Engineering electricity storage using hydrogen

12 April 2024

Klim MacKenzie: UKES 2024

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Agenda

- Introduction to SSE
- SSE Gas Storage
  - Aldbrough Gas Storage
  - Gas storage capacity and deliverability
- Aldbrough Hydrogen Pathfinder
- Challenges of developing hydrogen storage projects

Capability Across the Value Chain

Continued wealth of opportunities right across the net zero electricity value chain

2030 BUSINESS GOALS

- Cut Carbon intensity by 80%
- Increase renewable energy output fivefold
- Enable low-carbon generation and demand
- Champion a fair and just energy transition

Electricity networks

Expected over 20% of planned GB investment enabling decarbonisation

Offshore wind

SSE-led projects delivering ~20% of UK's offshore wind target

Onshore wind

Targeting over 10% of Scotland's onshore wind additions and beginning to build in Southern Europe

Hydro options

Coire Glas: more than doubling UK's electricity storage capacity

Solar and Battery

Progressing over 1GW of pipeline as part of SSE Renewables business

CCS and Hydrogen

Plans to build CCS at Keadby and Peterhead to help keep the lights on in a net zero future, with Hydrogen optionality

FUTURE ENERGY SYSTEM

- **Energy independence**
- Renewables-led
- Efficient networks
- Critical flexibility
- Storage capacity
- Greening demand
- **Lowest cost for consumers**

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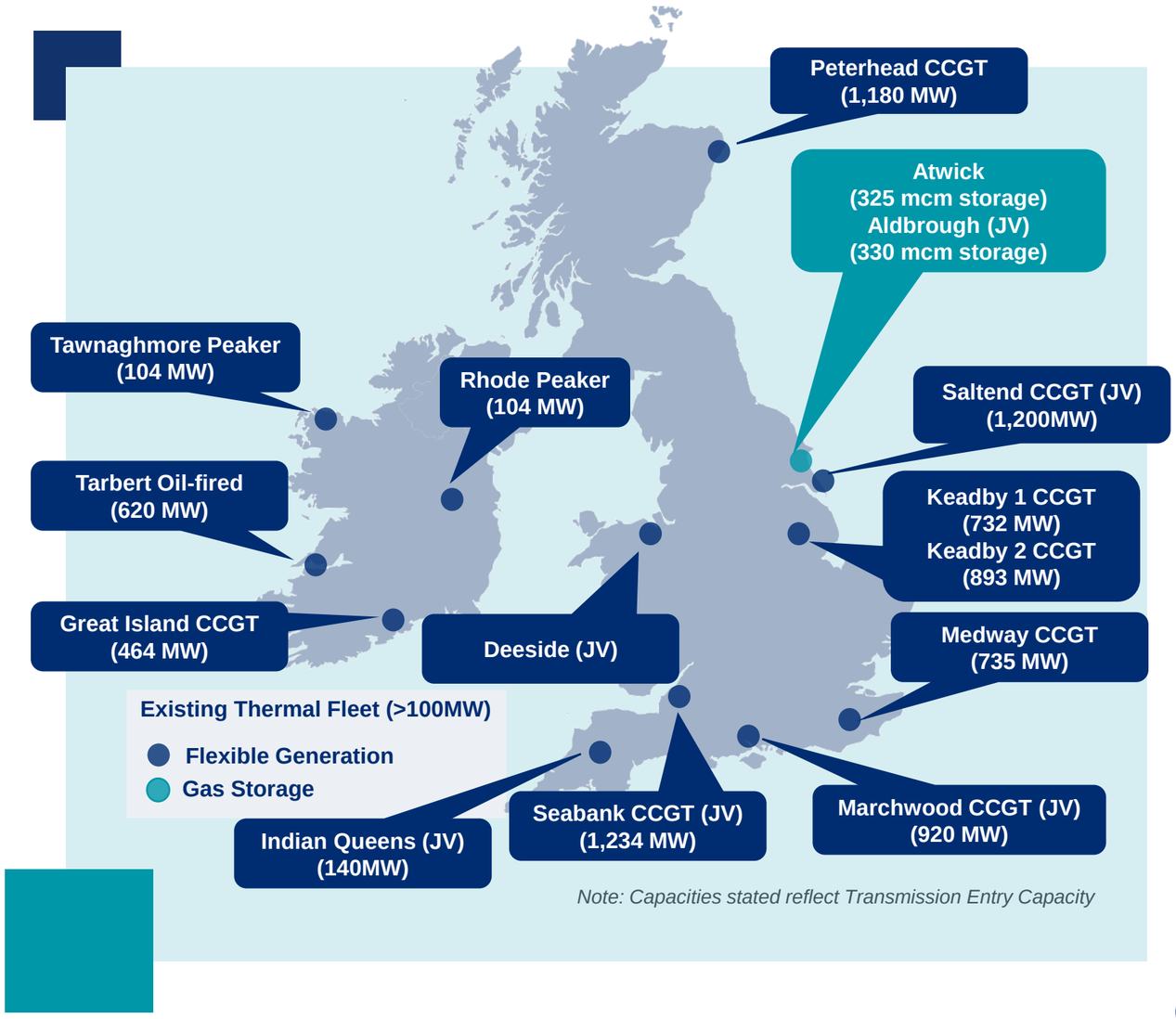
SSE Thermal Sites

