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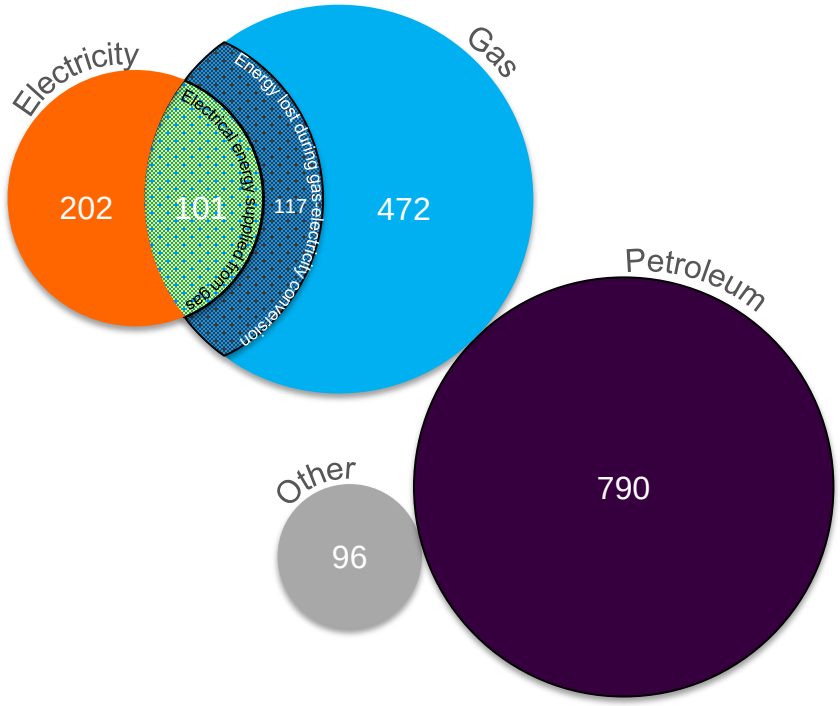
Network Transition Challenges

Jo Coleman, Strategy Director

Energy networks are a core part of the energy system

- Energy networks enable the right amount and type of energy to be delivered where and when it is needed
- Long term changes are expected for:
  - energy generation type and geographic location
  - demand patterns and energy use requirements
- The UK's energy network infrastructure will need to evolve to manage these fundamental long term changes
- Energy storage today is huge; perhaps 10,000x that of Dinorwig

How energy is delivered today



Energy carried by networks in the UK (TWh/yr)

Estimated from data published by DECC (2014)

