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The global role for energy storage

7th Annual LCEDN conference, Loughborough,
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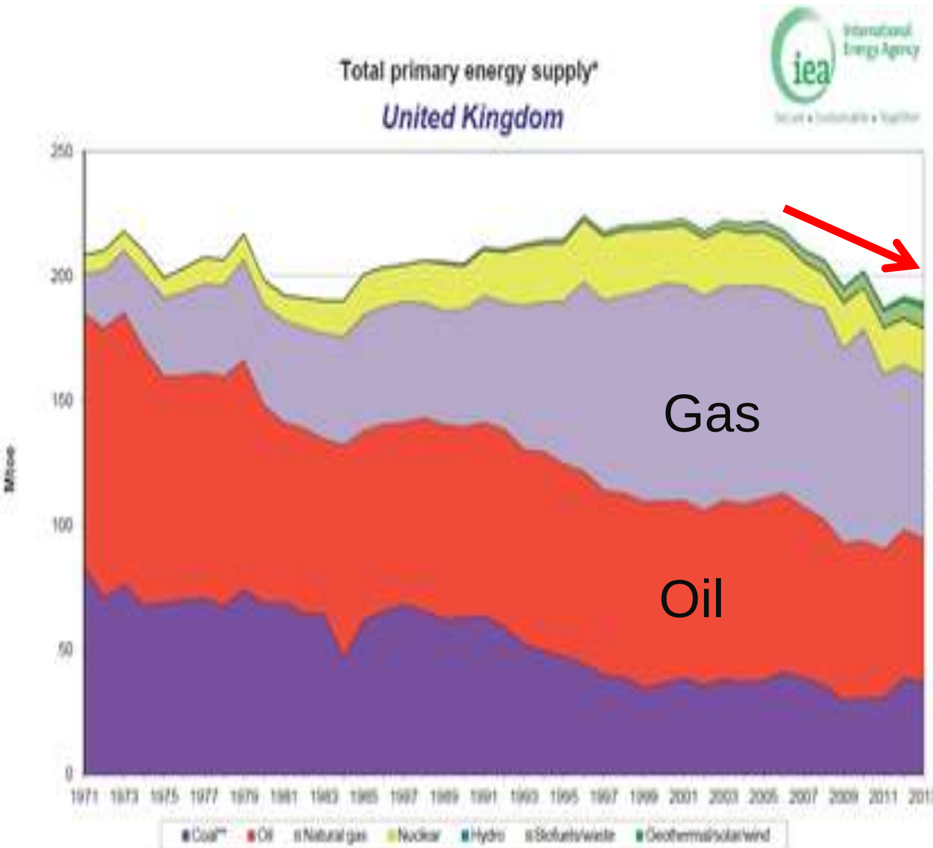
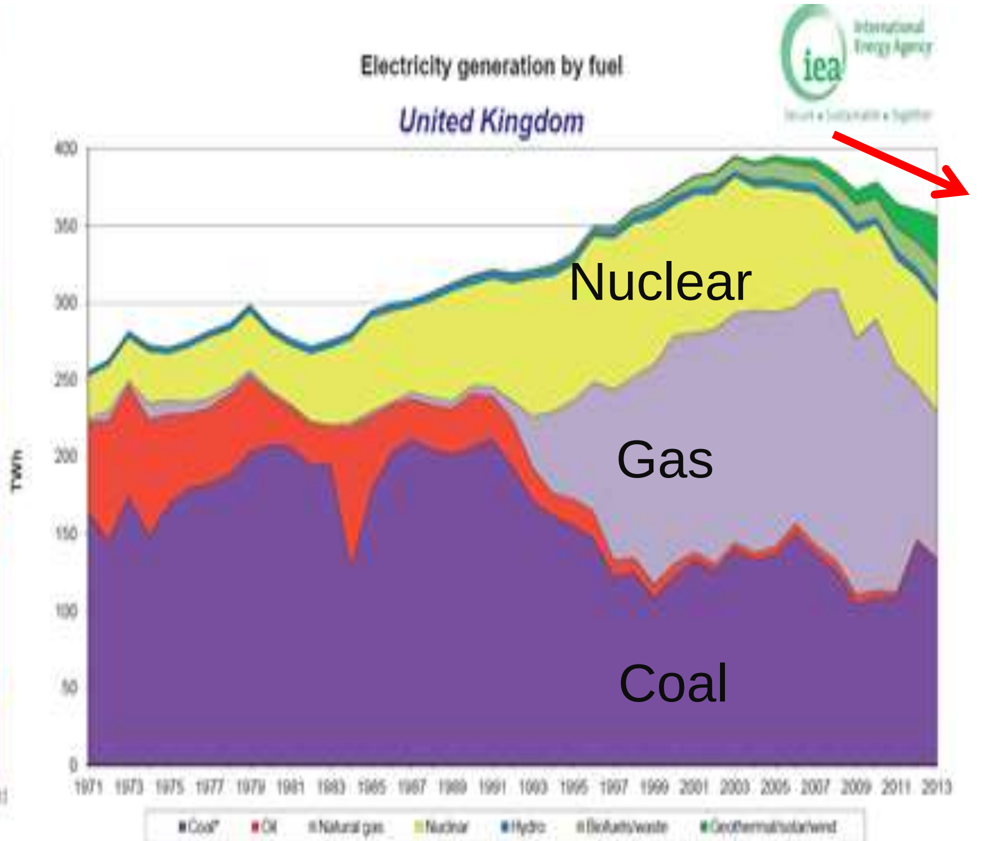
Outline

