UK-wide take on Salt Cavern H_2 Storage

UK Energy Storage Conference, Edinburgh

17 April 2026

Patryk Tomaszewski
Senior Geologist & Cavern Engineer

AtkinsRéalis

Content

Where we work – Markets

Buildings and places

Defense

Industrial

Minerals & metals

Nuclear

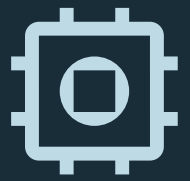
Power & renewables

Transportation

Water

What we do – Services

Consulting, strategy & advisory



Engineering & design

Project & program management

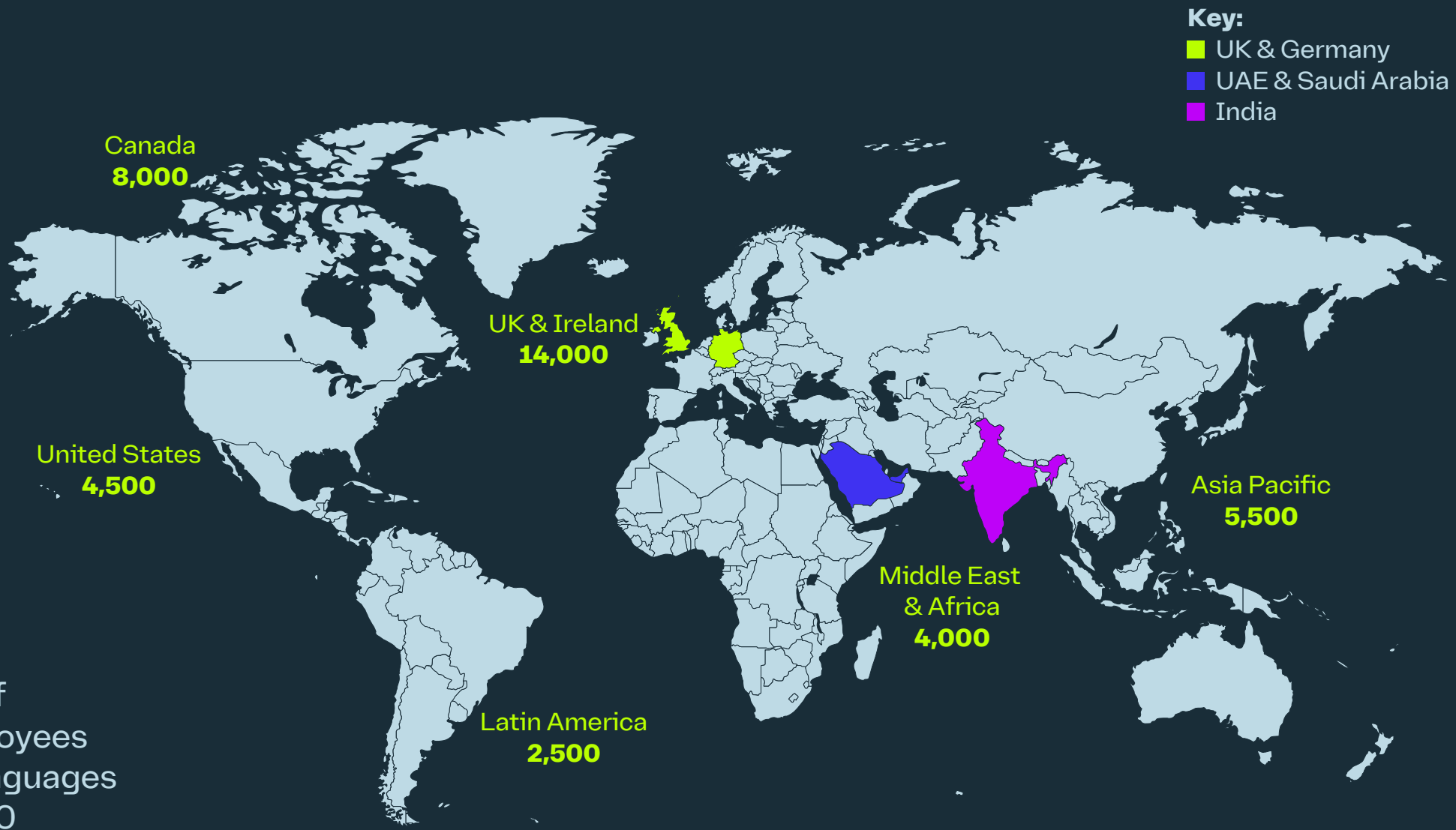
Project delivery

Operations & maintenance (O&M)

Capital

Decommissioning

Global reach



Our global team of over 40,000 employees speaks over 70 languages and represents 130 nationalities across six continents.

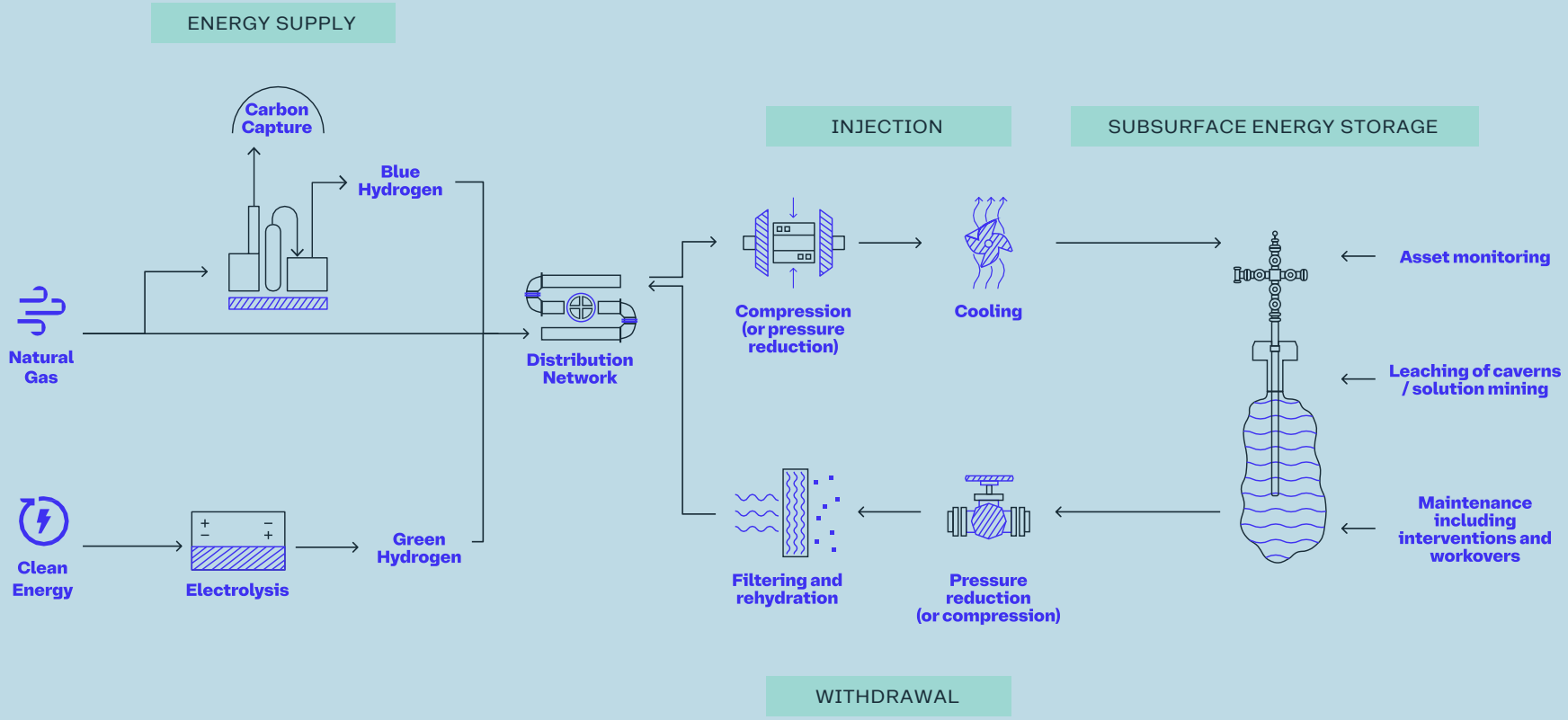
Power & Energy Solutions
We have 160+ staff across the key disciplines

OUR SERVICES – Power & Energy Solutions

Engineering Net Zero

A comprehensive end-to-end service offering.

We are experienced in delivering **integrated surface and subsurface** energy storage projects and can offer a comprehensive set of services from initial development, design, and engineering through to implementation (including drilling, leaching and completions), operation, and maintenance.