Current portfolio of 7.5GW providing critical system balancing role

- Industry leading existing fleet provides vital flexibility and fast response in volatile markets
- Gas storage holds ~**40% of the UK's conventional underground gas capacity**
- Opportunities to decarbonise many with hydrogen or CO2 capture due to locations within UK industrial clusters
- Exploring other low carbon fuels



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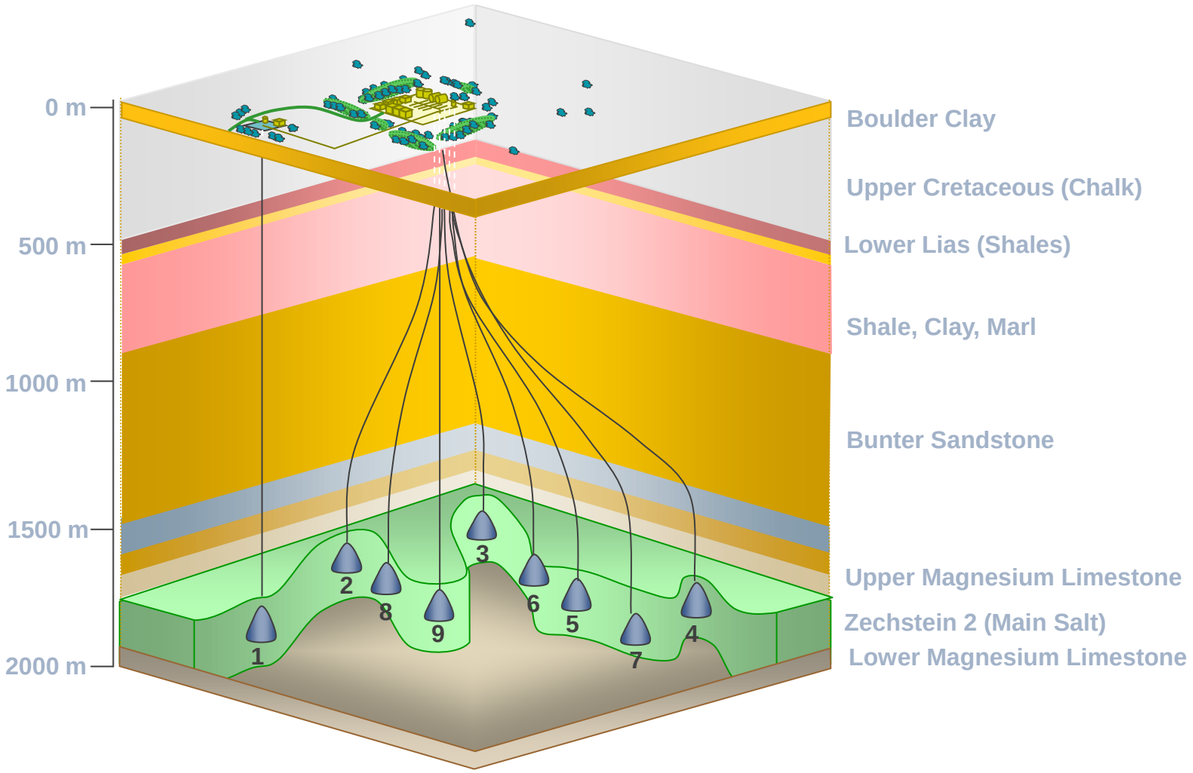
SSE Aldbrough Gas Storage



