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Research Councils UK Energy For a Low Carbon Future

Energy Storage for Low Carbon Grids

Energy storage: a game changer for the energy market

Goran Strbac
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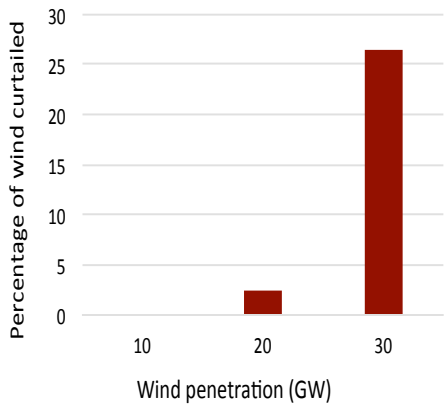
System integration challenges of lower carbon system

Degradation in infrastructure utilisation

Year	Utilisation
2015	**55%**
2025	**35%**
2030+	**<25%**

Balancing and need for flexibility



Potential volume of the market for **flexible technologies – storage** - post 2030 **UK > £8bn/year**

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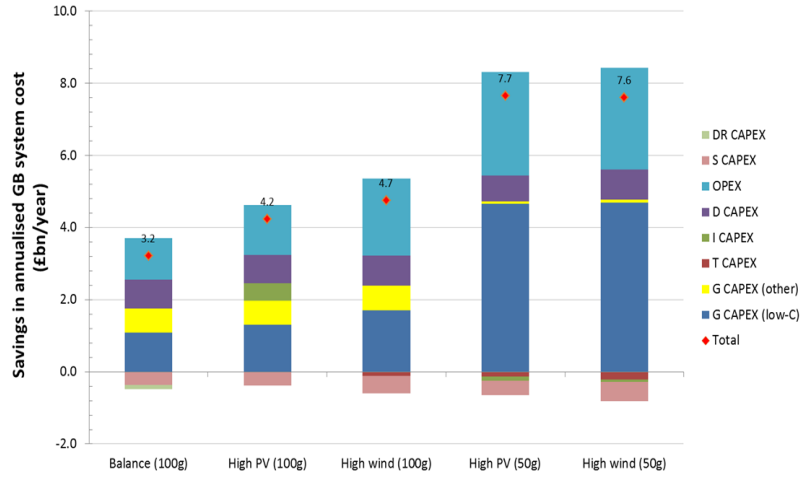
System benefits flexibility (storage)
CCC Roadmap scenarios



Meeting carbon target with minimum low carbon generation

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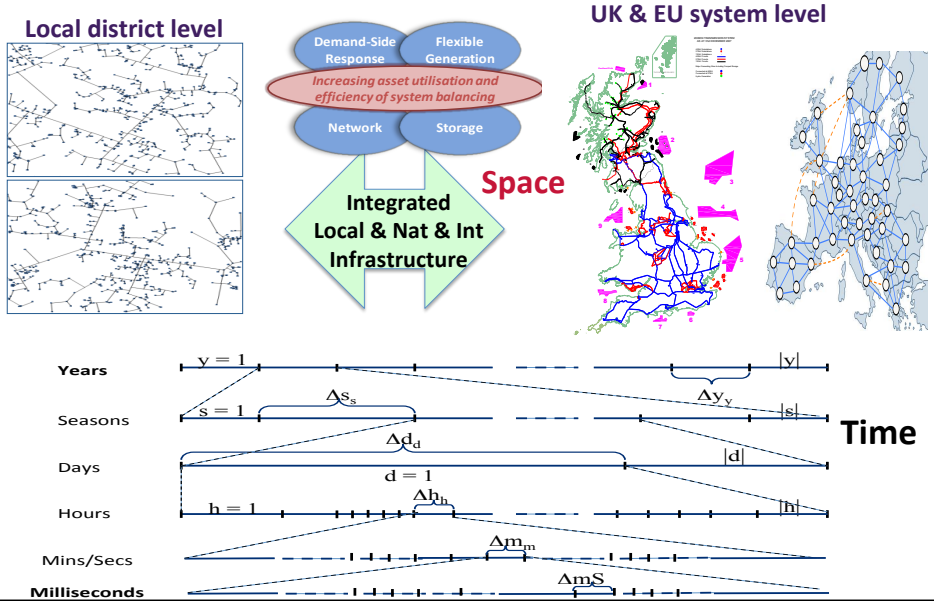
Whole-system modelling critical for capturing Time and Location interactions in *low carbon systems*