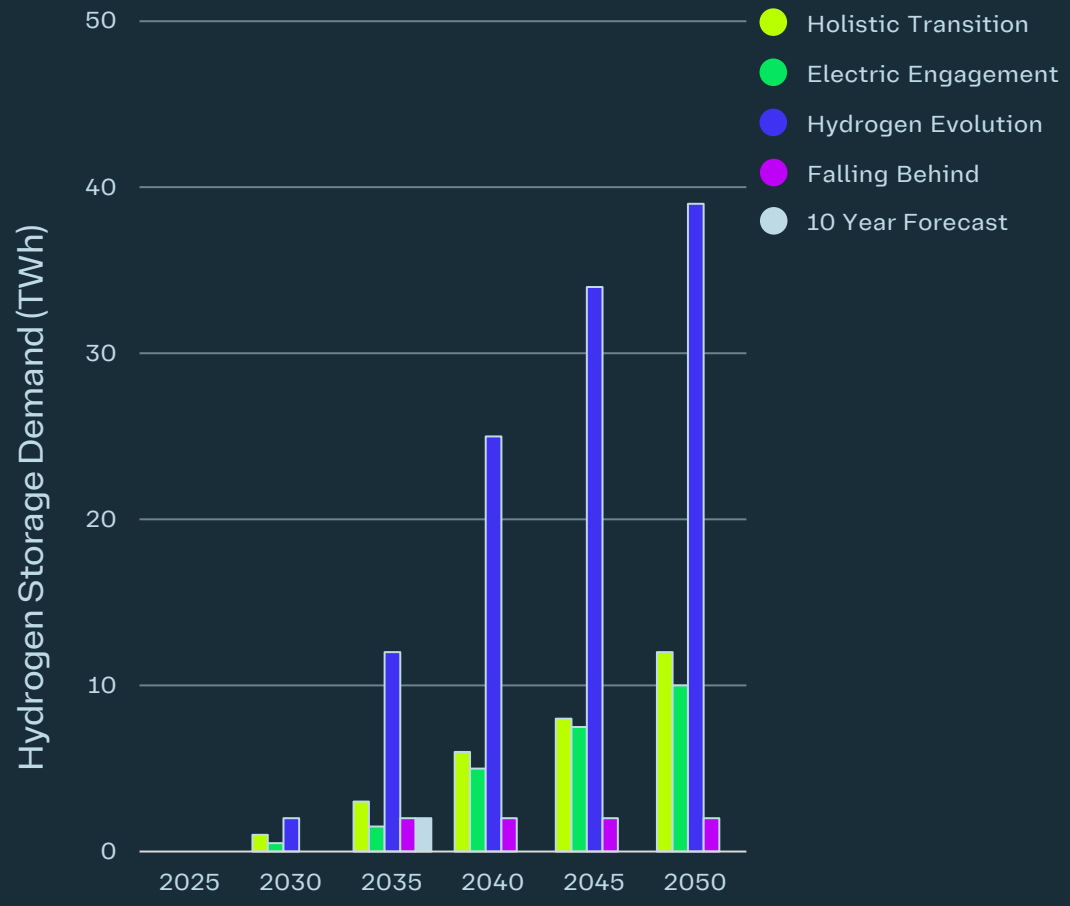
SUBSURFACE ENERGY STORAGE LIFECYCLE

We have experience collaborating and working closely together across each of the following key areas of expertise to ensure risks are identified and managed and maximum value is extracted from the storage asset.

- **Geology**
  Analysis of subsurface data sets and assessment of geological formations
- **Geomechanics**
  State-of-the-art analysis and numerical modelling to assess subsurface conditions
- **Ground Modelling**
  Integration and analysis of proprietary and legacy datasets to model subsurface conditions across the site or region of interest
- **Solution Mining**
  Minimising the risk of latent issues which can impact future operations
- **Well Engineering**
  Manage, plan, engineer, and supervise well operations, understanding the risks and differences between energy storage and E&P well requirements
- **Surface Plant Engineering**
  Process, Mechanical, Electrical, C&I, Civil
- **Process Safety**
  Process safety studies, risk assessments, and safety management systems
- **Site Management and Supervision**
  Ensuring works are implemented safely and in compliance with project requirements

The Challenge

- **Energy security** and **Net Zero** challenge
  - New demands on existing storage assets.
- Need to define, develop and implement **new storage infrastructure**.
- **Developing a salt cavern** and filling it with cushion gas can take **10–12 years**.
- NESO Future Energy Scenarios 2025 pathways
  - 2 TWh of hydrogen storage by 2035 is a prudent choice.
  - 5 TWh by 2040 required by all pathways.
- To accomplish hydrogen evolution targets by 2050 (39 TWh), the equivalent of **122 Aldbrough Hydrogen Storage** *(9 new caverns, Yorkshire coast)* **projects** are required to be commissioned.

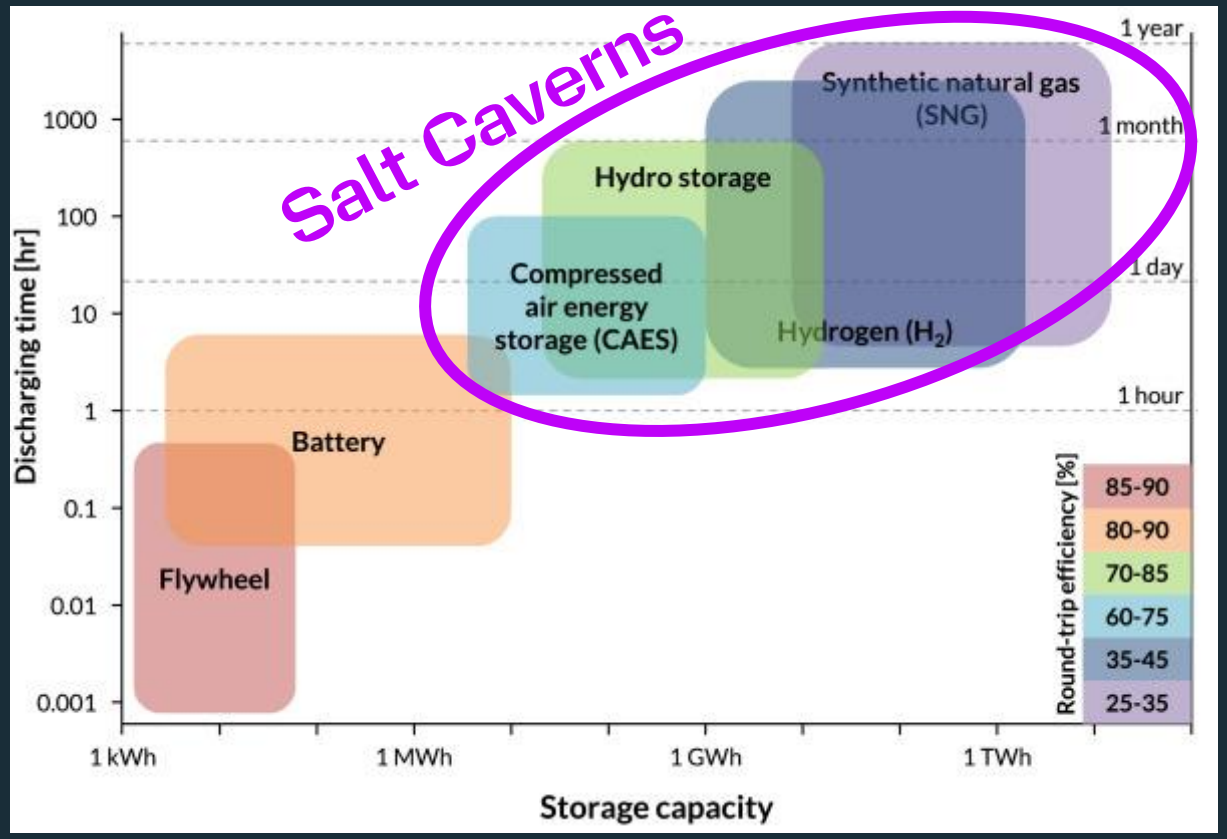


Note: TWh = Terawatt-hours of hydrogen storage capacity per annum.

HYDROGEN STORAGE CAPACITY REQUIREMENTS [1]

[1] NESO 2025, Future Energy Scenarios

Why



Gabrielli et al., 2024, Energy Conversion and Management

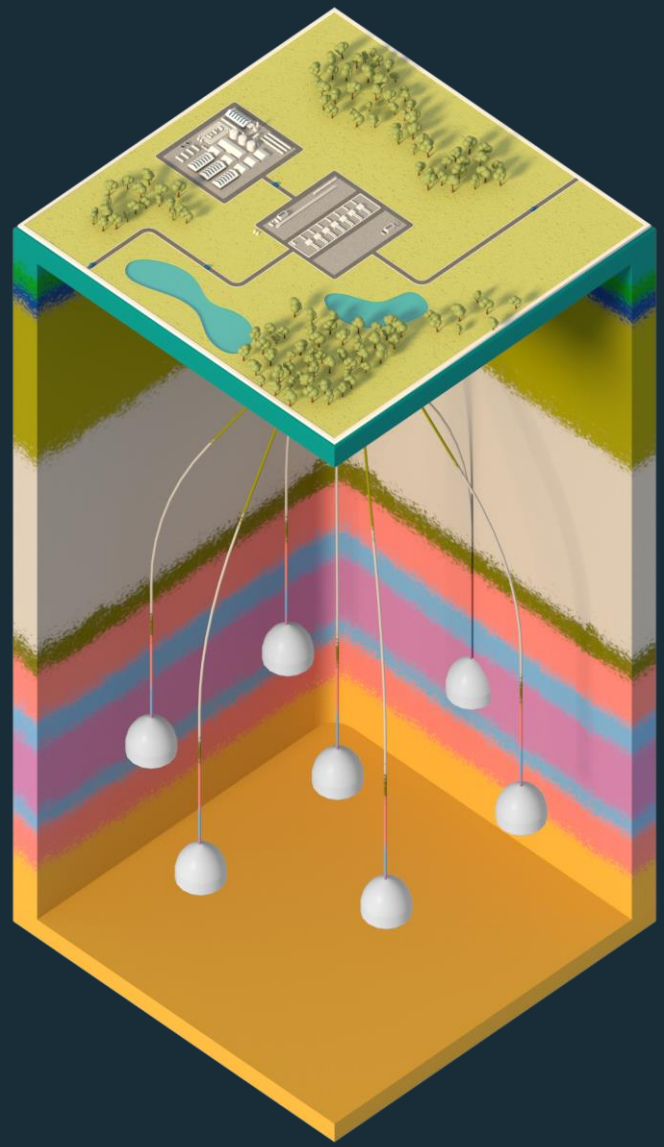
Salt Caverns

- Limited surface land use
- Large volume
- High storage capacity
- Lower cushion gas volume (vs porous rock)
- High deliverability

