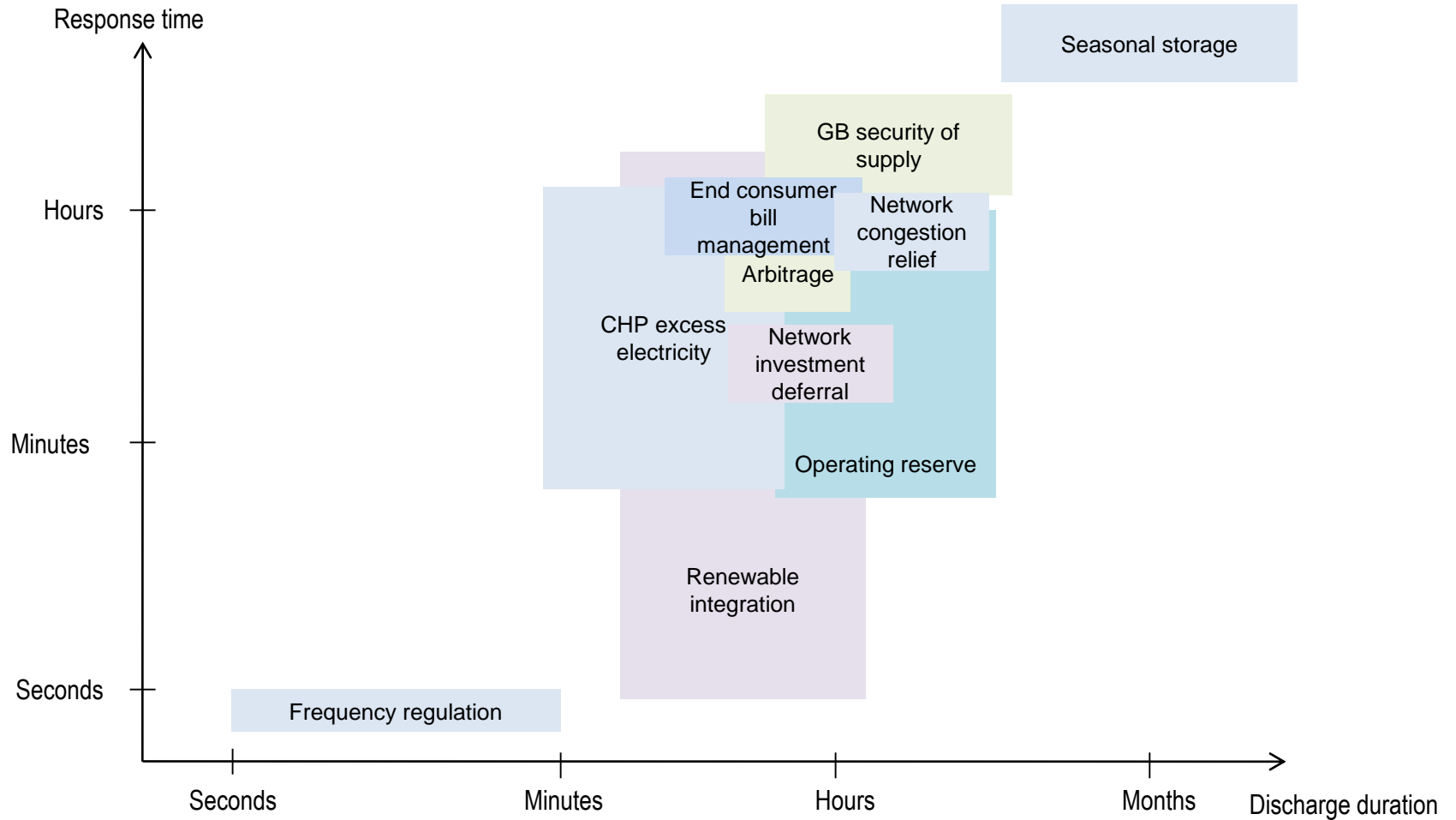


Iisentropic
A new era in electrical energy storage and recovery

**WESTERN POWER
DISTRIBUTION**
Serving the Midlands, South West and Wales



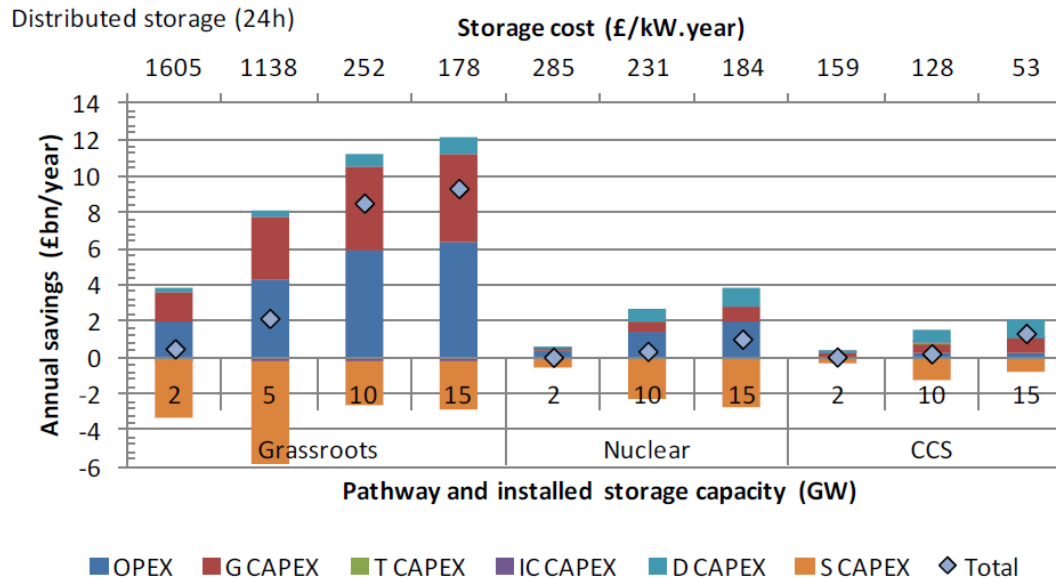
Energy storage applications





Value of storage to 2050

- Modelling the value of storage is complex and requires a system wide view across multiple time durations
- The value of energy storage can be heavily influenced by: the generation mix (inc renewable integration); ability to 'stack' revenues; and the availability of alternatives to storage