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Multi-service provision by storage

- **Arbitrage**
  - ✓Participate in day-ahead energy market
- **Balancing services**
  - ✓Participate in real-time balancing market
- **Frequency regulation services**
  - ✓Providing primary/secondary / tertiary frequency regulation services
- **Contribution to meeting peak demand**
  - ✓Reducing need for peaking plant
- **Network Support**
  - ✓Reducing need for network reinforcement
- **Low carbon generation mix**
  - ✓Meeting carbon targets with minimum LC generation
- **Option value**
  - ✓Providing flexibility to deal with uncertainty

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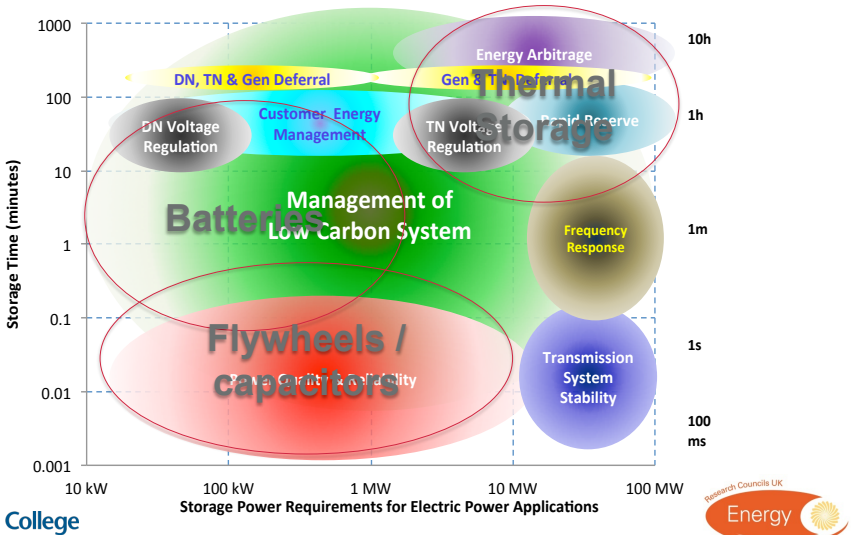
Storage technologies and grid applications: *Hybrid Solutions should be considered*



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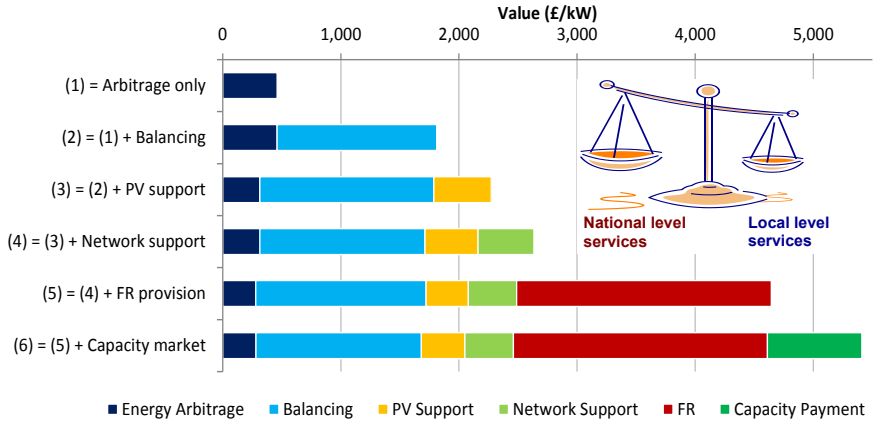
Business case for energy storage:
Provision of multiple services and access to corresponding revenue streams



Flexibility- market design?

