

# Insights and experience from starting up hydrogen projects

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# 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

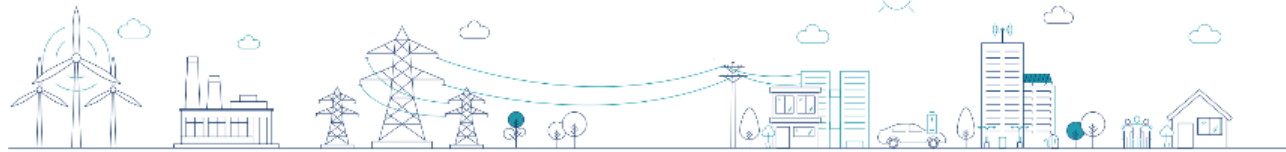
Progressing over 1GW of pipeline as part of SSE Renewables business

### 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

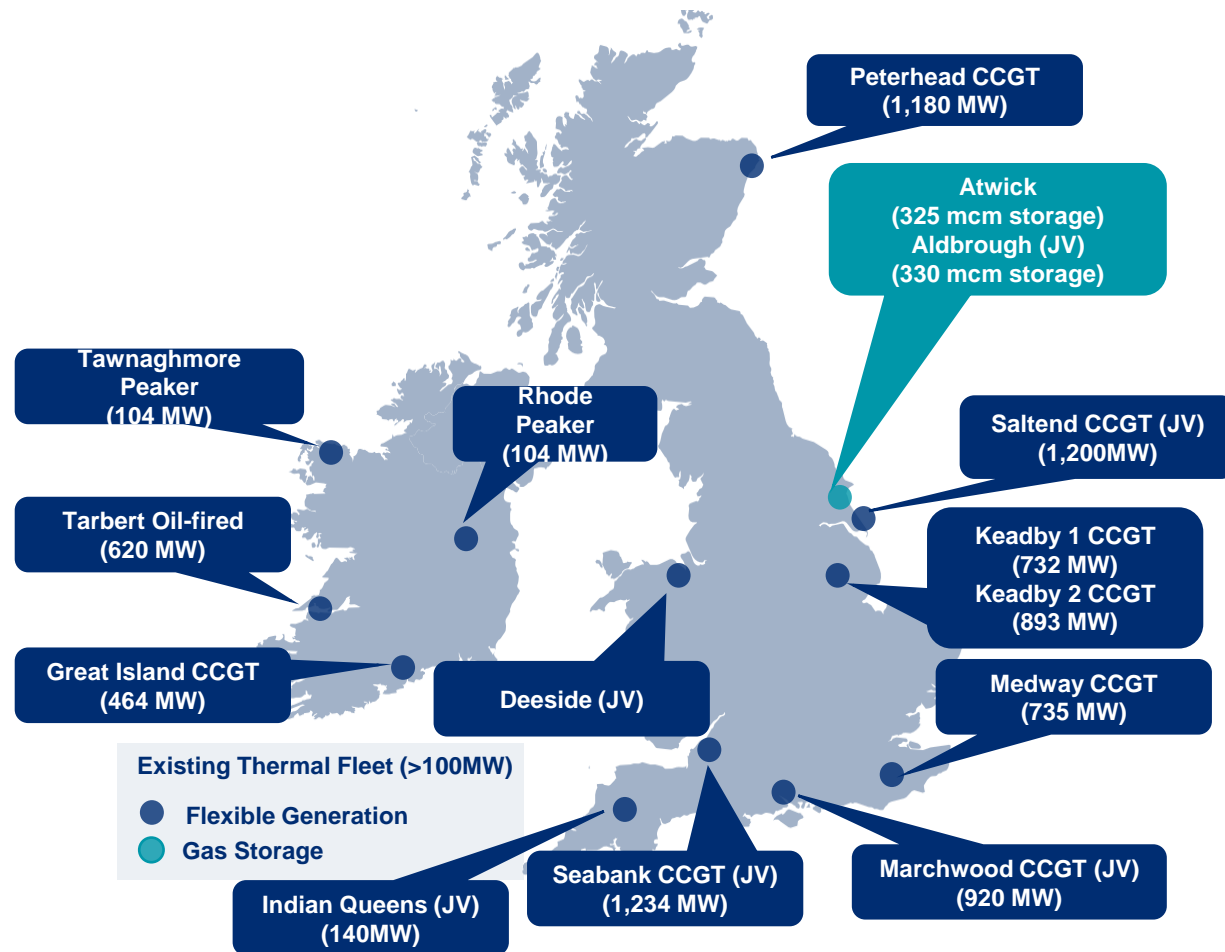
- Energy independence
- Renewables-led
- Efficient networks
- Critical flexibility
- Storage capacity
- Greening demand
- Lowest cost for consumers