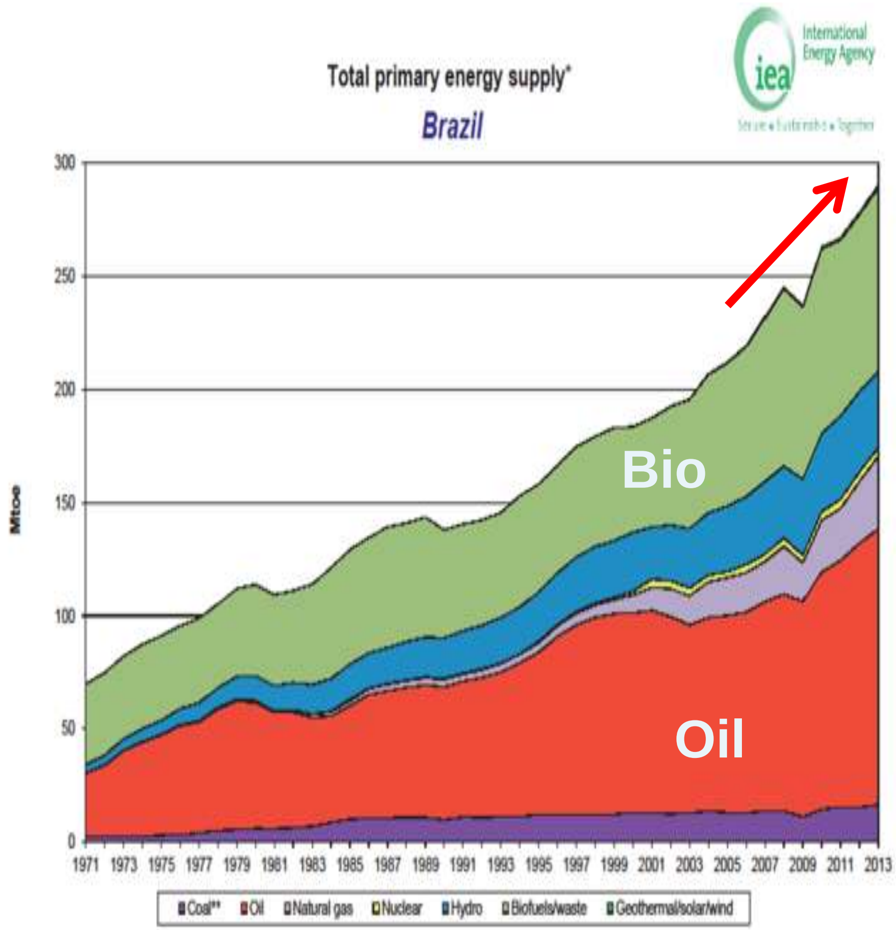
- Energy systems in the UK and Brazil
- How energy storage could be valuable
- Newton Fund institutional links project in Mexico
- UoB's Institute for Global Innovation, Resilient Cities theme