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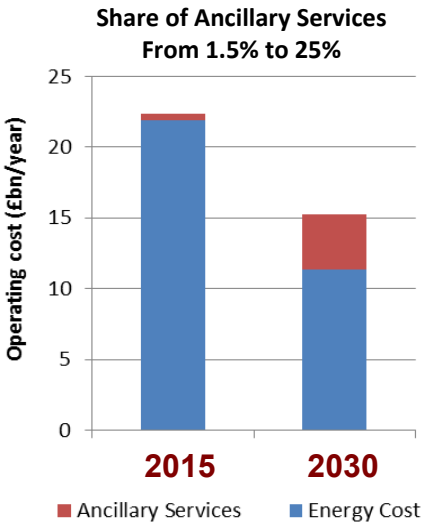
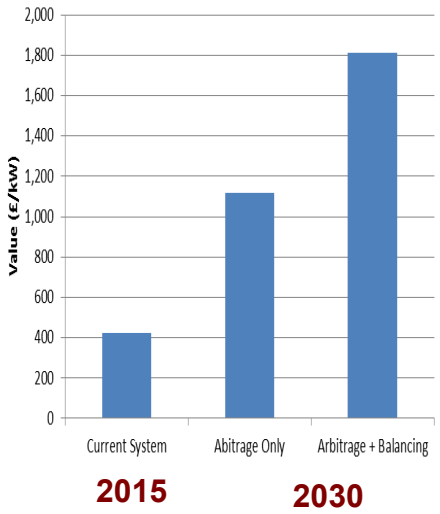
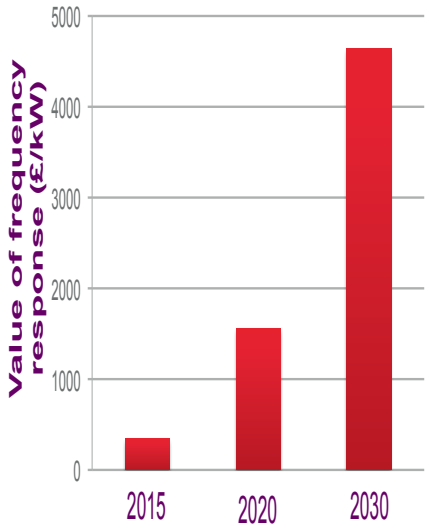
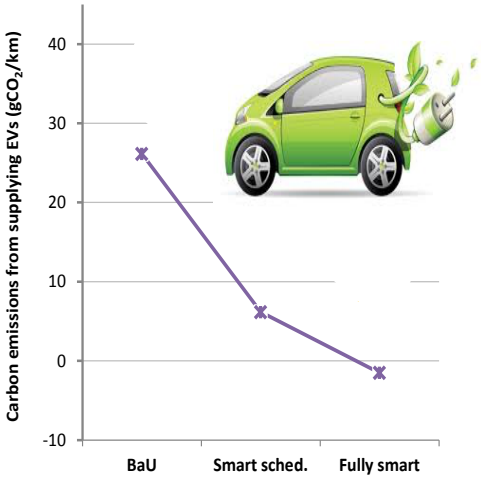
Value of storage in supporting system balancing





Frequency regulation challenge





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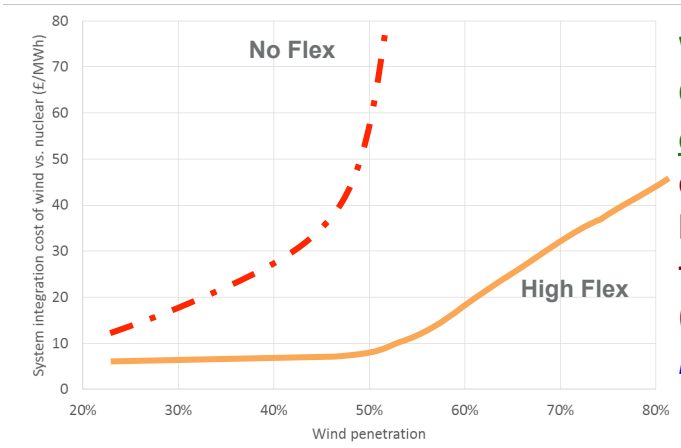
Storage increases the ability of the system to integrate intermittent RES

$WSC_{RES} = LCOE_{RES} \pm$ System Integration Cost



Whole-System Costs and competitiveness of RES driven by by system flexibility (storage)

Market design?