Overarching challenges for transitioning networks

Adapting and enhancing existing network infrastructures

Enabling creation of efficient and effective new network infrastructures

Integrating new and existing networks to enable optimisation across vectors

But challenges are pathway dependent, eg

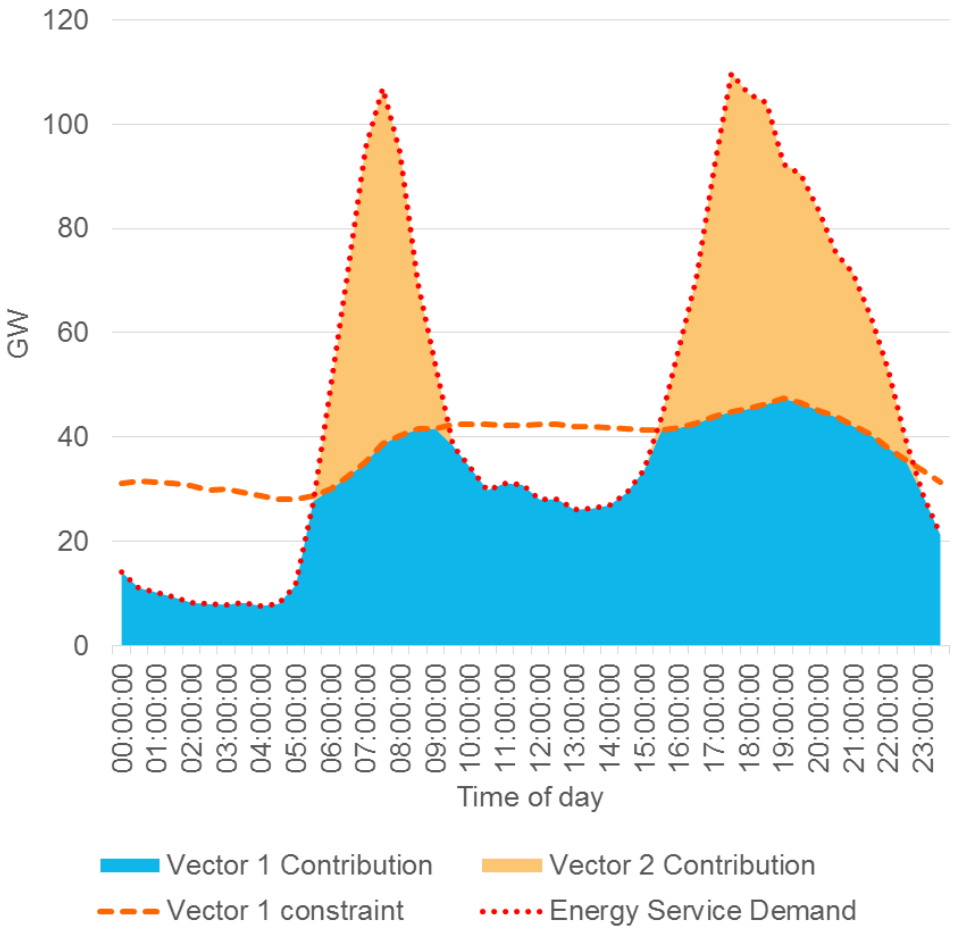
- Capacity increase & new connections in electricity network
- Role of hydrogen networks

Integrating networks to optimise across energy vectors and deliver flexibility

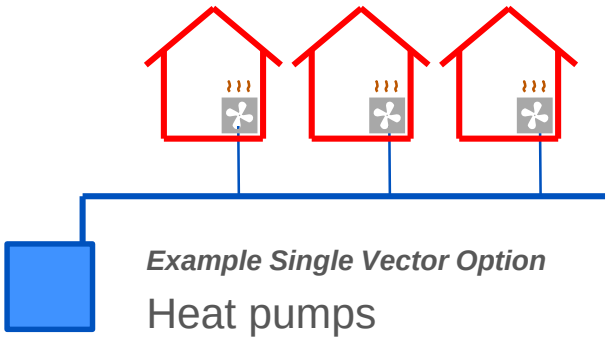
Future flexibility options extend beyond just grid-connected electricity storage, for example:

- Gas and hydrogen fuelling peaking plant to help balance electricity supply
- Heat storage in homes allowing the load on electricity networks to be reduced at peak times
- Gas as peak support for heat pumps
- Managed charging of plug-in vehicles

- How applicable and successful these are also affects the extent to which storage is needed