# 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 CO<sub>2</sub> capture due to locations within UK industrial clusters
- Exploring other low carbon fuels



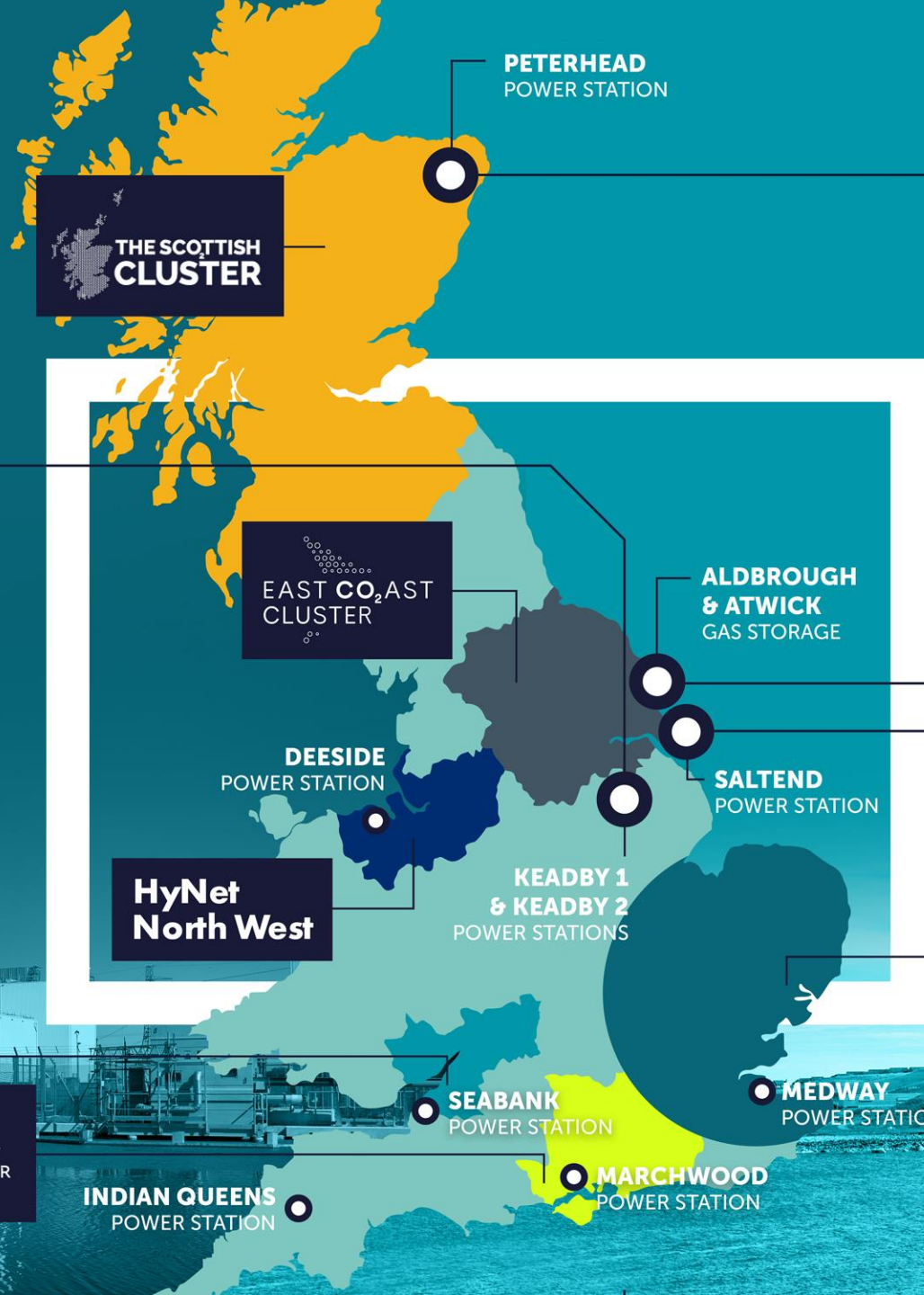
Note: Capacities stated reflect Transmission Entry Capacity

# PRESENCE ACROSS UK INDUSTRIAL CLUSTERS



## KEADBY

- Carbon Capture Power Station
- Hydrogen Power Station



## PETERHEAD

- Carbon Capture Power Station

## ALDBROUGH

- Aldbrough Hydrogen Pathfinder
- Aldbrough Hydrogen Storage

## SALTEND

- Hydrogen blending at existing power station

Bacton  
Thames  
NetZero.