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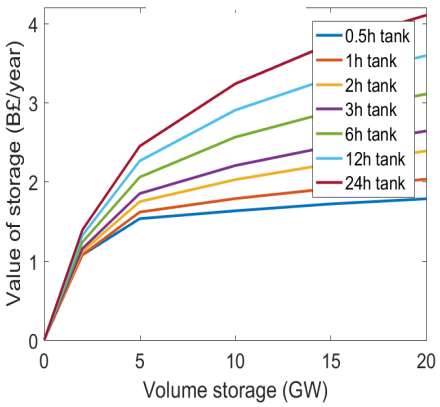
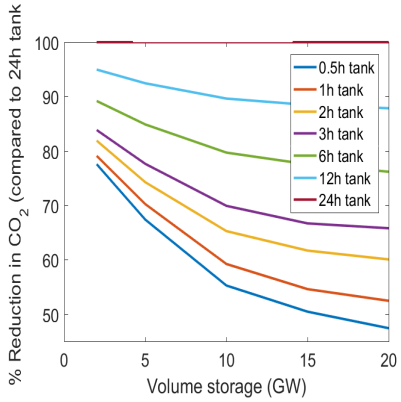
Value of storage with different durations (operation costs)





Size of the storage tank has a significant impact for large volumes of deployed storage capacity

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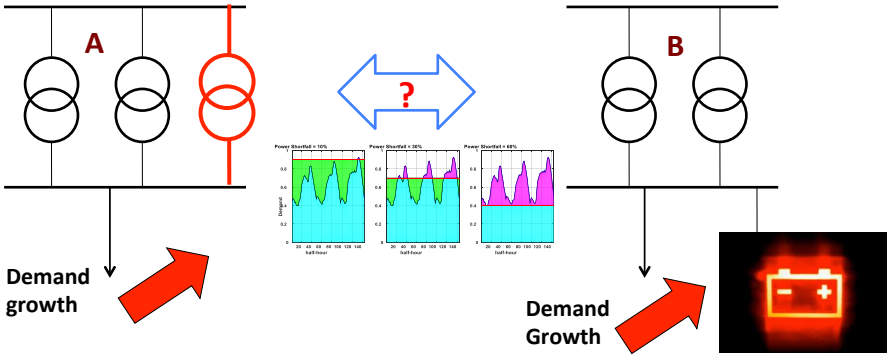
Avoiding network reinforcement with energy storage



Fundamental review of network security standards: Establishing level playing field is critical

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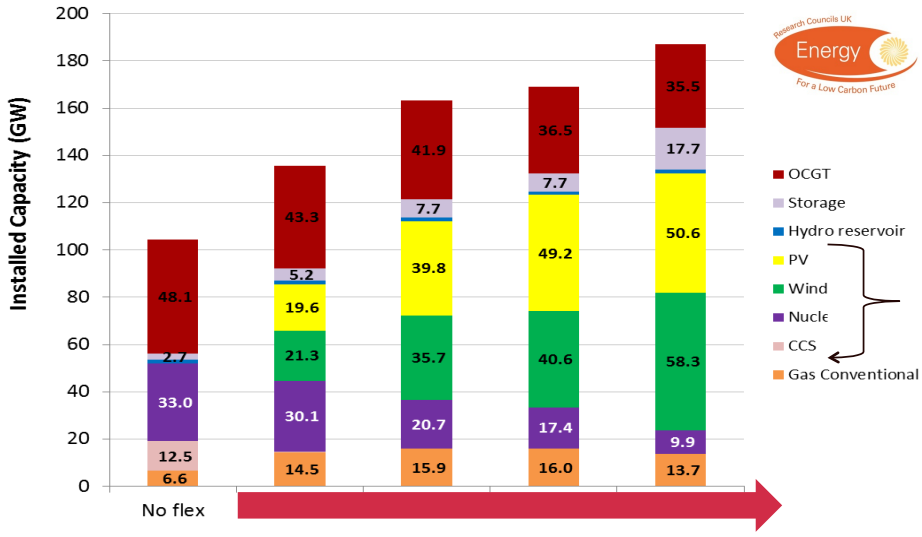
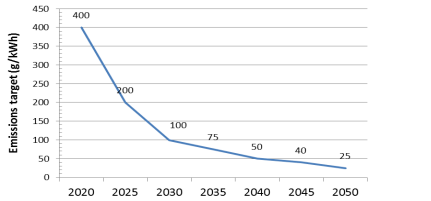
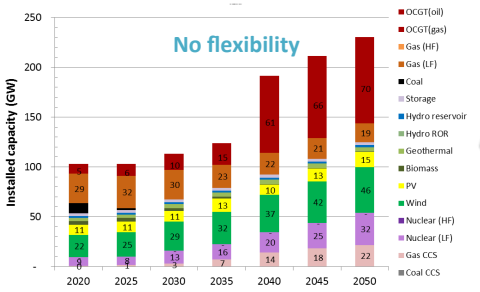
Flexibility – key driver for cost effective evolution to low carbon energy system