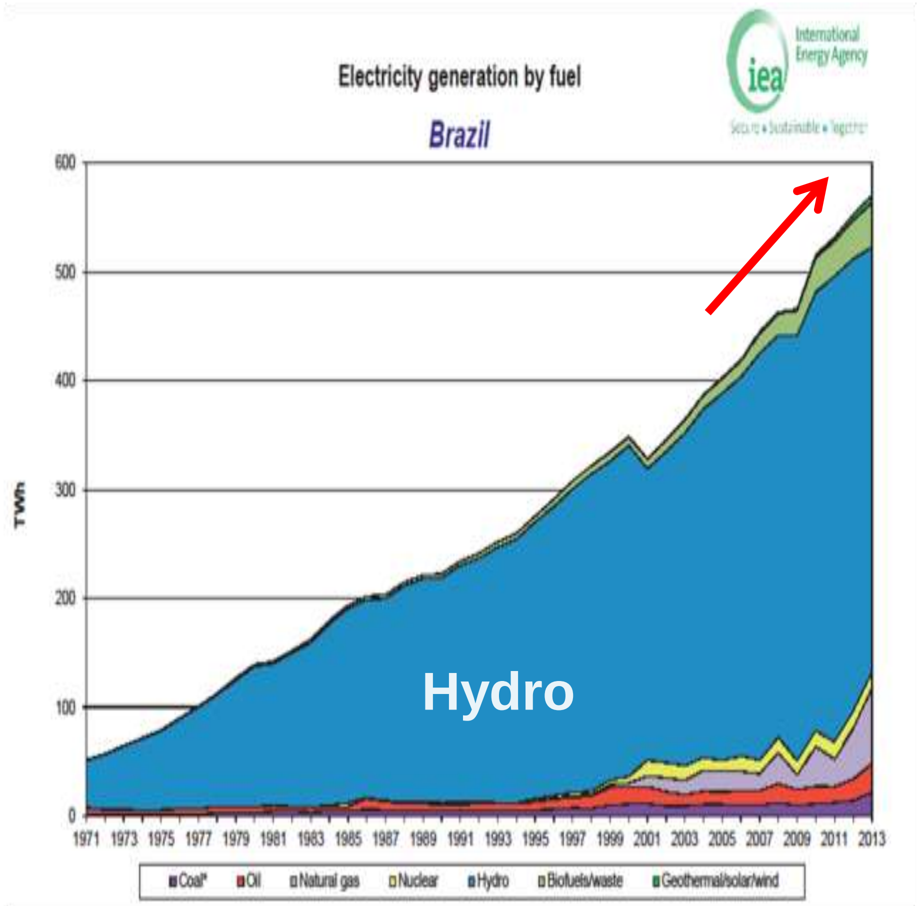
Energy in the UK: historical trends





Energy in Brazil: historical trends





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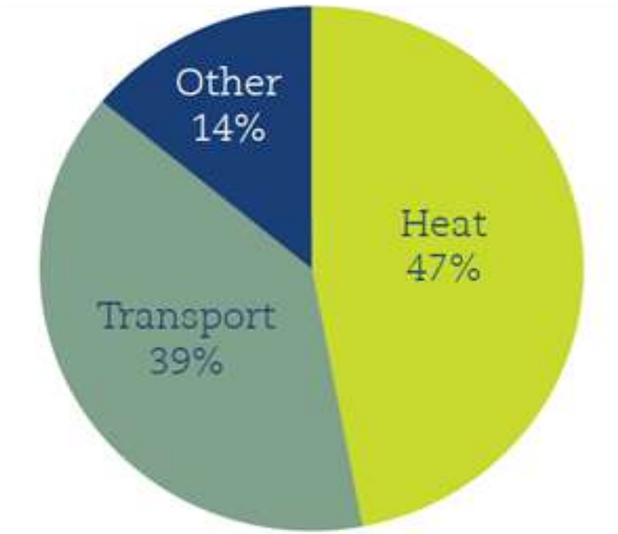
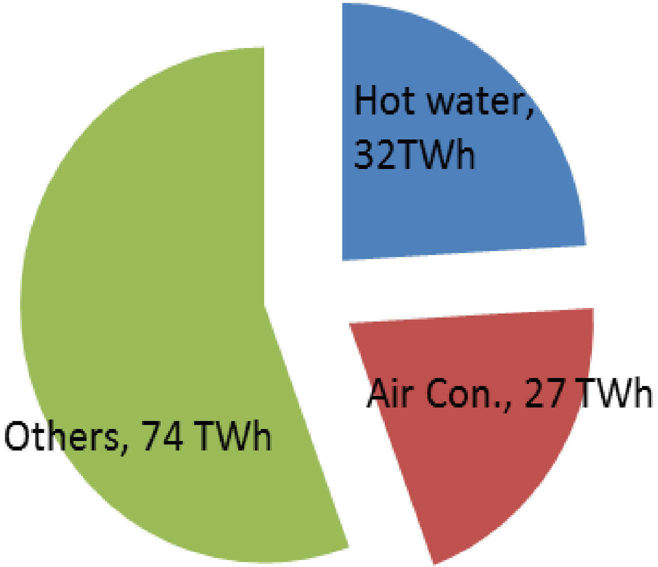
UK-Brazil energy consumption