- Work by Imperial College London and ESME modelling both show greater role for storage towards 2030
- LCICG identified cost reduction potential of £4.6bn (£1.9-10.1bn) to 2050 associated with deploying 27.4 GW (7.2-59.2GW)

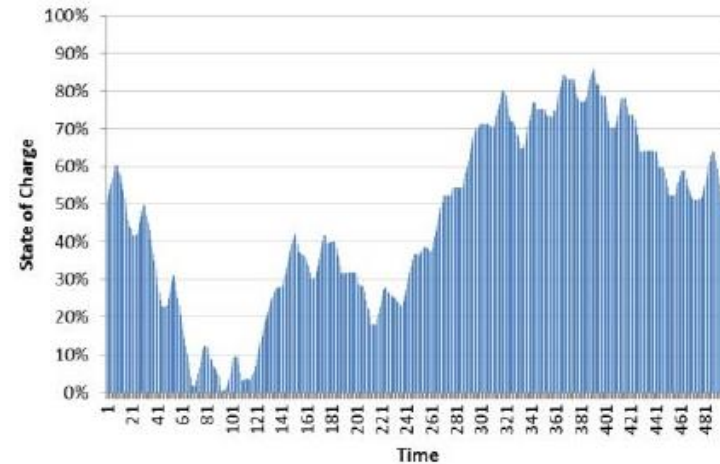
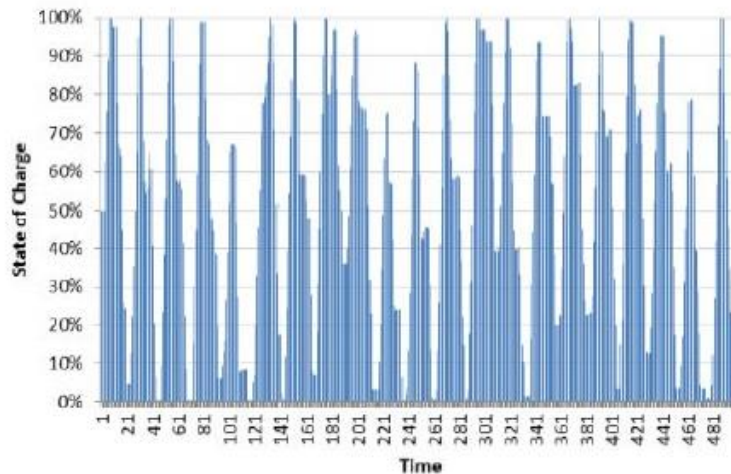


Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future, Imperial College London (2012)



Energy storage applications continued

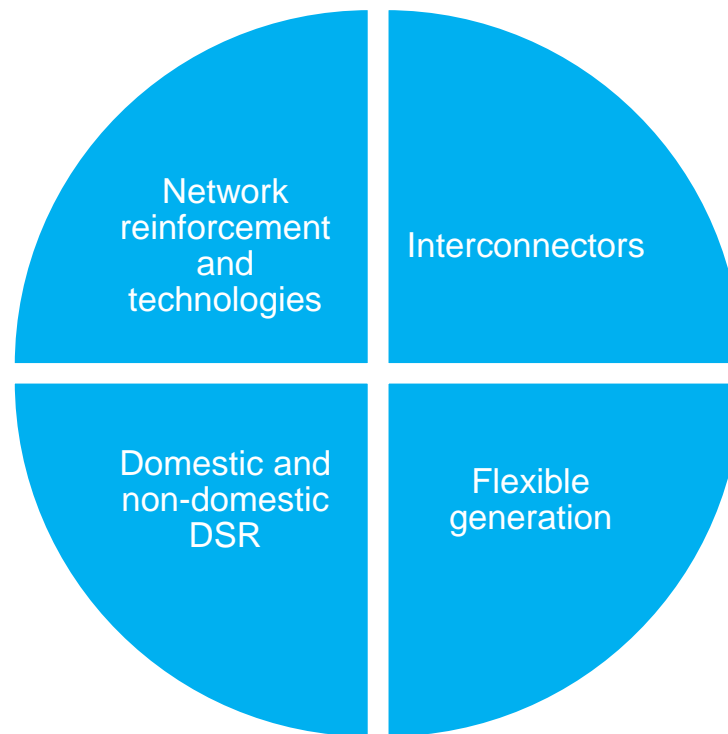
- Technology choice and application are associated with different operational characteristics



Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future, Imperial College London (2012)



Alternative technologies





UK experience of electricity storage



- 3 GW pumped hydro in Wales and Scotland
- Approx 20 MW storage commissioned, under construction or in development stages in GB including battery; liquid air and pumped heat energy storage



UK policy and regulation

- UK energy policy driven by sustainability, energy security and affordability aims – ‘the Trilemma’

Generation

- CfDs
- Capacity mechanism

Supply and wholesale markets

- Future trading arrangements
- Smart meter roll out
- Price volatility

Balancing

- Focus on sharpening price signals (cash out)
- New market creation (DSR)

Networks

- RIIO
- Smart Grid Forum



Storage - illustrative market prices

Example market	Overview	Market status	Illustrative current prices
System balancing: frequency response; operating reserve; reactive power etc	Procured by system operator. Current markets include mandatory arrangements, bilateral contracts and competitive tenders	Developed markets but potential for new products in future	Frequency response: availability £24/MWh; utilisation £1.25/MWh STOR: availability £4.50/MWh; utilisation £130/MWh (UKPN 2013)
Arbitrage	Wholesale market	Developed market for large generation	le off-peak £35/MWh, peak £45/MWh
Transmission and distribution services: avoided reinforcement; congestion management etc	Procurement by network owners	No current market	UKPN example: £1,033/kW avoided cost of reinforcement (UKPN 2013)
Inertia	Provides system stability	No current market	N/a



UK storage innovation policy

- LCICG core members expect to invest up to £75m between 2011 and 2015 in RD&D for energy storage technologies (LCICG 2012)
 - DECC: Energy Storage Technology Demonstration Competition – focus on demonstration of innovative and diverse energy storage technologies
 - £8ml to Viridor Waste Management Ltd and Highview Power Storage in 2014
 - 3 projects funded in 2013: Moixa Technology Ltd; REDT UK Ltd; and EValu8 Transport Innovations Ltd
 - EPSRC: £30m for five centres to support new science capital facilities for grid-scale energy storage
 - ETI: £14m investment in Isentropic project to develop and demonstrate a 1.5MW/6MWh grid-scale electricity storage unit
- Ofgem Low Carbon Networks Fund (LCNF) and Network Innovation Competition (NIC)
 - Funds awarded to network owners to trial novel technologies
 - Storage competes against other technologies
 - Largest award for storage is Smarter Network Storage project by UKPN (£13.2ml)



Future challenges

- **Understanding the role and value of storage in individual markets**
 - Modelling the value and role of storage in future energy system scenarios remains complex due to system dependencies and uncertainties
 - Availability of mid to long term forecasts varies across different markets with various methodologies and assumptions used
- **Technology development and demonstration**
 - Realising potential cost reductions
 - *“Over the next 10 years, innovation could lower costs by around 13%, with further savings after 2020 capable of lowering costs by around 44% by 2050 compared with 2010 costs” (LGICG 2012)*
 - Preparedness
 - *“We expect that actual future deployment will heavily favour a subset of dominant technologies, and we do not know with certainty which those will be” (LCICG 2012)*



Future challenges

- **Building industry knowledge and capacity**
 - Development and demonstration of operation and commercial models for revenue stacking and development of best practices
 - Development of cross-sector/ cross-vector collaborations and partnerships
 - Experience in new market mechanisms and frameworks
- **Ensuring market frameworks enable efficient deployment of new technologies**
 - Transparent and open markets frameworks
 - Market arrangements that enable efficient revenue stacking and capture of cross-sector/ cross-vector revenues streams
 - Potential creation of new markets



Registered Office
Energy Technologies
Institute
Holywell Building
Holywell Park
Loughborough
LE11 3UZ

Energy Technologies Institute (SSH)
6220 Bishops Court
Birmingham Business Park
B37 7YB



For all general enquiries
telephone the ETI on
01509 202020.



For more information
about the ETI visit
www.eti.co.uk



For the latest ETI news
and announcements
email info@eti.co.uk



The ETI can also be
followed on Twitter
[@the_ETI](https://twitter.com/the_ETI)



References and further reading

- [Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future](#), Imperial College London (2012)
- [Technology Innovation Needs Assessment \(TINA\) Electricity Networks & Storage \(EN&S\)](#), LCICG (2012)
- [SNS4.11 Investment Model Template – Jul 13](#), UKPN (2013)
- [Energy Storage: the Missing Link in the UK's Energy Commitments](#), Institution of Mechanical Engineers (2014)
- [Energy Storage Opportunities and Challenges: A West Coast Perspective White Paper](#), Ecofys (2014)
- [Electricity Storage Handbook](#), DOE/EPRI in Collaboration with NRECA (2013)