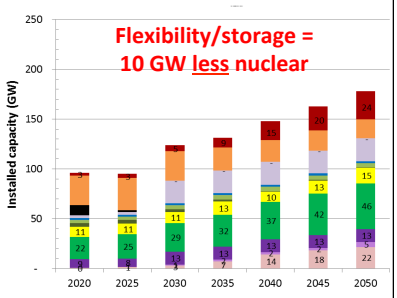


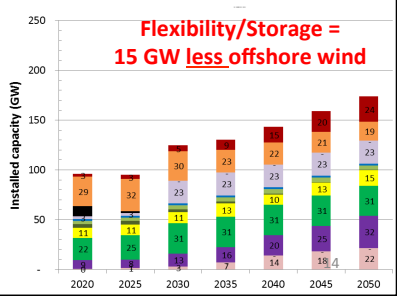
Flexibility –Storage and flexible demand

Carbon benefits of storage









UK scenario

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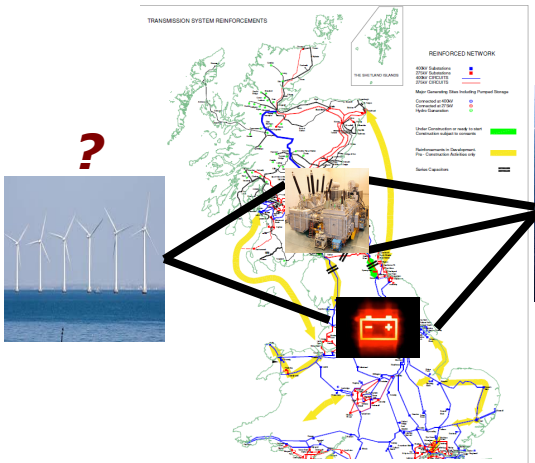
Dealing with uncertainty in future development: where, when and how much to invest? into what?



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Significant value in investing in flexibility to deal with uncertainty

Present deterministic planning leads to investment strategies that may ignore energy storage and favour conventional investments

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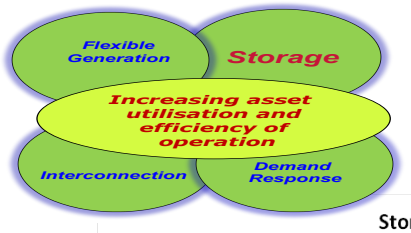
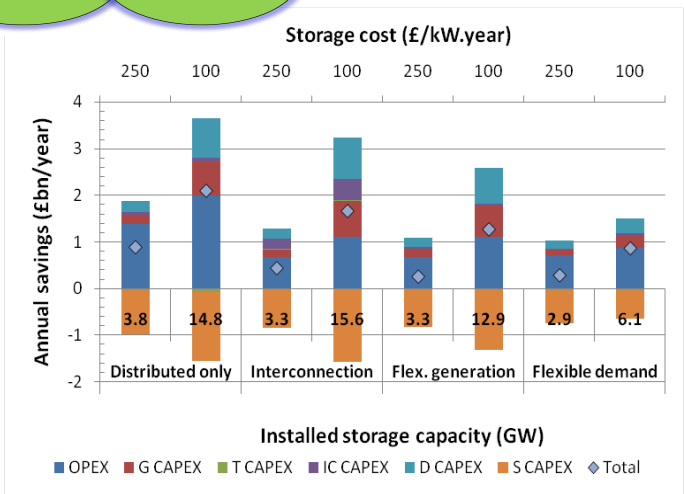


Warning from economists: think about competition!



Challenges

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- **Technology**: reducing costs, improving performance . . .
- **Standards, Markets & Policy**
  - Network planning standards, level-playing field, T&D services
  - Market design – align objectives of industry with objectives of society . . .
  - Option value . . .
  - Regulation, business models . .
    - Significant Increase in responsibilities and complexity of system operation
- **Government**: role of storage in UK low carbon energy future – turning the problem into opportunity ?

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