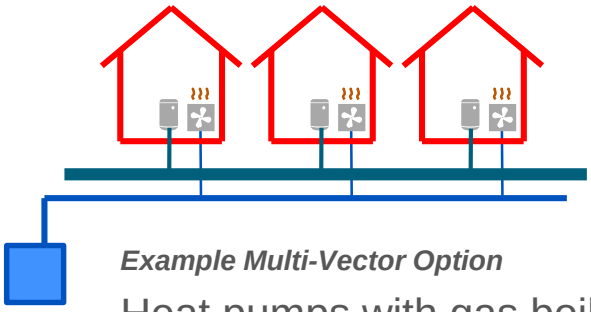


Decarbonising heat through single and multi-vector routes



Example Single Vector Option

Heat pumps



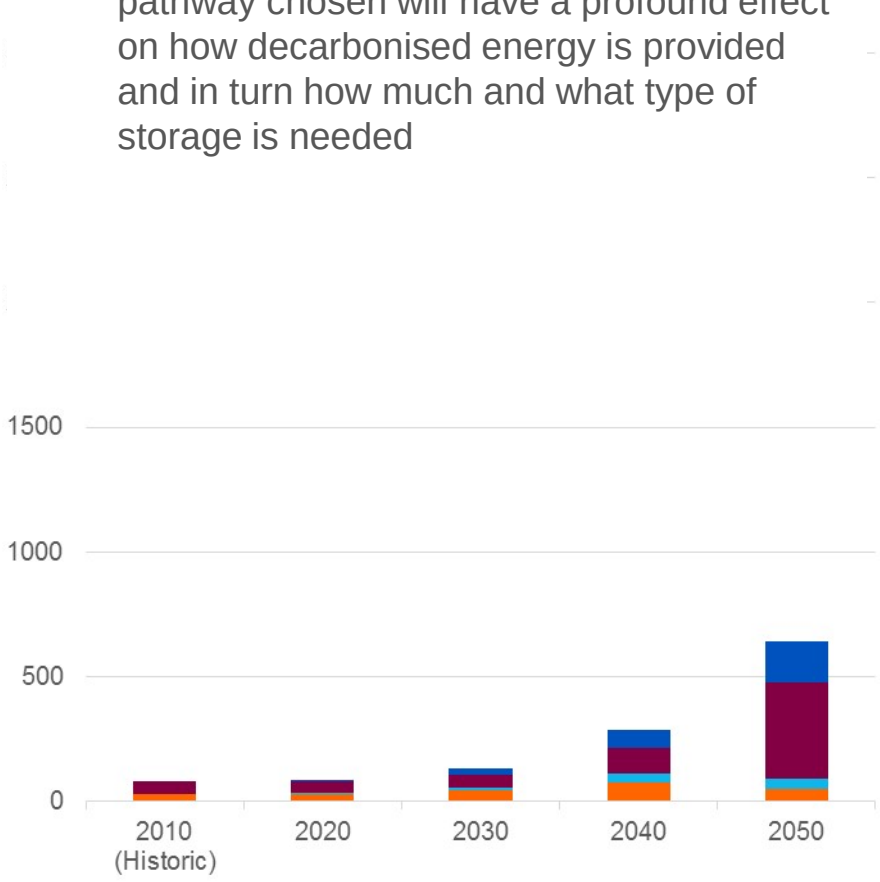
Example Multi-Vector Option

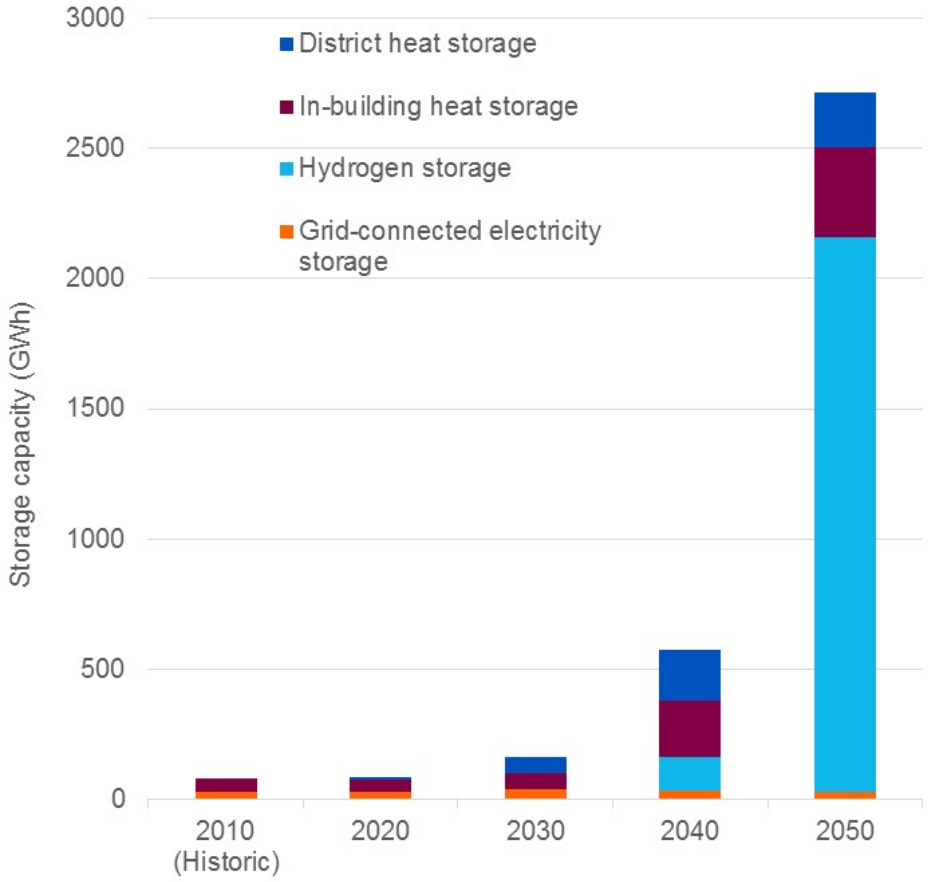
Heat pumps with gas boiler peaking

Heat pump will need to be sized to meet peak electricity demands (i.e. in the winter when HPs are at their least efficient)	A smaller less expensive heat pump can be used to provide the bulk of heating with a small boiler (or equivalent) providing additional heat when needed
Network reinforcement will be required and relevant parts of the gas network will need to be decommissioned	Network reinforcement can reduced but gas network operation costs still need to be covered
All heating supplied by electricity	The bulk of heating supplied by electricity with gas providing supplementary heating at the coldest times