# Carbon Capture & Storage Projects

## Pipeline of two shovel ready carbon capture projects

### Peterhead Carbon Capture Power Station

- SSE Thermal and Equinor are developing a CCGT with post combustion carbon capture at Peterhead.
- Peterhead Carbon Capture will be the only flexible power plant in Scotland and connect to the Scottish Cluster CO<sub>2</sub> transportation and storage network.



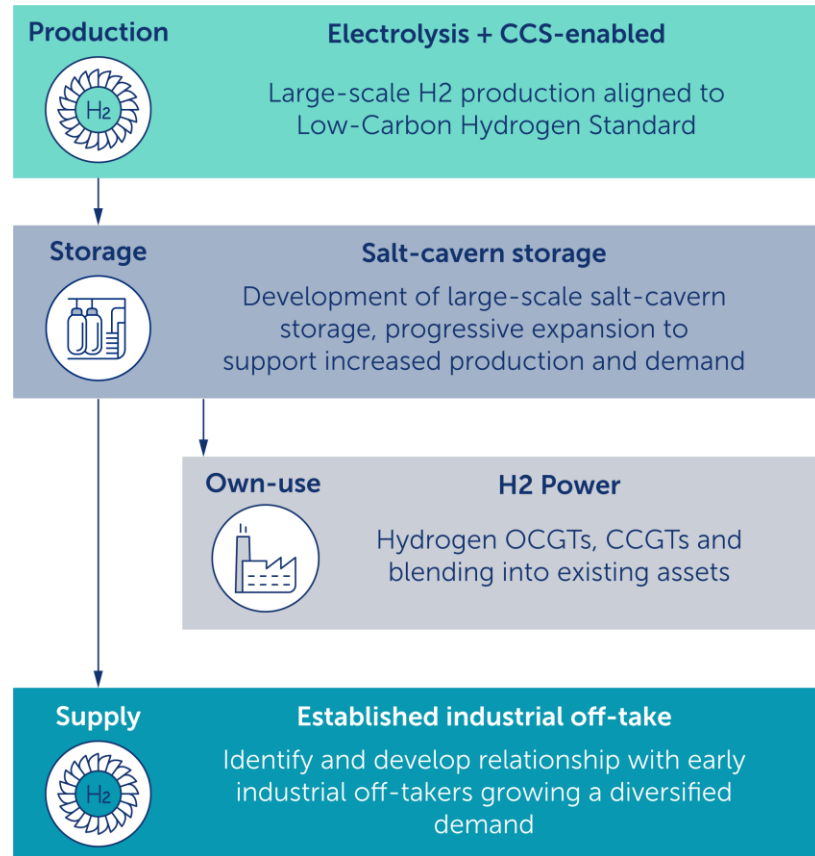
### Keadby 3 Carbon Capture Power Station

- SSE Thermal and Equinor are developing a CCGT with post combustion carbon capture at Keadby.
- Keadby 3 will reduce the emissions intensity of power generation in the Humber region whilst creating new highly skilled job opportunities.



# SSE Thermal Hydrogen Strategy

Cross value chain approach - producing, storing, supplying and using low-carbon H2



## Building Strategy for success

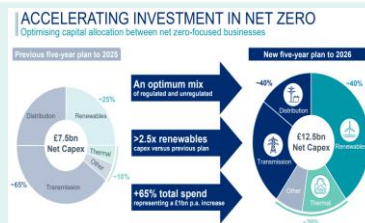


Expanding core teams across SSE Thermal has seen a growth of **135 FTE additional employees** between 21/22 and 22/23, over **200 offers to be accepted** this FY



Utilising SSE Thermal strengths for H2 and CCS growth

- **Gas handling & storage expertise**
- **Power generation expertise**
- **Gas and power trading capability**
- **Strong OEM and partner relationships e.g. Siemens, Mitsubishi**
- **Safe operators with engineering excellence**