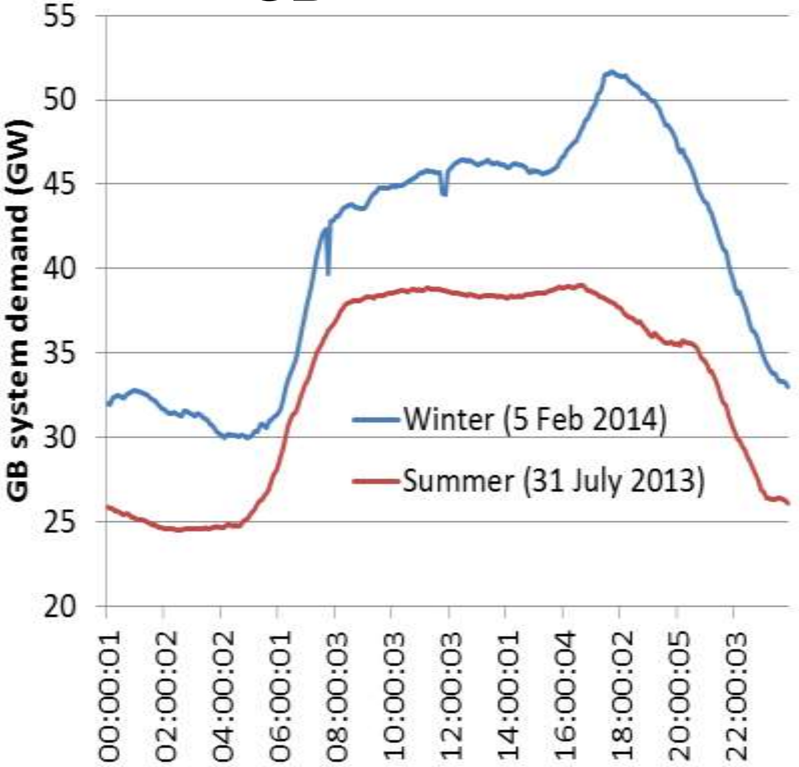
UK



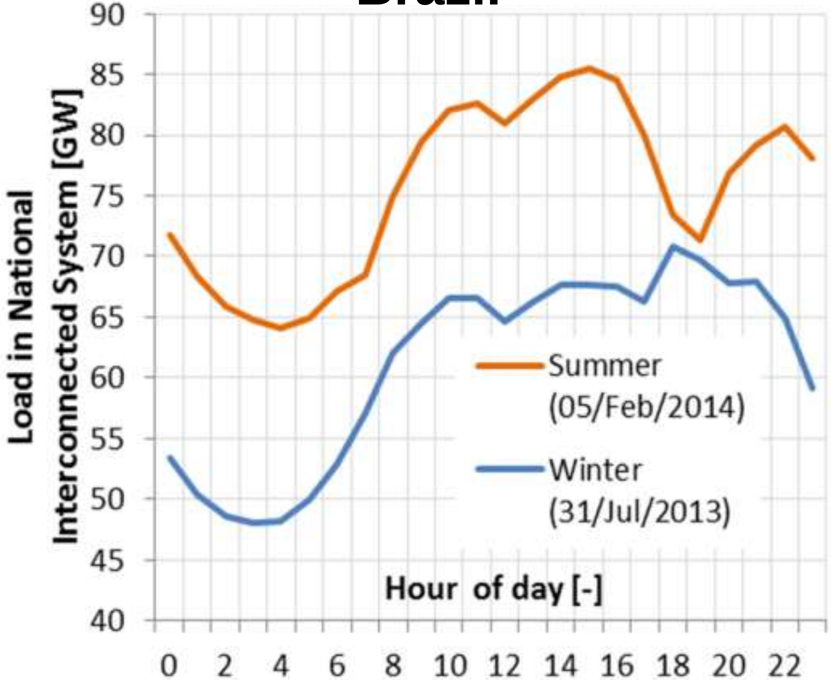
Brazil residential

Electricity demand profiles

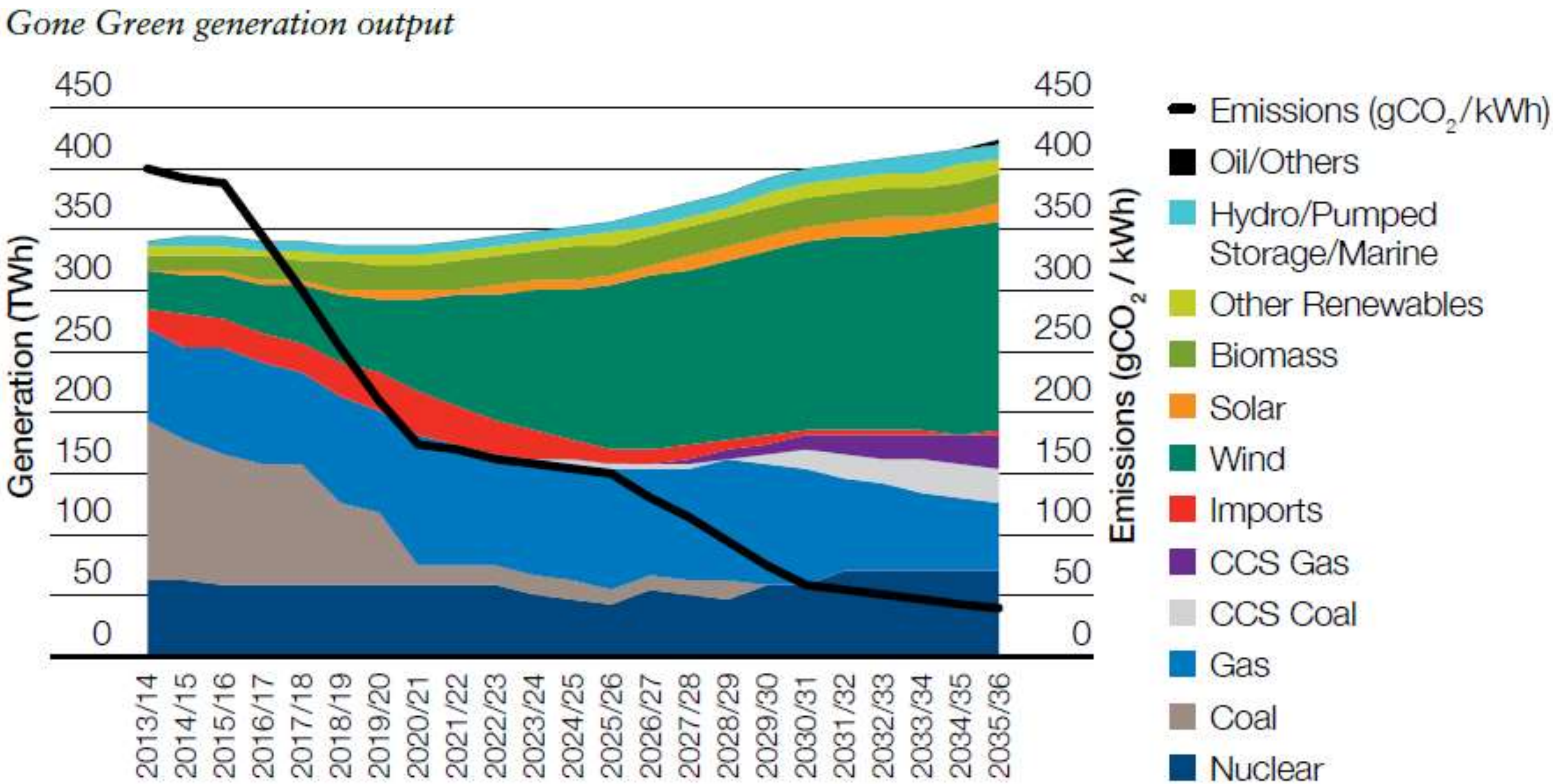
GB



Brazil



Decarbonising electricity in the UK



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National Grid, Future Energy Scenarios (2014)

Energy system need for flexibility

Challenges will become more acute in pathways to 2050 and will emerge at different times:

- Growing proportion of intermittent generation
- Increase in demand for electricity for heating/cooling and transport

Analysis shows that last-cost pathways have more flexible energy systems

Energy storage is one option for providing flexibility…

Timescale	Challenge
Seconds	Renewable generation introduces harmonics and affects power supply quality.