Fully decarbonised heating (providing power sector is fully decarbonised)	Some emissions associated with gas boiler use
Smart control offers the potential to increase the efficiency of the system	Smart control will be needed to manage changeover between gas and electricity supply, in the premises and on the network

To what extent is energy storage needed?

- The need for storage depends on the make-up of the wider energy system in which it operates
- In a decarbonised energy system the pathway chosen will have a profound effect on how decarbonised energy is provided and in turn how much and what type of storage is needed

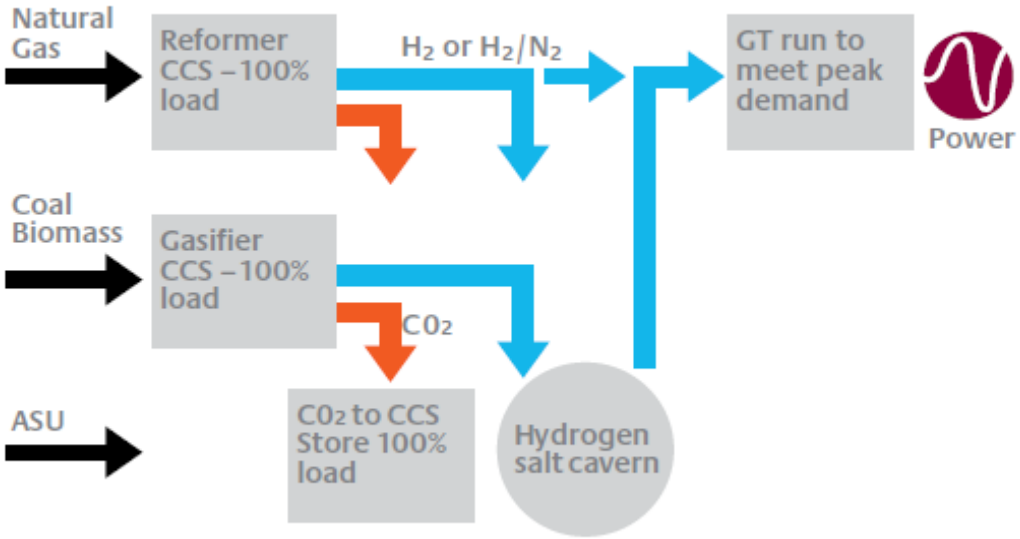


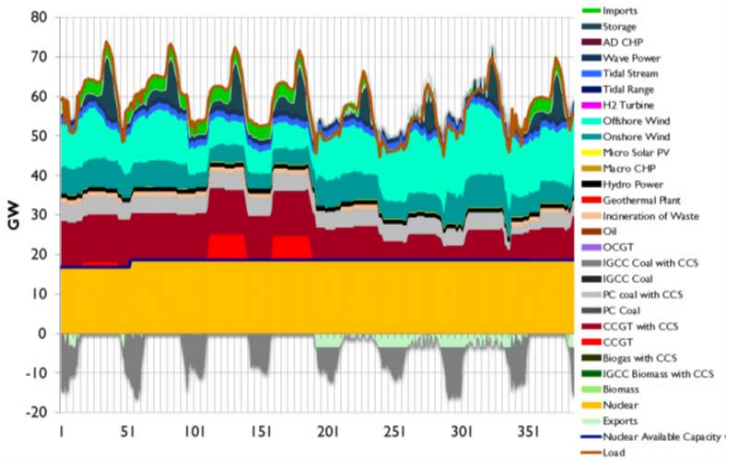


Using H2 storage to maximise use of CCS investment in the power system

- H2 storage in caverns could supply grid level quantities of load following and peaking power
- For CCS schemes operating below 40% load factor (turbine) the store adds value by reducing overall system investment.