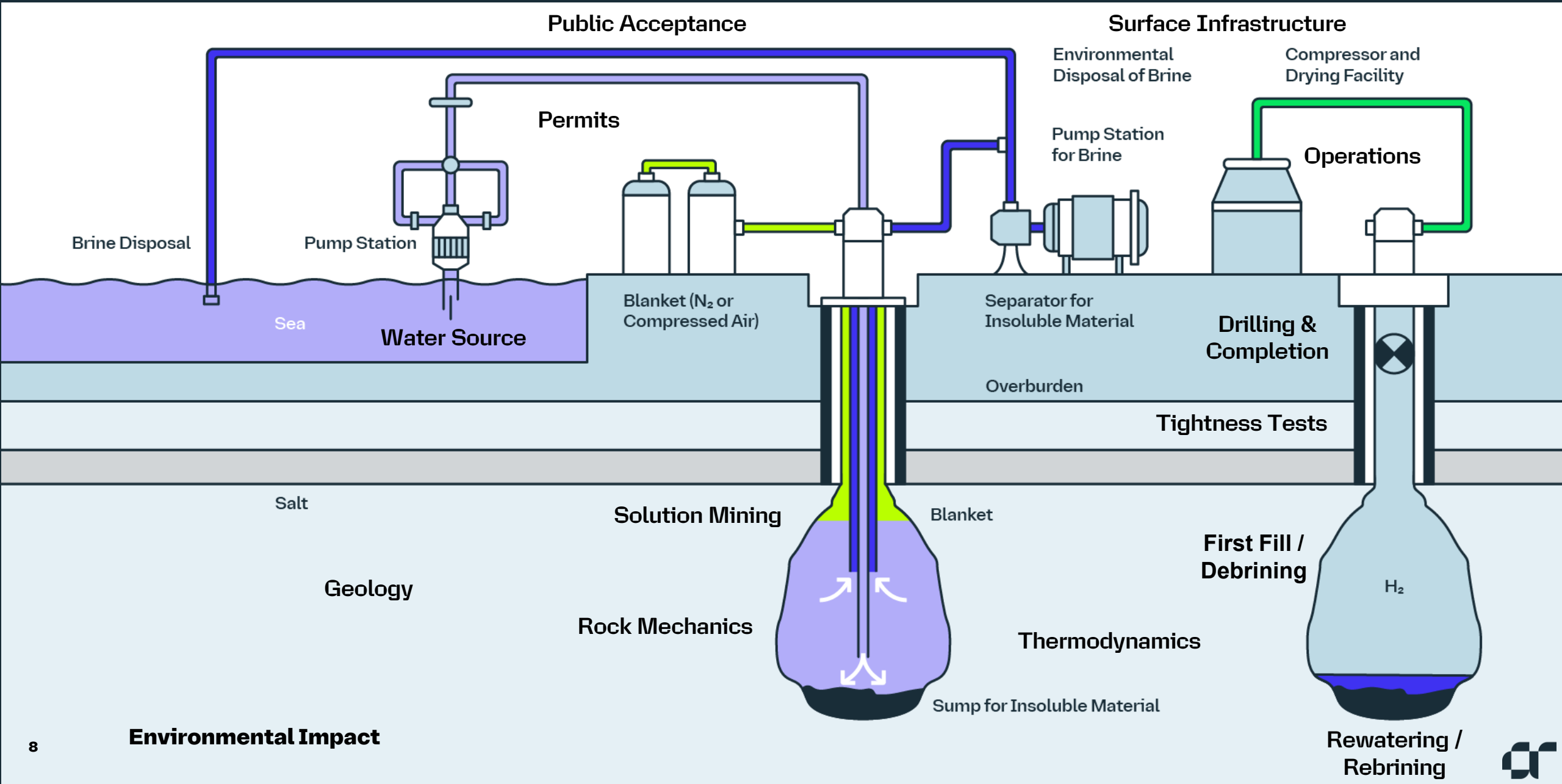
Salt

- Water-soluble
- Impermeable
- Viso-elastic and plastic
- Self-healing
- Non-reactive, inert

↑ (vs porous rock)



Considerations and Constraints



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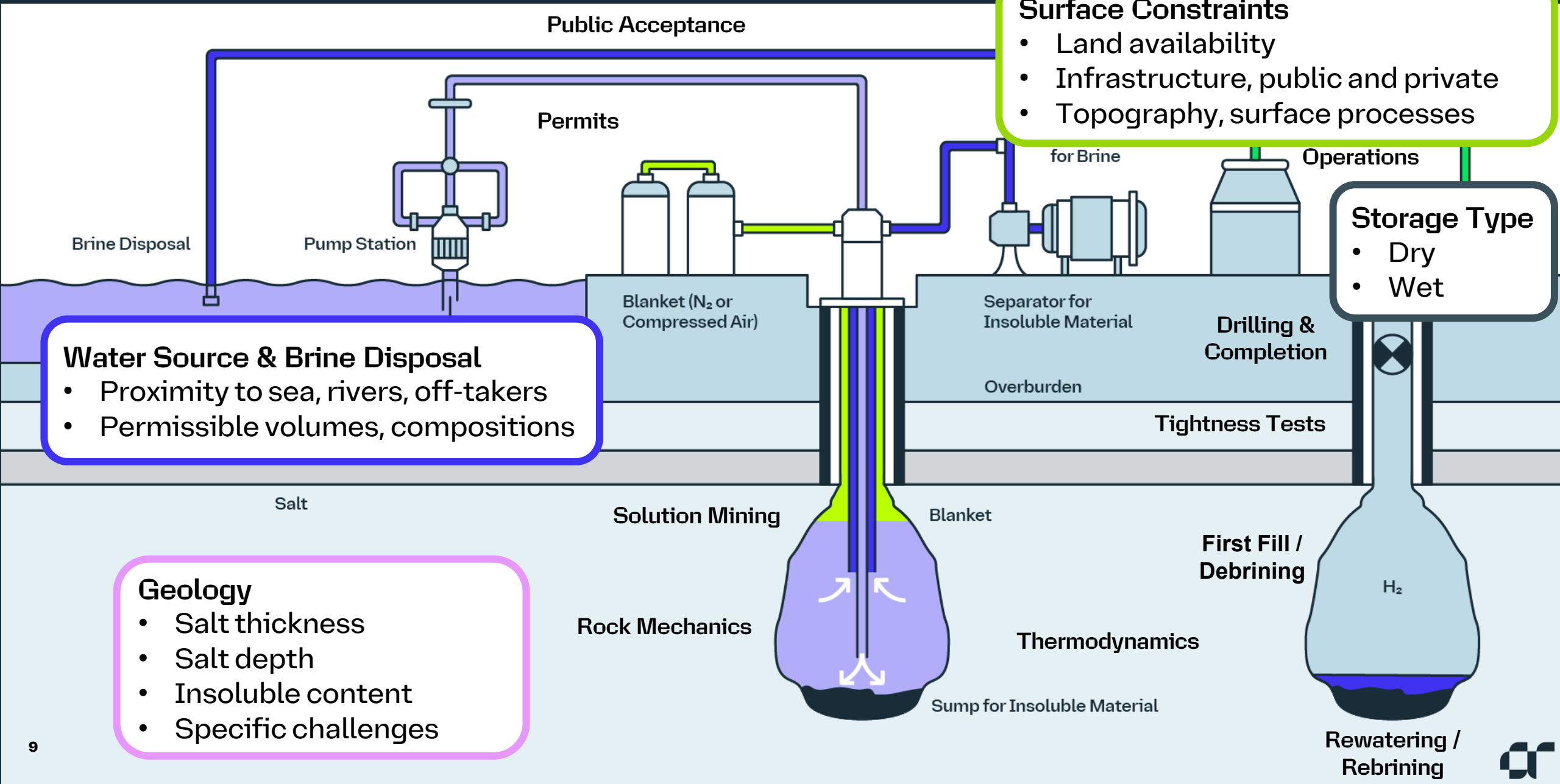


Surface Constraints
- Land availability
- Infrastructure, public and private
- Topography, surface processes

Storage Type
- Dry
- Wet

Water Source & Brine Disposal
- Proximity to sea, rivers, off-takers
- Permissible volumes, compositions