Aldbrough Gas Storage provides 8% of UK storage capacity and 30% of deliverability, enough to supply the whole UK for 1 day, or 220,000 homes for 1 year

Key Data for Aldbrough Gas Storage	
No. caverns developed	9 caverns
Site area	27 hectares
Working gas capacity	330 mill Sm^3/d (3670 GWh)
Gas injection rate	30 mill Sm^3/d (340 GWh/d)
Gas withdrawal rate	40 mill Sm^3/d (450 GWh/d)
Operating pressure range	120 – 270 bar
Production availability	>98%

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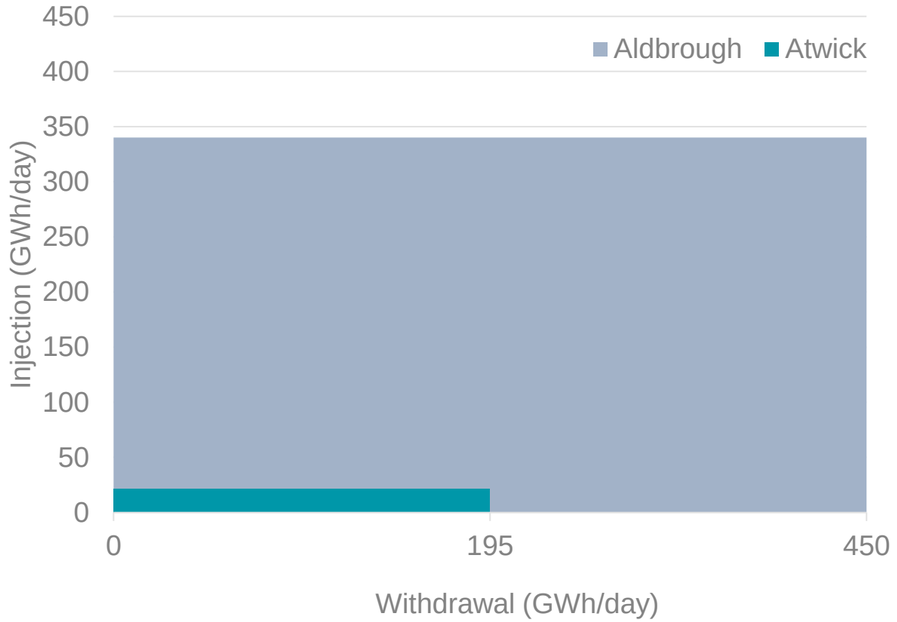
Engineering a Gas Storage Cavern

The use case for the facility leads to profound differences in the operation of the facility, even when the nameplate capacity is very similar:

- Security of supply (Atwick), or;
- Flexible gas trading (Aldbrough)

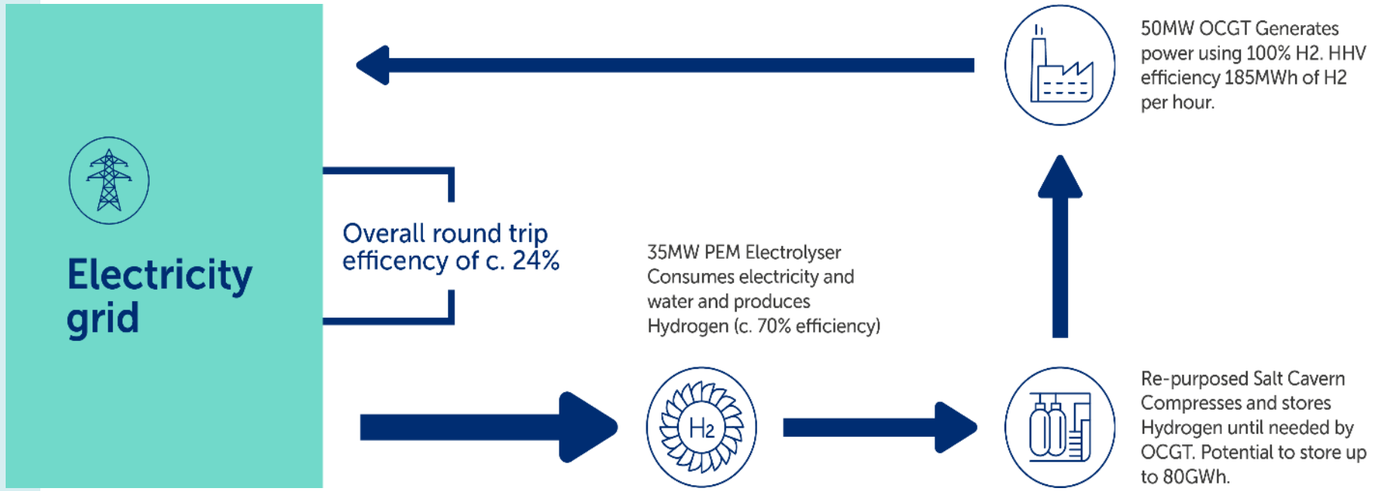
Site	Capacity	Filling	Emptying	Cycles/yr
Atwick	3530 GWh	180 days	18 days	2
Aldbrough	3670 GWh	16 days	8 days	15