Power station configurations using H_2 storage

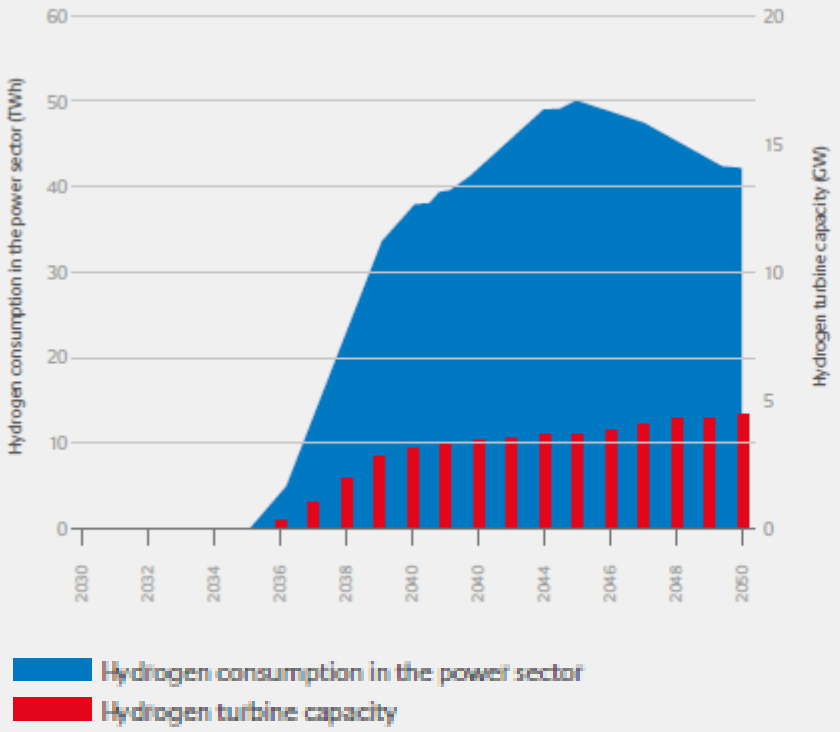




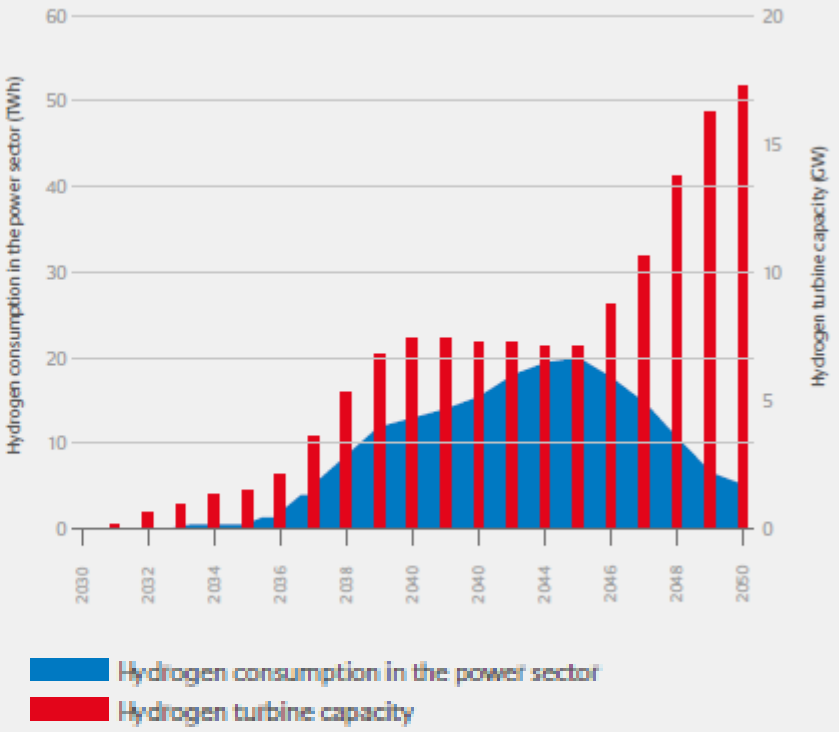
How might storage be operated?