Geology
- Salt thickness
- Salt depth
- Insoluble content
- Specific challenges

Considerations and Constraints

AtkinsRéalis

Public Acceptance

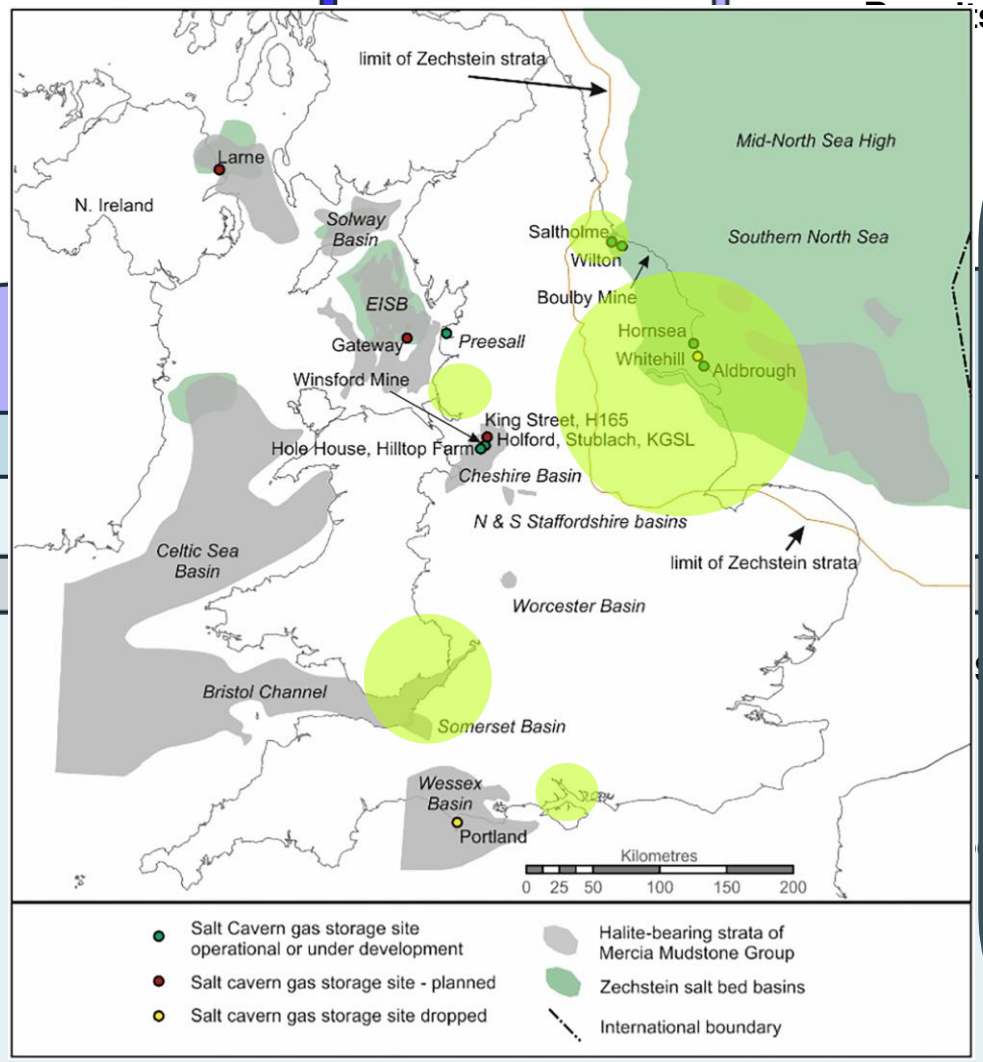
Surface Constraints

- Land availability
- Infrastructure, public and private
- Topography, surface processes