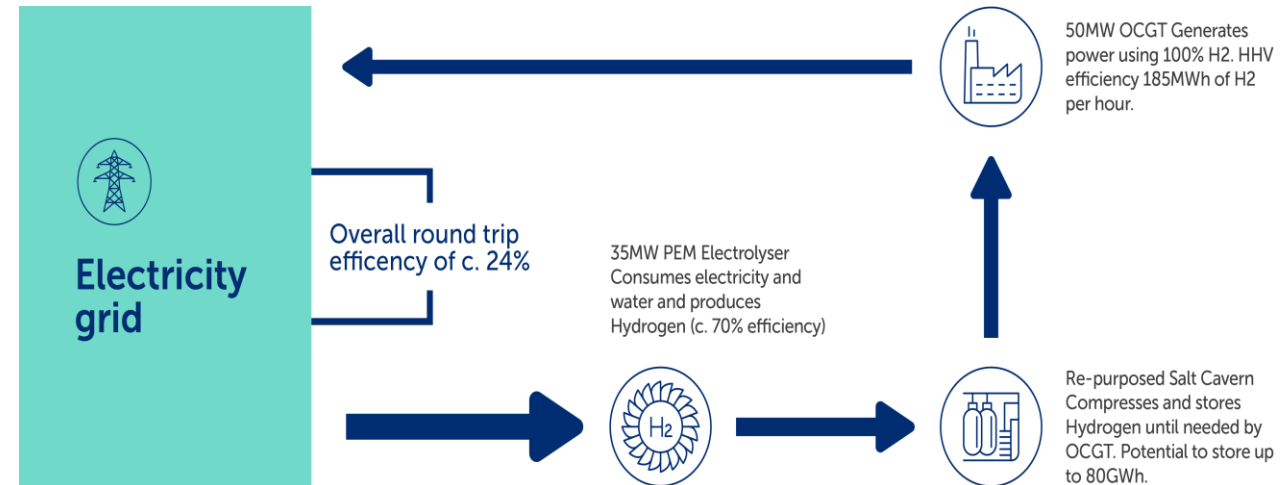


Built expertise across green hydrogen, blue hydrogen and power CCS, capitalising on common links between technologies including markets, potential offtakers, regulatory framework and business models.

# 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**
- Contract signed with **Siemens Energy and Black & Veatch** for topside FEED, and **Atkins** for subsurface FEED



### Hydrogen Production

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

### Hydrogen Storage

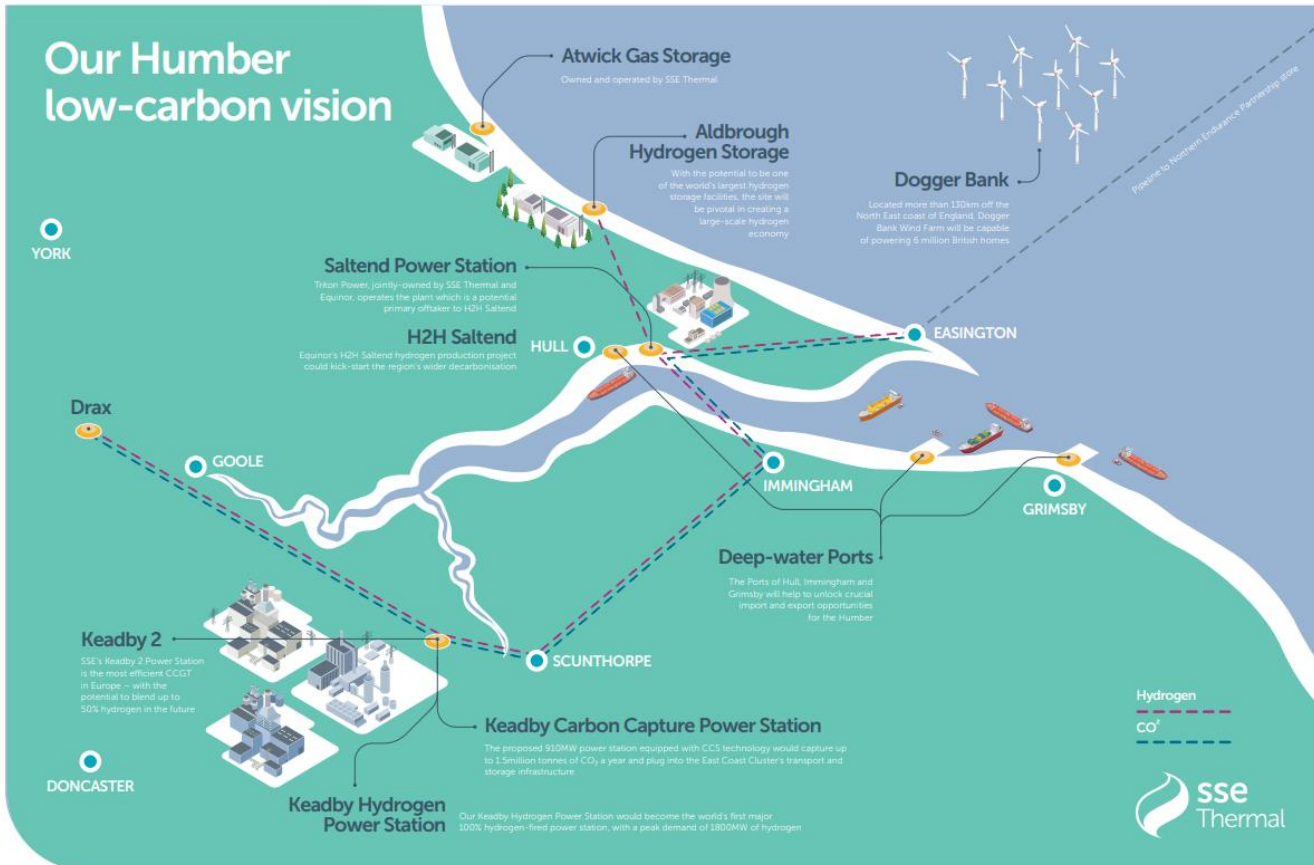
Stored in a converted salt cavern – currently used for natural gas – with a capacity of c.20GWh