Minutes	Rapid ramping to respond to changing supply from wind generation.
Hours	Daily peak for electricity is greater to meet demand for heat.
Hours - days	Variability of wind generation needs back-up supply or demand response.
Months	Increased use of electricity for heat leads to strong seasonal demand profile.

Global challenges

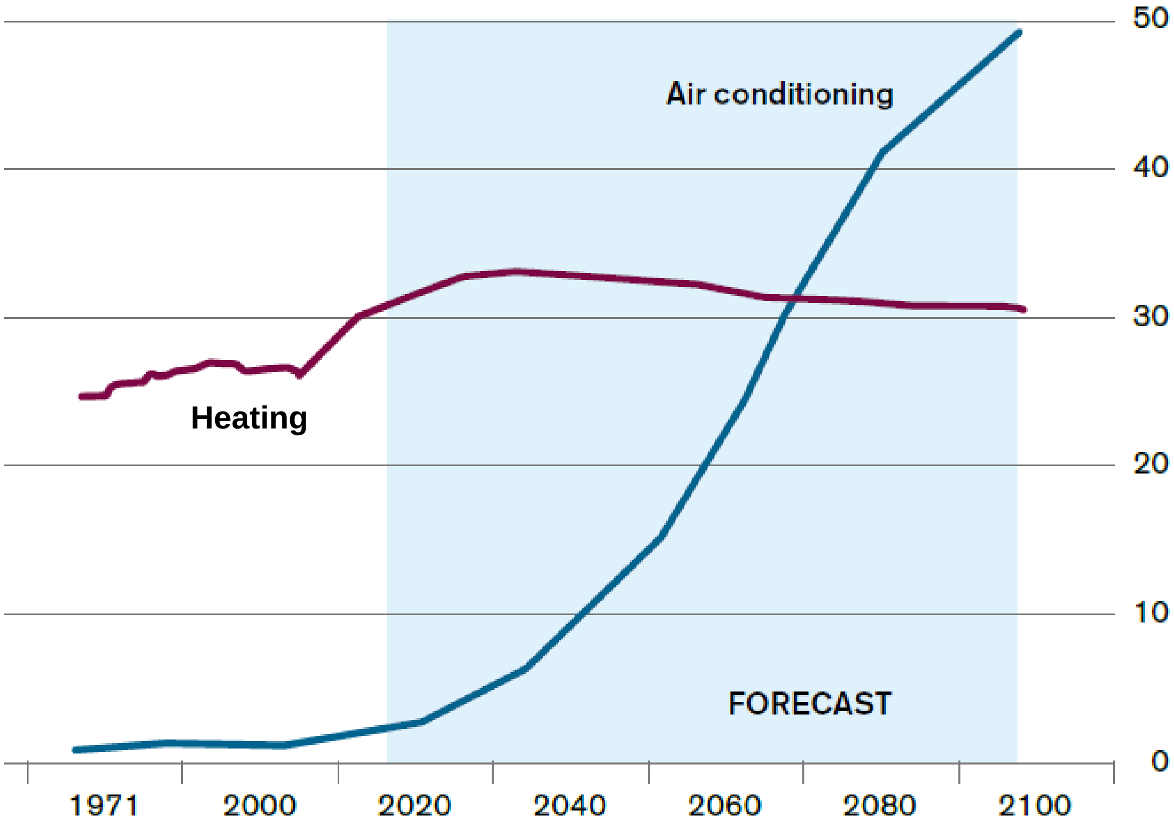
Challenges to: reduce environmental impact, improve reliability, lower costs, increase access, manage greater urbanisation, secure supplies…

Applying technologies for

- ‘Smart grids’
- Growing cooling demand
- Rise in distributed generation from solar PV
- Maximising use of infrastructure
- Managing power quality
- ‘Behind the meter’
- Off-grid small-scale renewables

….