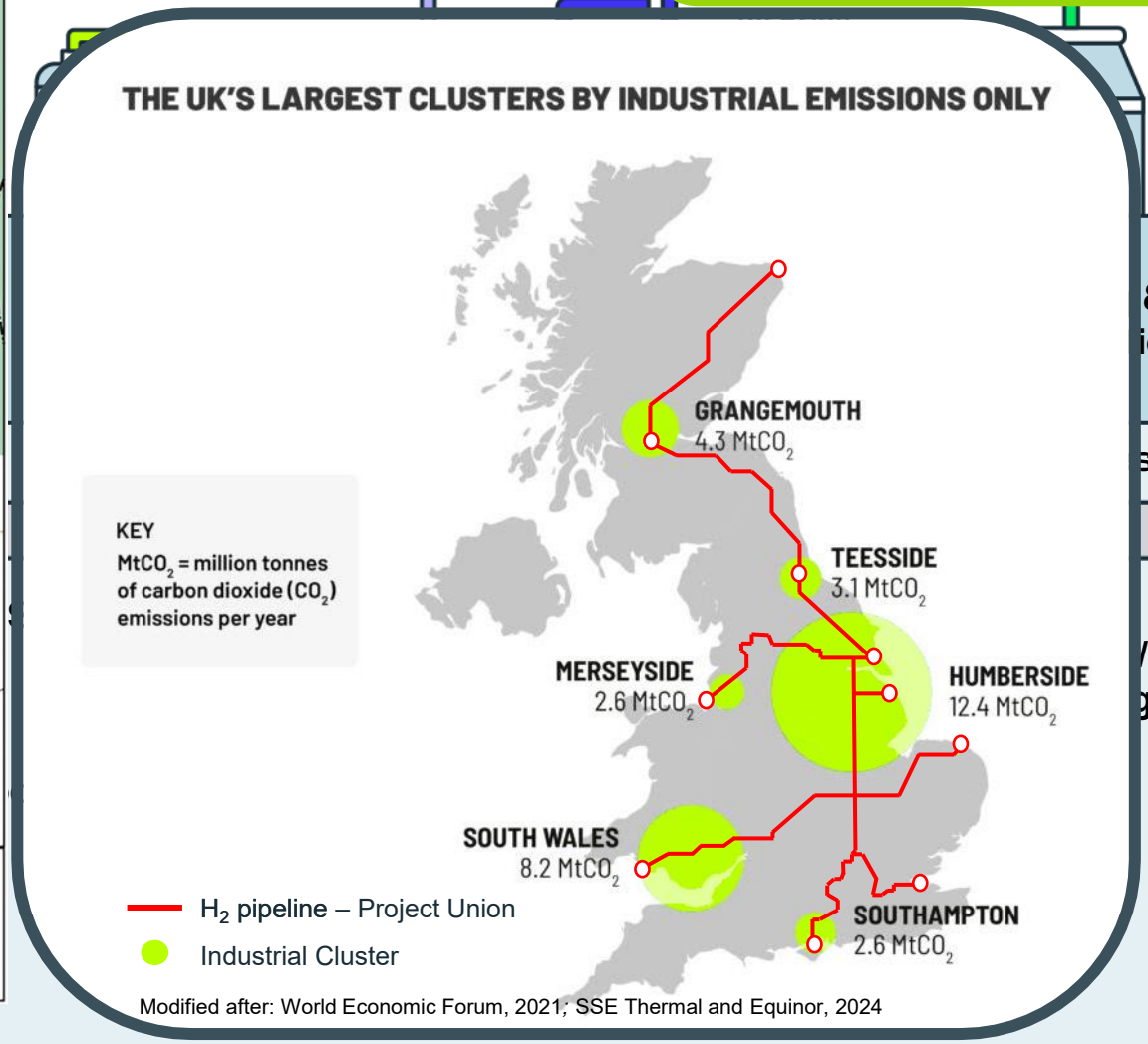
Operations

Storage Type

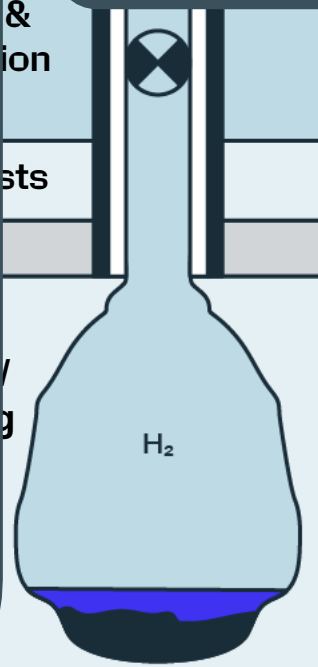
- Dry
- Wet



Williams et al., 2022, *Journal of Energy Storage*, vol. 53



Modified after: World Economic Forum, 2021; SSE Thermal and Equinor, 2024



Rewatering / Rebrining

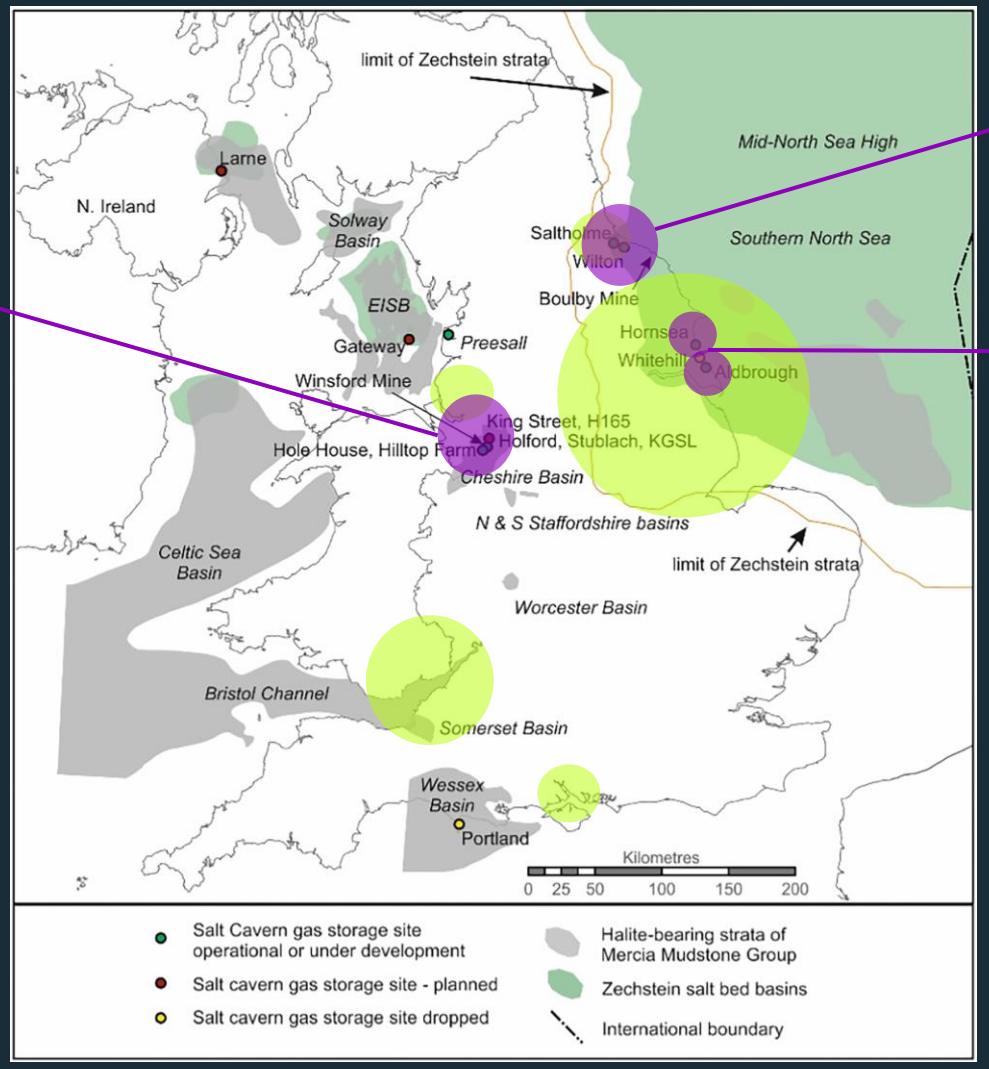
UK Salt Cavern Storage

Cheshire

Stublach
20 caverns
Working gas: 400 MSm³
Salt thickness: 220-230 m

Hill Top
5 Caverns
Working gas: 63 MSm³
Salt thickness: 220-230 m

Holford
8 Caverns
Working gas: 237 MSm³
Salt thickness: 220-230 m



Williams et al., 2022, *Journal of Energy Storage*, vol. 53

Teesside

Wet caverns – brine compensation
Salt thickness: 30 - 45 m

East Yorkshire Coast

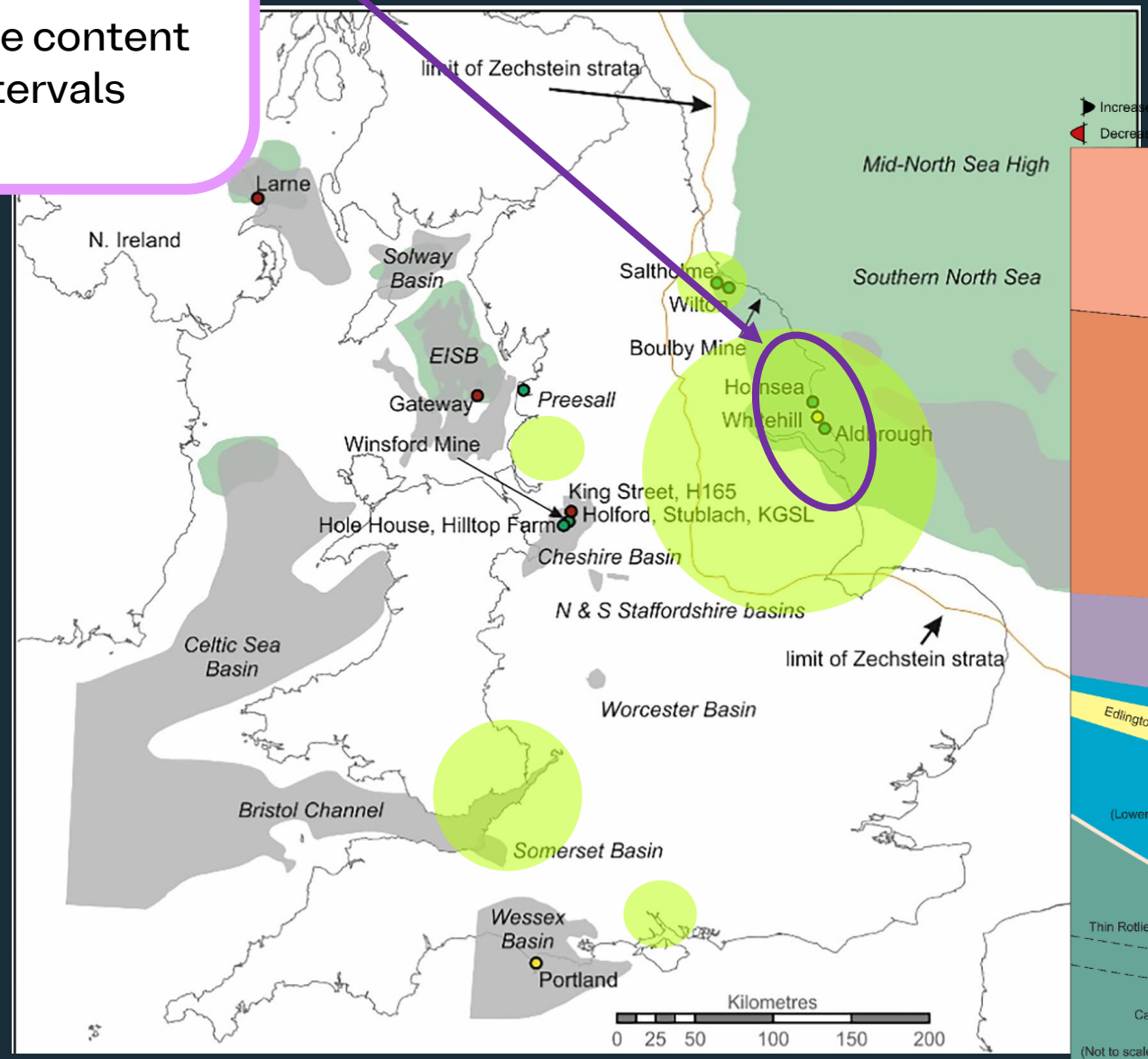
Atwick Gas Storage
9 caverns
Working gas: 309 MSm³
Salt thickness: 170 m

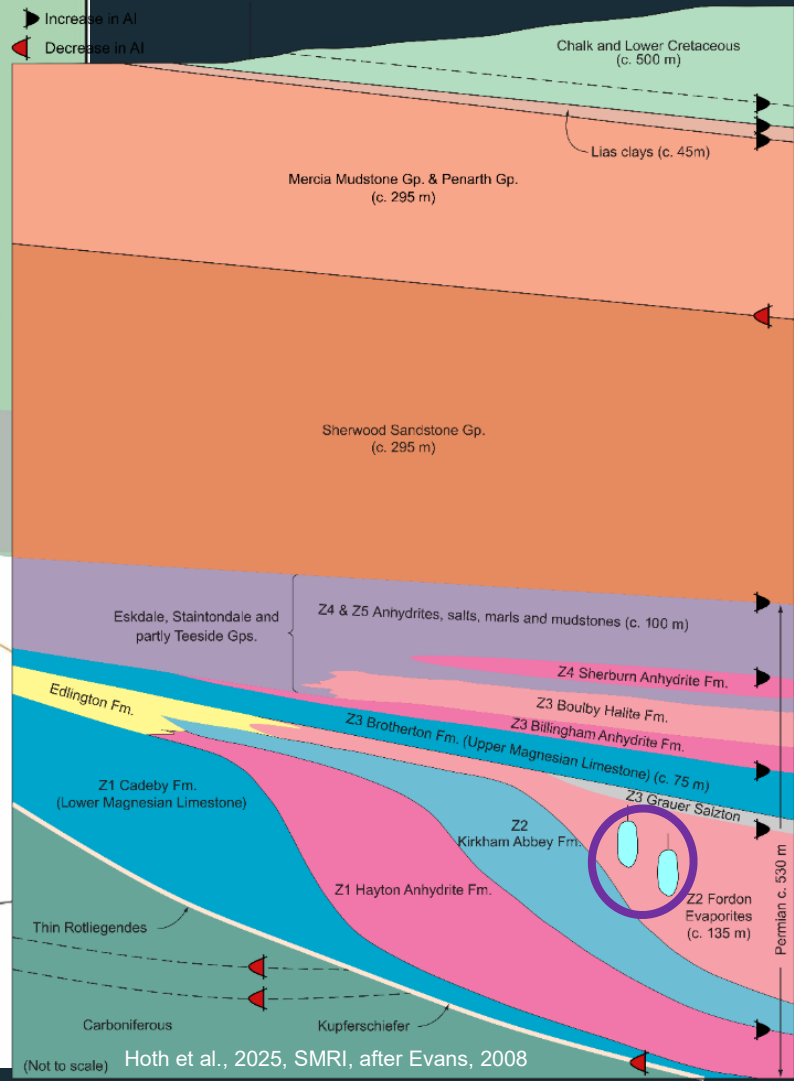
Aldbrough Gas Storage
9 Caverns
Working gas: 330 MSm³
Salt thickness: 170 m

Industrial Clusters
Gas Caverns Storage

East Yorkshire Coast

- Edge of Zechstein Basin (Permian)
- Salt depth ~1,800 mbgl
- Salt thickness ~170 m
- "Clean" salt – insoluble content
- Highly-soluble salt intervals
- Structural features