- How energy storage is used will impact which investment models are appropriate
- Example of hydrogen turbine deployment and hydrogen consumption in the power sector when built to operate as:

(a) mid-merit plant (only during the heating season);



(b) peaking plant.



Salt caverns for hydrogen storage in conjunction with flexible turbines

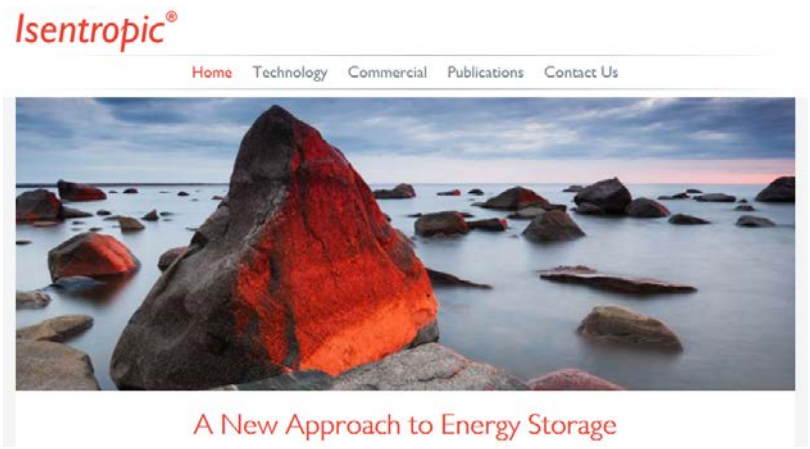
20th October 2016:

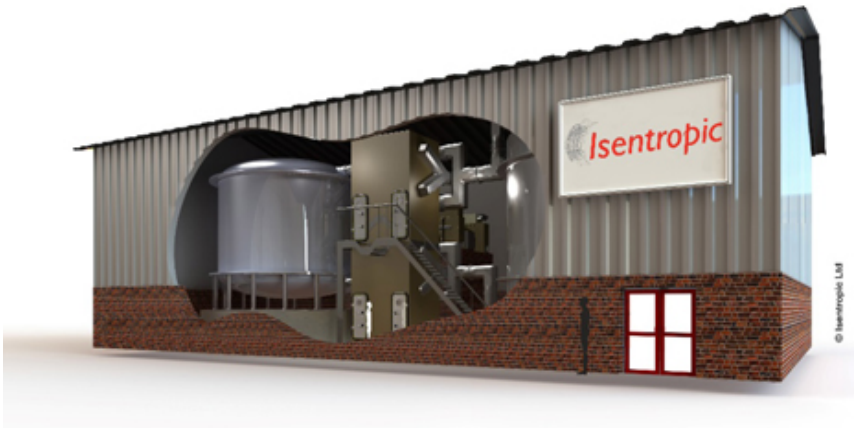
ETI appoints Atkins to identify and examine salt caverns suitable for storing hydrogen and gas

- The ETI will invest £170,000 in the six month project
- The project builds on earlier ETI work which showed that storing hydrogen in salt caverns could provide a significant contribution to decarbonising the UK's future electricity grid
- The new project will identify and examine representative salt caverns in Cheshire, Teesside and East Yorkshire that could store hydrogen to be used in power generation.
- The UK's leading cavern storage operators, including Storengy, SSE Gas Storage and SABIC, who will provide critical data and technical expertise.

UK salt beds are not widespread but are situated in good locations

Pumped Heat Electrical Storage





- Development of grid scale energy storage technology
- Technology developed by Hampshire SME Isentropic – using a combined heat pump/heat engine to generate electricity to create temperature difference for storage efficiency

“ Isentropic's facilities and operations are currently in the process of being taken over by the Sir Joseph Swan Centre for Energy Research based at Newcastle University. ”

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