Doing cold smarter



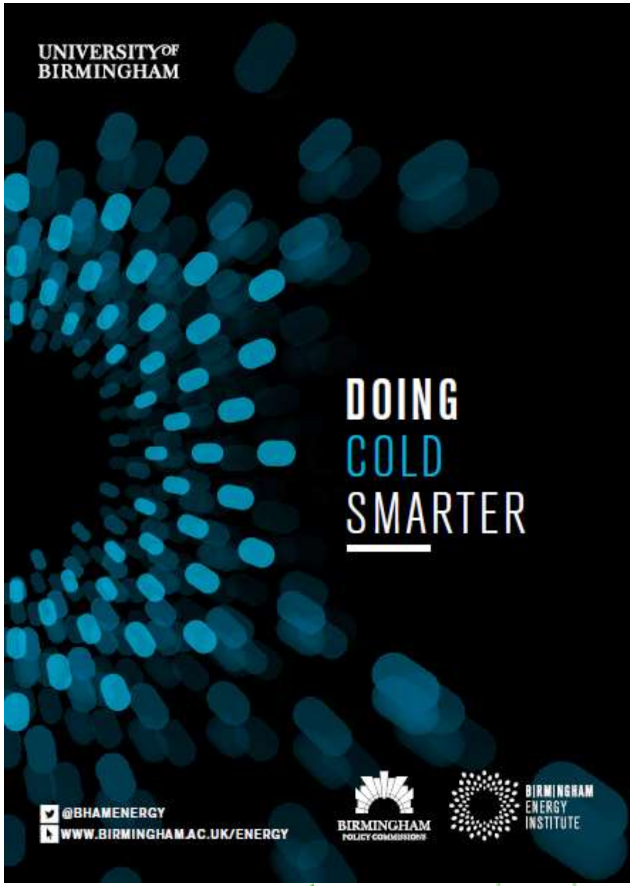
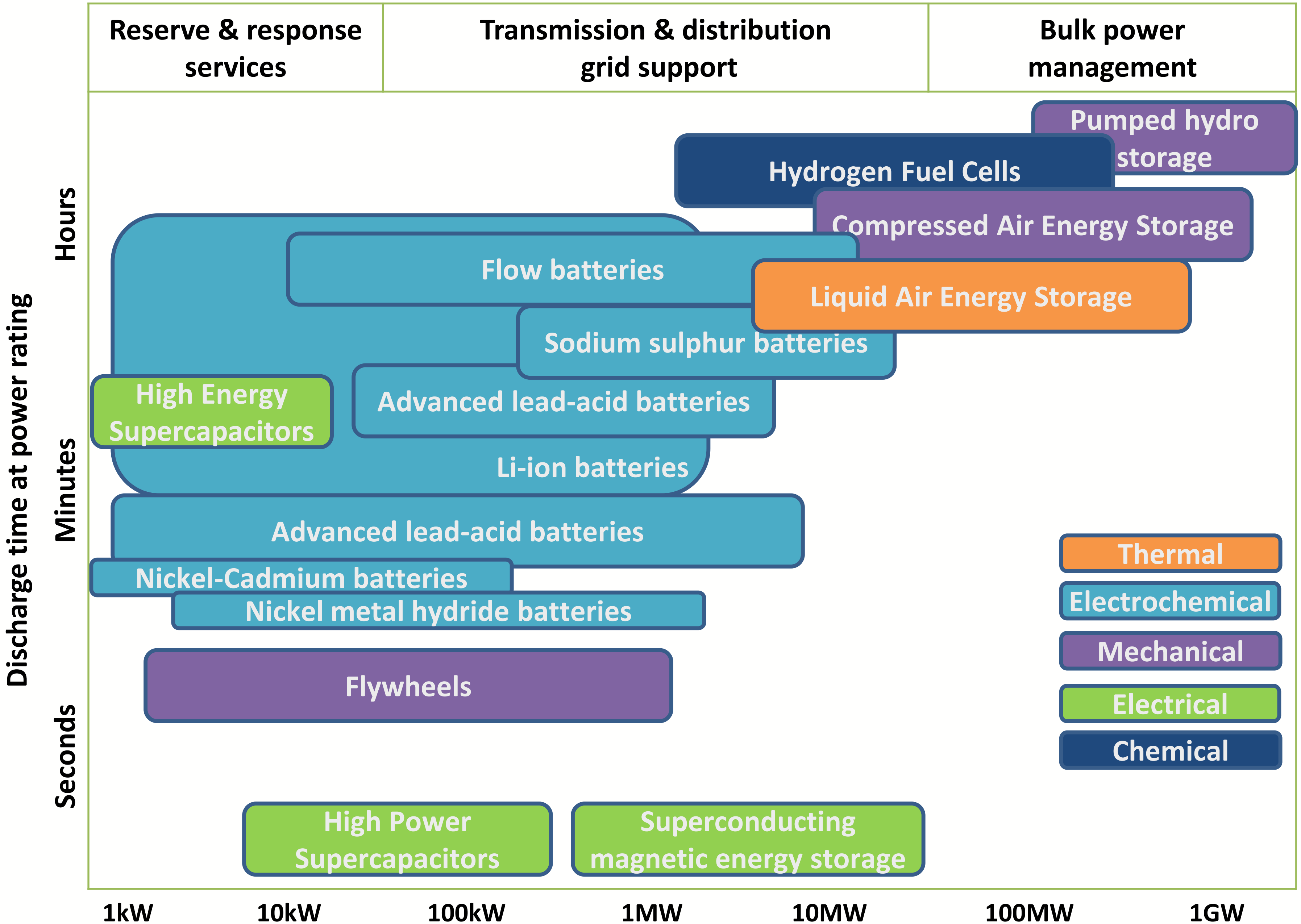