Hoth et al., 2025, SMRI, after Evans, 2008

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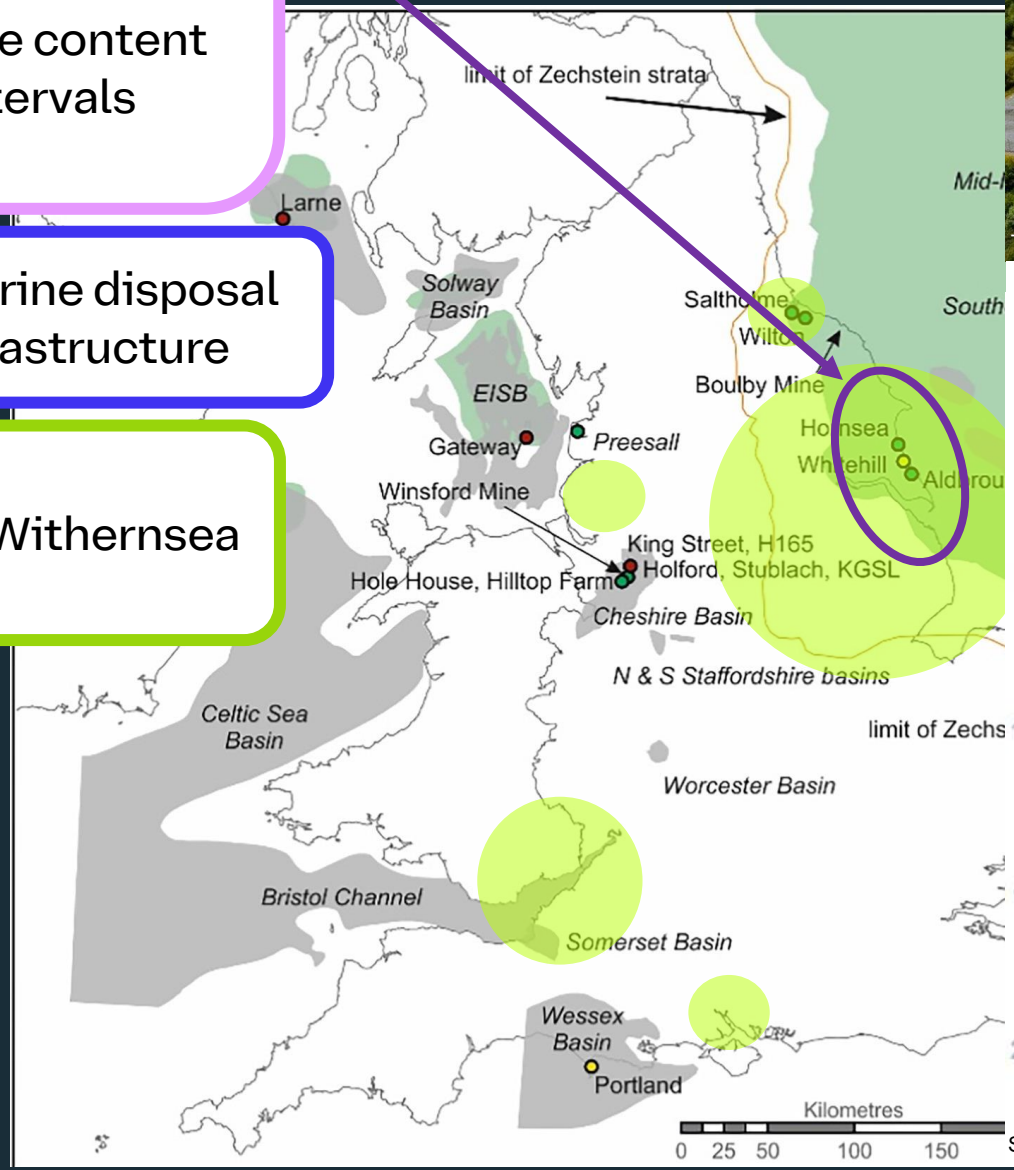
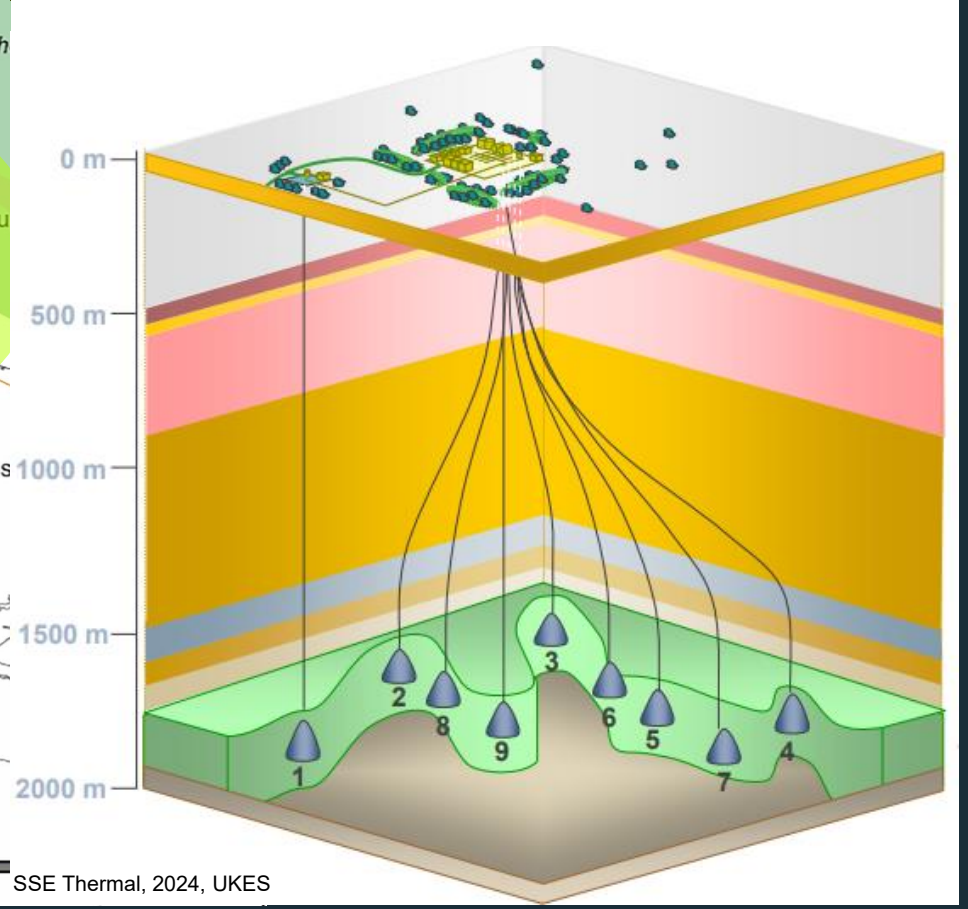
- Coastal – seawater, brine disposal
- Pipelines, marine infrastructure

- Mostly farmlands
- Bridlington, Hornsea, Withernsea
- Coastal erosion




The Yorkshire Post, 2023



SSE Thermal, 2024, UKES

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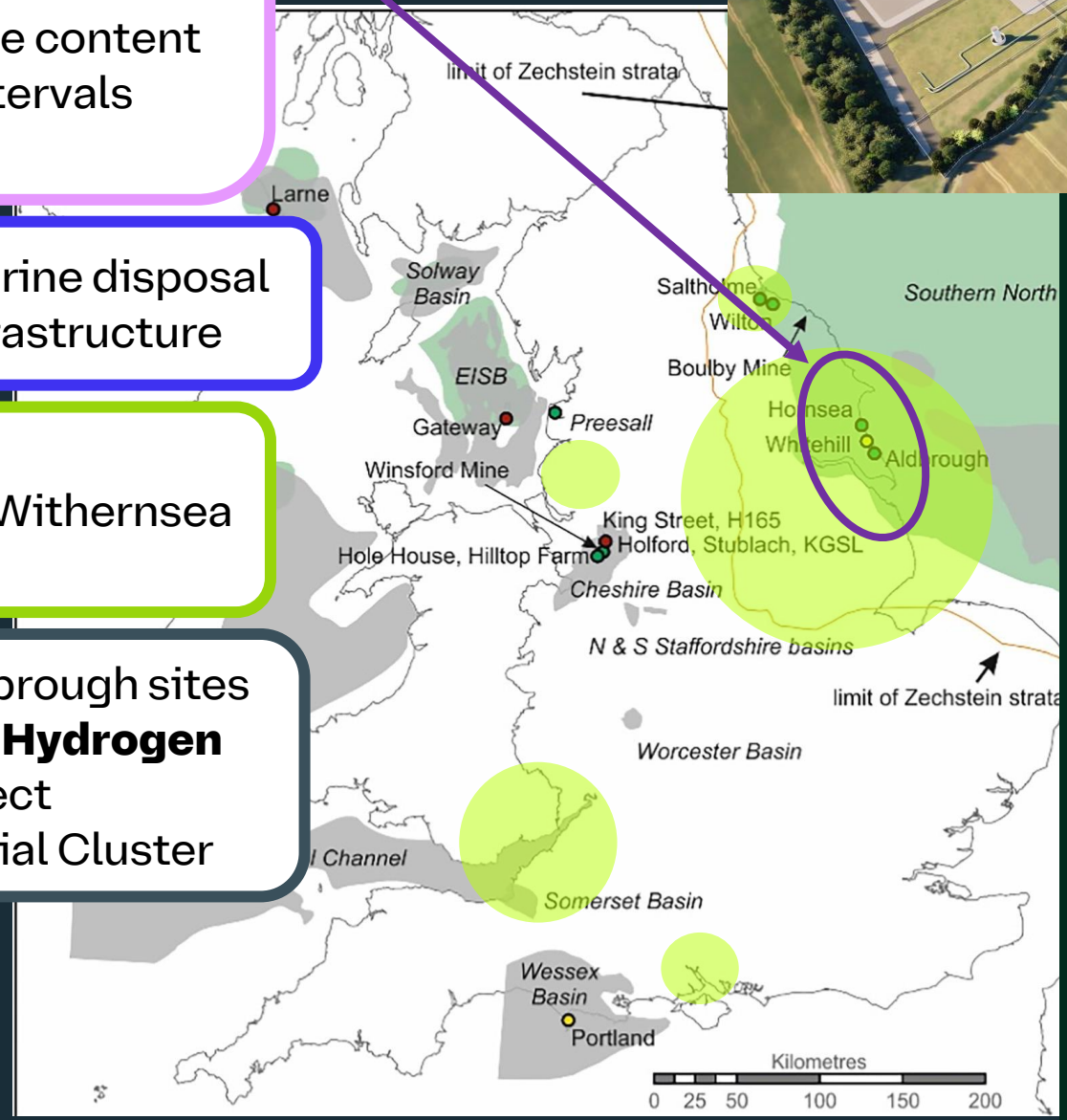
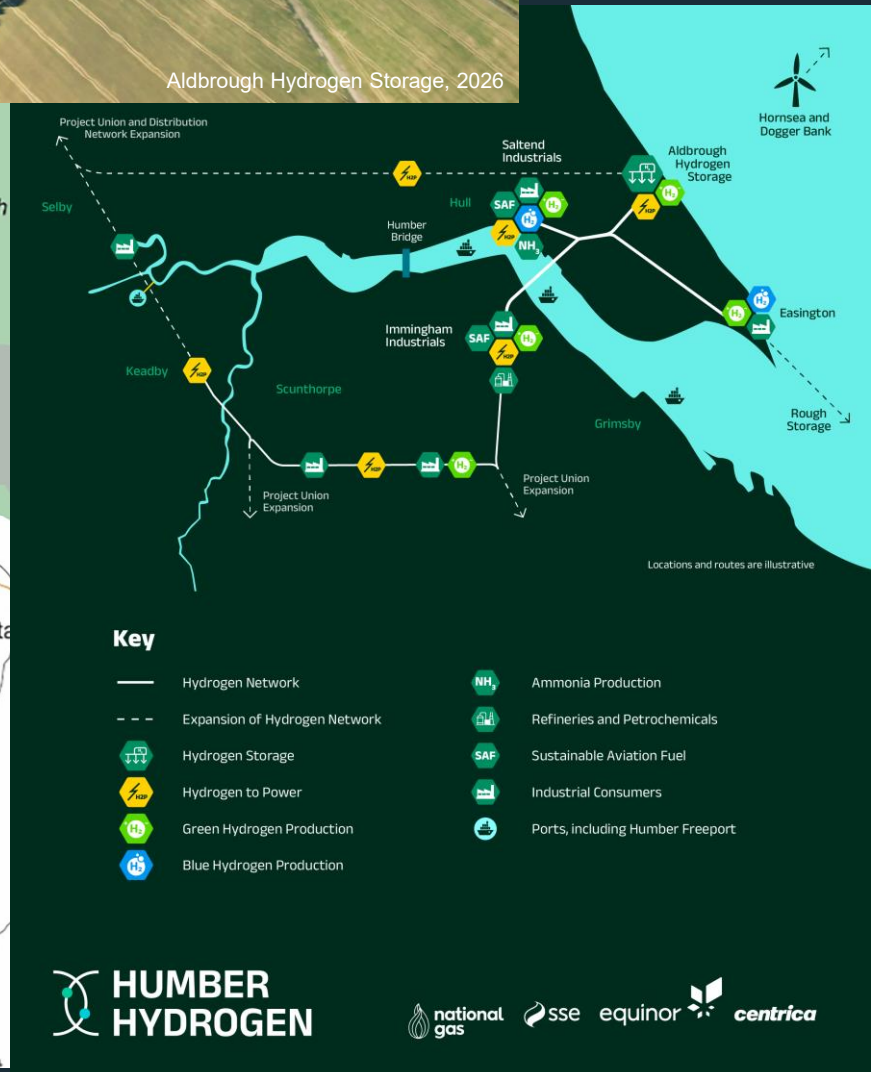
- Mostly farmlands
- Bridlington, Hornsea, Withernsea
- Coastal erosion