Aldbrough Hydrogen Pathfinder

First-of-a-kind project in the Humber

- Located at SSE Thermal's existing Aldbrough Gas Storage site on the East Yorkshire coast, designed to demonstrate the interactions between **electrolysis, cavern storage and 100% hydrogen dispatchable power**
- Supports evidence base for **wider deployment of flexible hydrogen** power in the UK's net zero journey and major enabler of SSE Thermal's wider Humber ambitions
- Project seeking support in the UK Government's **Net Zero Hydrogen Fund**
- FEED undertaken with **Siemens Energy and Black & Veatch** for topside, and **Atkins** for subsurface



Hydrogen Production

Produced via a 35MW electrolyser, using electricity from the grid that complies with the LCHS

Hydrogen Storage

Stored in a converted salt cavern – currently used for natural gas – with a capacity of c.20GWh

Hydrogen Power Gen

Used in a 50MW OCGT operating on 100% hydrogen, exporting flexible green power back to grid

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Challenges of Developing Hydrogen Storage

Supply agreements and permits

- Grid connections in the Humber: 2035+
- Planning application reviews
- Regulator reviews

Technology qualification takes time and capital-intensive testing

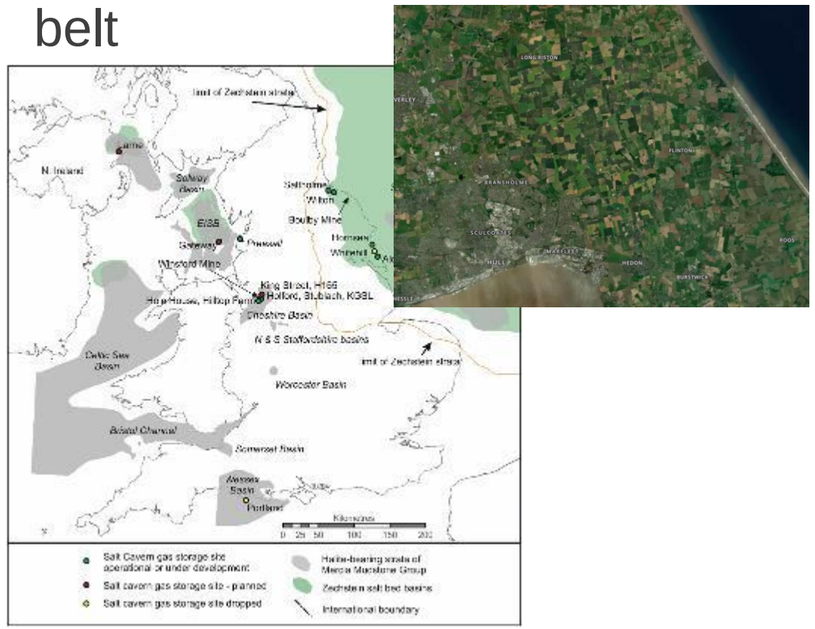
5	Minimum Technology Readiness Level (TRL)	The proposed geological storage site and associated above ground infrastructure must meet a comprehensive minimum TRL of 7.

Hydrogen Storage Business Model: Market Engagement on the First Allocation Round (publishing.service.gov.uk)

Procurement of FOAK equipment with long lead times and fixed price approach from GOV adds contingency and suppliers will not fix prices for extended periods

Public perception

- Hydrogen safety
- Industrialisation of green belt



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Thank you

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