### Hydrogen Power Gen

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

# Existing Hydrogen Power and Storage Projects

Keadby 4 could be the world's first 100% hydrogen fuelled power station



- **Aldbrough Hydrogen Pathfinder** - A first-of-a-kind project which unites hydrogen production, storage and power generation in one location.
- **Keadby 2 Power Station** – A state of the art 893 MW CCGT with the potential to blend hydrogen.
- **Saltend Power Station** – Preparing the power plant to blending up to 30% hydrogen from 2027, with an ambition to increase up to 100%.
- **Keadby 4** - The 900 MW project could be the world's first 100% H<sub>2</sub> fuelled power station, producing zero emissions at the point of combustion.
- **Aldbrough Hydrogen Storage** – Developing plans for what could be one of the world's largest hydrogen stores at 320 GWh



# Challenges and Learnings: Hydrogen Technology

## Gas Turbine Technology

Single CAN/ burner testing to full engine testing with 100% H<sub>2</sub>

Flashback prevention

NO<sub>x</sub> control

Startup with or without a natural gas supply

## Other

Limited experience with high pressure and high flow rate compression

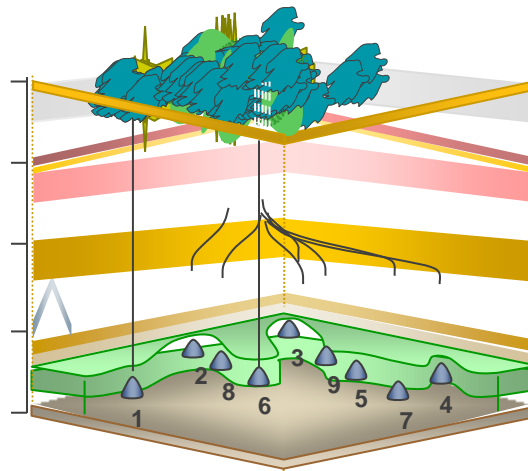
H<sub>2</sub> metering

Gas and flame detection

## Salt Cavern Storage

Development of design and test standards for hydrogen, and qualification of subsurface components

Hydrogen interaction in the subsurface



## Electrolysis

Confidence in ability to perform

Input water requirements

Water rejection

## Learnings:

- Technology development and demonstration
- Learning together across OEMs and partners
- Leading development of design standards
- Insurability of FOAK hydrogen technology
- Experience designing and operating new technologies

# Challenges and Learning: Safety and Environmental

- Lack of formal guidance on Best Available Techniques (BAT) for electrolytic hydrogen production
- Fugitive emissions
- Lack of formal guidance on Best Available Techniques (BAT) covering 100% hydrogen combustion
- Limits on NOx from hydrogen combustion
- COMAH Safety Report modification

## Learnings:

- Sets safety case precedent for other hydrogen projects
- Learning together across regulatory agencies
- Advancing understanding of combustion control
- Refining guidance with real-world application

# Thank you

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