- Existing Atwick, Aldbrough sites
- Planned **Aldbrough Hydrogen Storage (AHS)** project
- Humberside Industrial Cluster

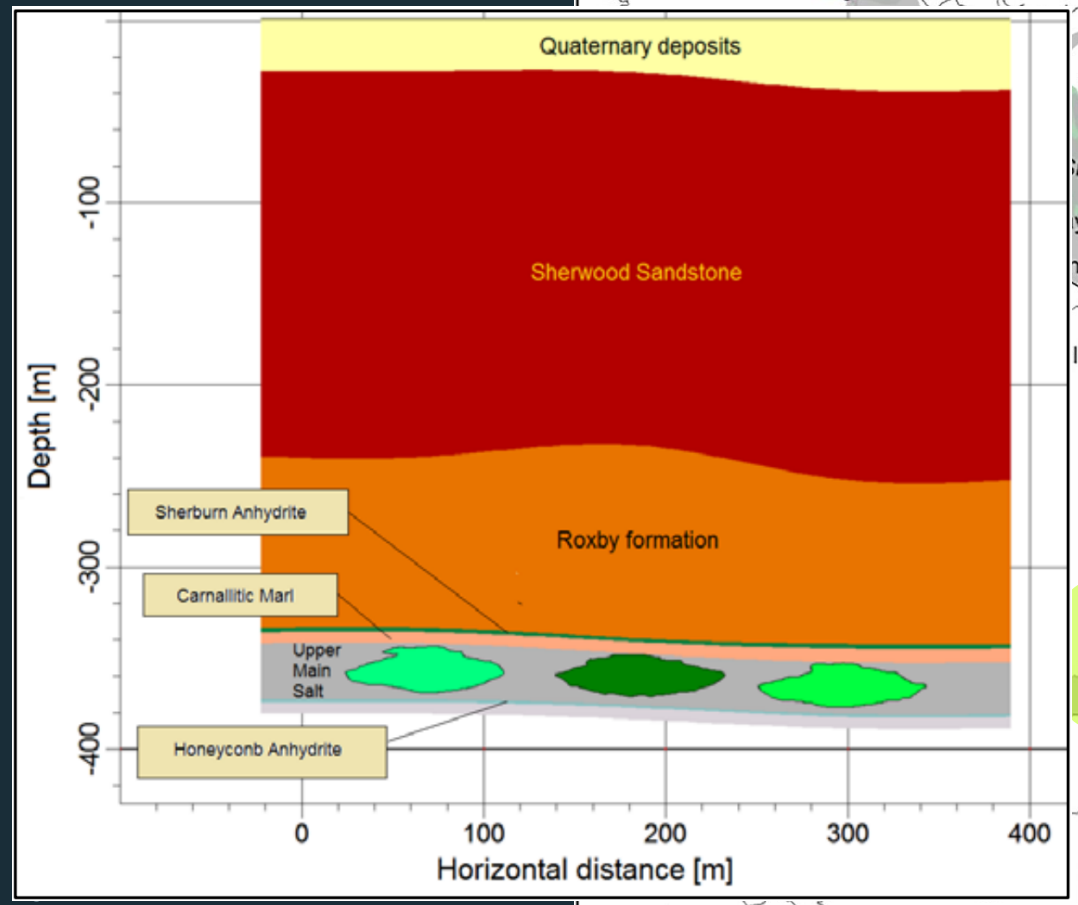

Aldbrough Hydrogen Storage, 2026



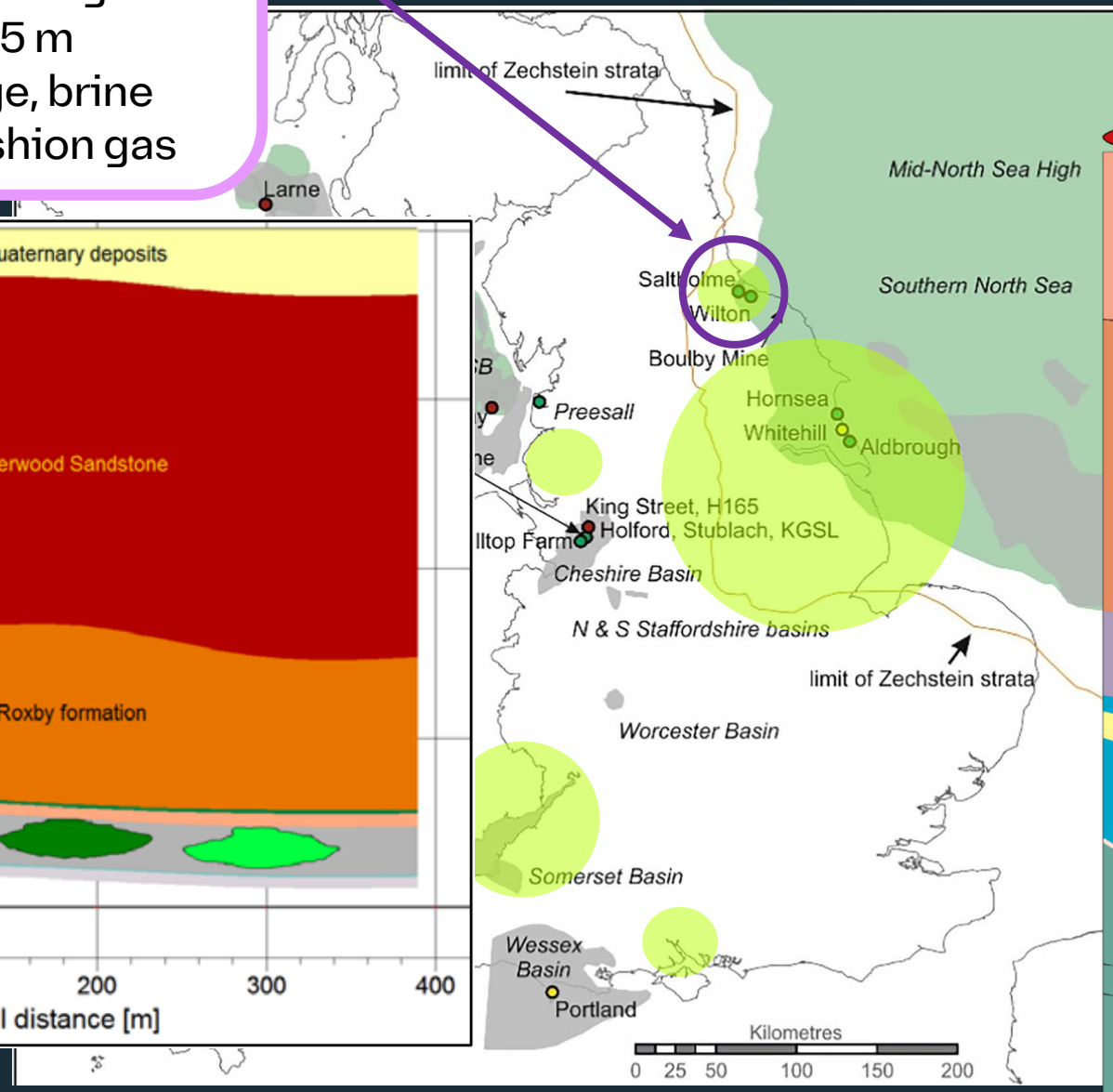


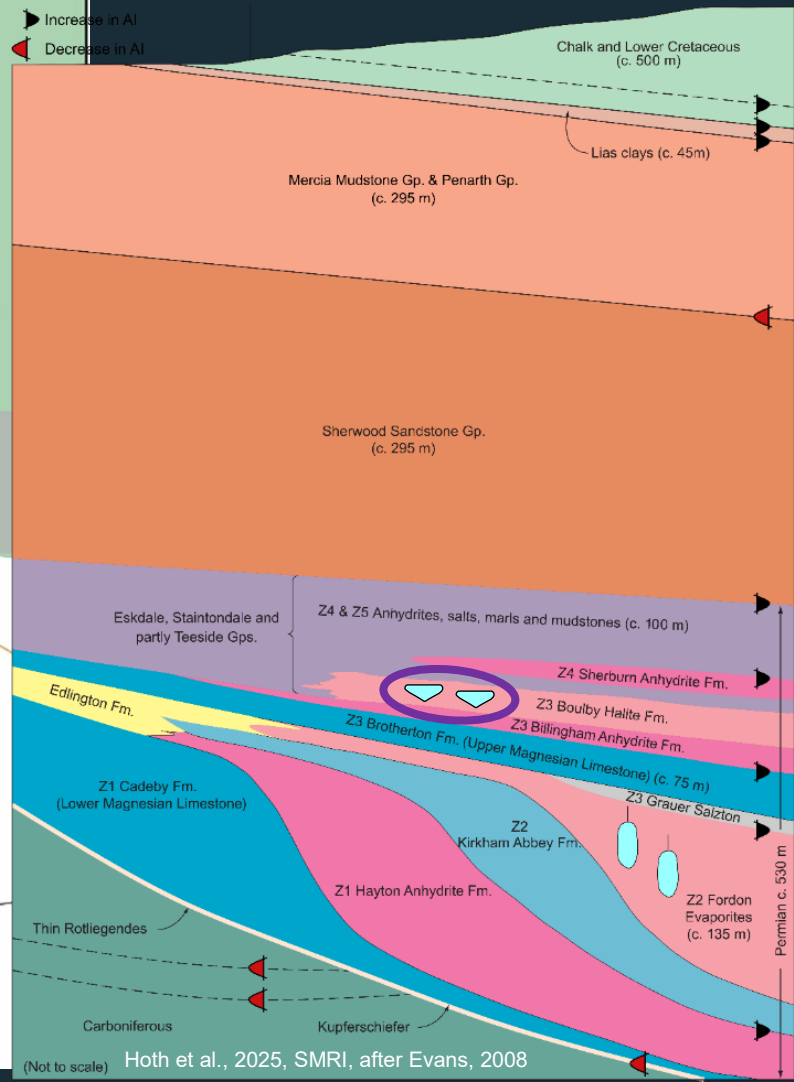
Teesside

- Edge of Zechstein Basin (Permian), but higher salt cycle (z3) used
- Salt depth ~340 - 650 mbgl
- Salt thickness ~30 - 45 m
- Thin salt → wet storage, brine compensation, no cushion gas



Passaris et al., 2018 Belfast