Figure 6: Worldwide forecast energy demand for space heating and space cooling, exajoules. Source: PBL Netherlands Environmental Assessment Agency[79]

http://www.birmingham.ac.uk/doingcoldsmarter

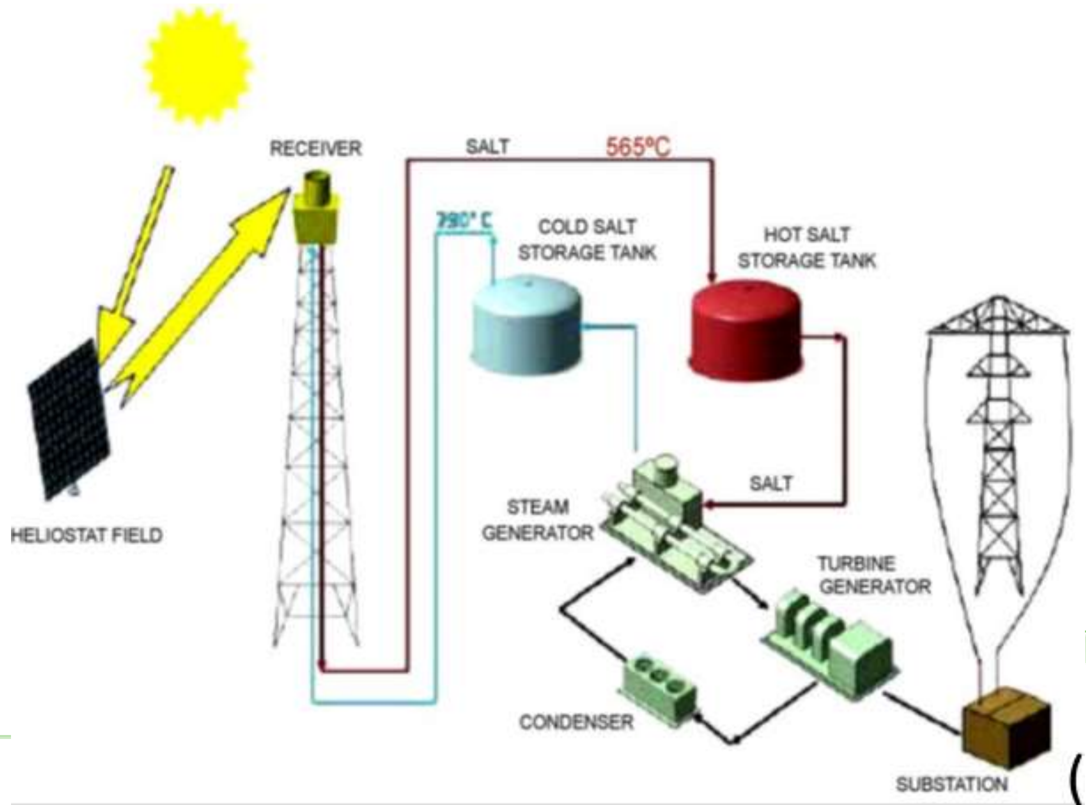
Electricity Storage Technology options



http://www.lowcarbonfutures.org/energy-storage-factsheets

Thermal energy storage

- Sensible heat: raising/lowering temperature of a material
- Phase change: stores latent heat at a constant temperature corresponding to the phase transition temperature of the material.
- Thermo-chemical: reversible chemical reaction which give up or absorb heat.



Barriers to deployment

- Technology cost and performance: other technologies are currently cheaper
- Uncertainty of value: the future value is dependent on the energy system mix
- Business: capturing multiple revenue streams is difficult to establish, both for a potential business and the market in which it will operate
- Markets: the true value of energy is not reflected in the price; more fundamentally, the future long-term value of storage cannot be recognized in today's market
- Regulatory/policy framework: restrictions on ownership; paying levies twice
- Societal: wider community acceptance has not yet been considered

UK-Brazil opportunities

System	Storage	Note
Large scale	PHS, PHES, CAES, LAES	• Replacing hydroelectric capacity • Renewable energy integration, primary and secondary reserve
Small scale	LAES (large) Batteries (small)	• Renewable energy integration • Backup generation • Remote area and distributed networks * Increasing transmission can reduce the role
Heat	TES, EES	• Solar thermal: thermal energy storage • Electric shower: time shift
Cold	TES, EES	• Solar cooling: thermal energy storage • Air conditioning: time shift
EV	Batteries	* Limited potential due to the competitive biofuel supply in Brazil

Report 'ENERGY STORAGE IN THE UK AND BRAZIL: Challenges, Capability and Opportunities' (July 2016) at https://www.birmingham.ac.uk/Documents/college-eps/energy/Publications/Energy-Storage-in-the-UK-and-Brazil-Dr-Jonathan-Radcliffe.pdf

Newton Fund Institutional Links project
Energy Storage Prioritisation in Mexico

Newton Fund

INSTITUTIONAL LINKS

- → Deploying Renewable Energy Technologies to promote social and environmental sustainability is a key Mexican energy policy (Energy Sectoral Programme 2013-2018).
- → Energy storage technologies can allow further penetration of renewables, and also provide other social benefits.
- → A whole-system assessment of the energy needs of individual communities will guide technological innovation and policy.
- → This feasibility study will create an evidence base for development of a demonstrator, and provide an assessment framework for energy storage options in other areas of Mexico.

This work was supported by an Institutional Links grant, ID 332240317, under the Newton-CONACyT partnership. The grant is funded by the UK Department of Business, Energy and Industrial Strategy (BEIS) and delivered by the British Council. For further information, please visit www.newtonfund.ac.uk

Project approach

- Multi-Criteria Decision Analysis (MCDA) approach will be employed to assess the benefits of individual energy storage technologies in specific locations against criteria e.g. social and economic benefit.
- Stakeholder consultation will refine these criteria, producing a list of potential developments which can provide most benefit.
- One development from this list will be prioritised; and a feasibility study undertaken, considering energy use

Kick-off meeting, April 2018

At INEEL HQ, Cuernavaca

Identified eight potential case study areas, from islands to cities to rural, and set of criteria for selecting a site:

Social needs	Practical
Environmental needs	Scalability
Health benefits	Replicability
Economic benefits	Renewable energy potential

INEEL currently making an assessment, next meeting in July at selected location.

See blog post (and more photos) at https://birminghamenergyinstitute.org/2018/05/29/energy-storage-prioritisation-in-mexico/

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The Institute for Global Innovation

The Institute for Global Innovation (IGI) is a designed to bring together diverse strands of research with the aim of supporting multidisciplinary programmes that will have impact at a global level.

Resilient Cities theme launched 17th April 2018

Other priority themes on gender, water and responsible AI

Resilient Cities

A more resilient city can limit the impact of forces that ‘trap’ a city and its inhabitants, or some of its inhabitants, in distress with an impact on health, economy and well-being.

Aim:

- To re-assess the concept of resilience and its measurement, as it is applied to cities that are undergoing transitions at different levels of analysis (individual, community, city, national), across multiple sub-systems and timescales.

Co-developed responses and interventions need to understand and embrace the specific complexities of individual cities, whilst being inclusive and sustainable.

Resilient Cities – Research questions

Initial set of Research Questions:

- How can we identify the drivers of urban distress, their interconnections and their compound effects?
- How can we understand ‘resilience’ as a useful concept for global cities seeking to tackle urban distress?
- How can approaches and knowledges from different disciplines be effectively integrated to develop interventions that increase the resilience of cities, sensitive to local contexts?
- What metrics are most appropriate to assessing the resilient state of cities, and outcomes of interventions?

Resilient Cities – Work streams

Considering how the framework can be applied to key city sub-systems:

Community	Dina Kiwan, School of Education, CoSS
Economy	John Bryson, Birmingham Business School, CoSS
Infrastructure	Miles Tight, Civil Engineering, EPS
Institutions	Vivien Lowndes, Government and Society, CoSS
Environment	Francis Pope, GEES, LES
Health	Matthew Broome, Institute for Mental Health, LES

with multi-disciplinary working groups.

Summary

‘Energy storage’ represents a range of energy system services that could be important to meet global transitions.

Different technologies can meet different needs, encompass electrical and thermal energy, across time and geographic scales.

Choice of technology should reflect the wider system need, not be driven by available technology; benefits may be beyond the engineered system.

People experience life in cities through interacting sub-systems; multi-disciplinary and co-developed approaches are needed when considering solutions to challenges.

Thank you

Energy Systems and Policy Analysis Group at Birmingham Centre for Energy Storage:

Xinfang Wang, Chunping Xie, Dan Murrant, Oluyemi Jegede, Omar Saeed