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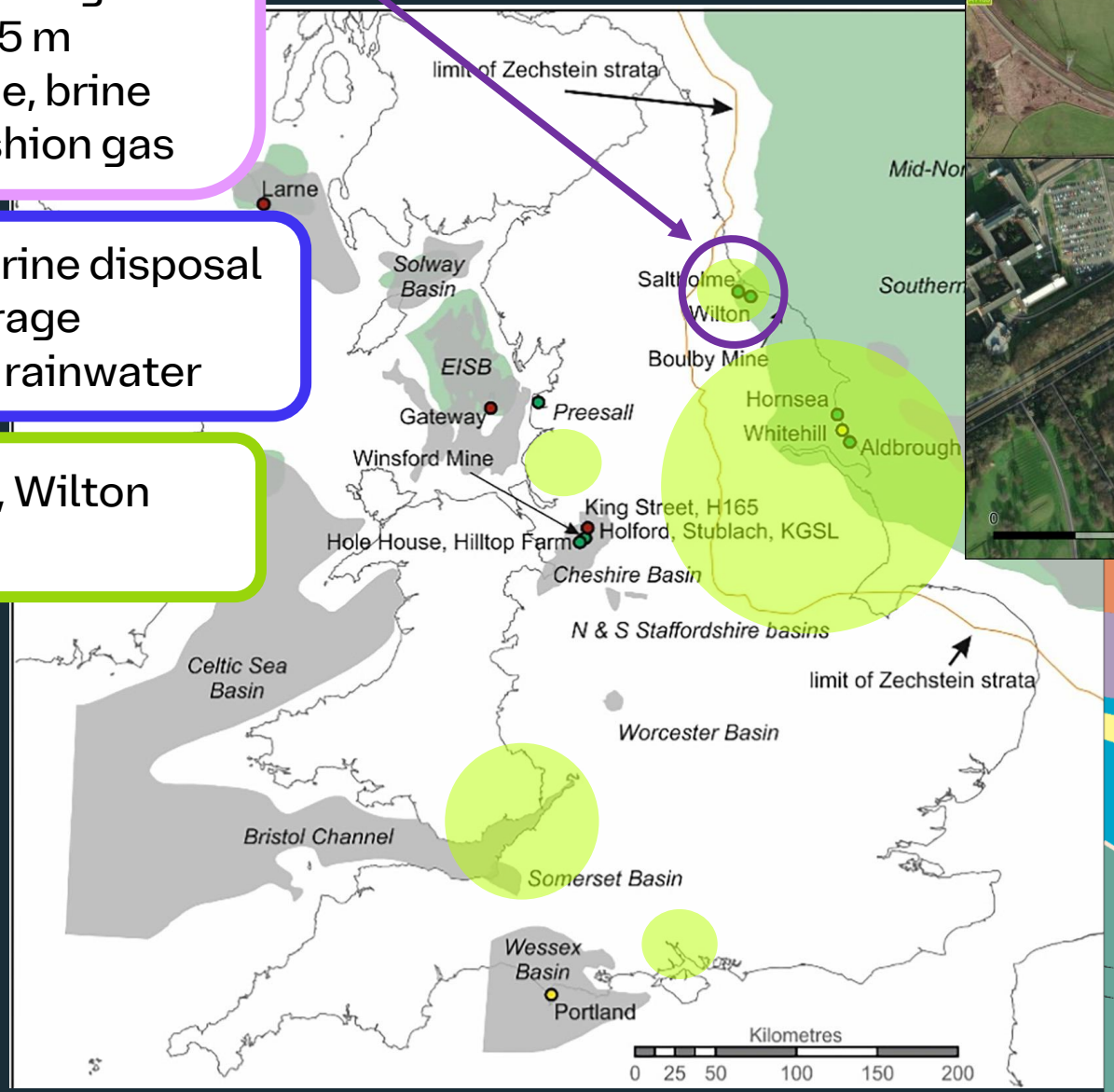
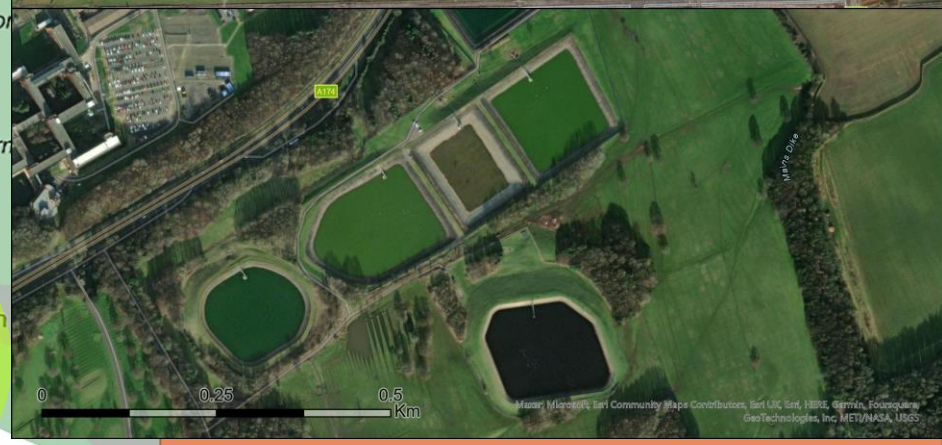
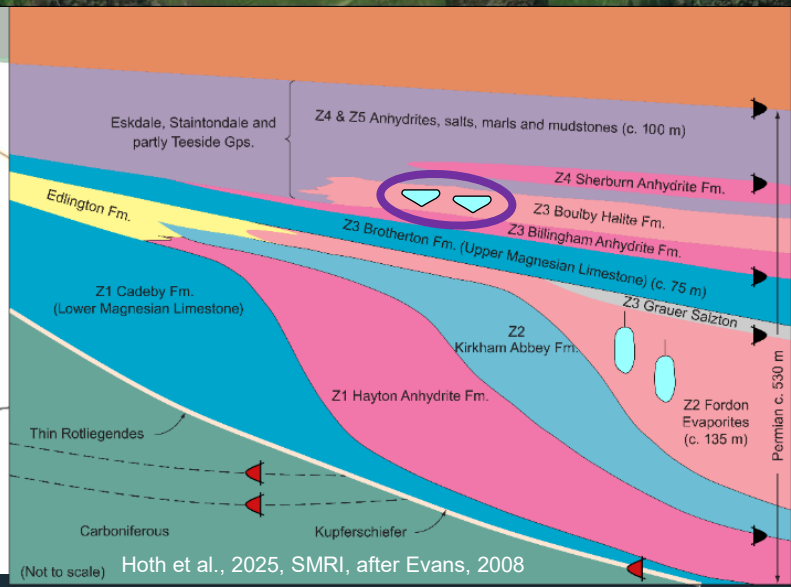
- Dilution of brine with rainwater

- Industrial – Saltholme, Wilton
- Nature Reserves







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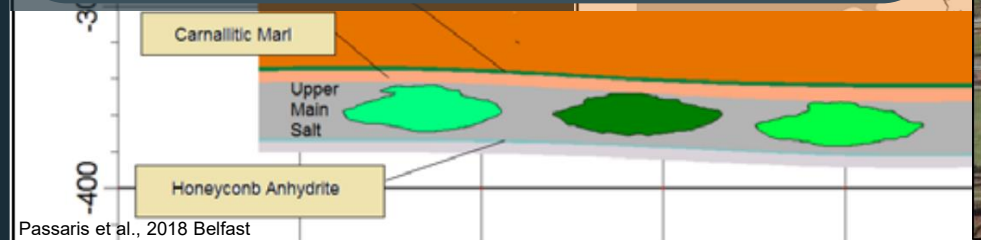
- First Town's Gas storage in 1959
- 3x Hydrogen caverns from 1972
- 100+ caverns by 1982
- Chemical feedstock storage today



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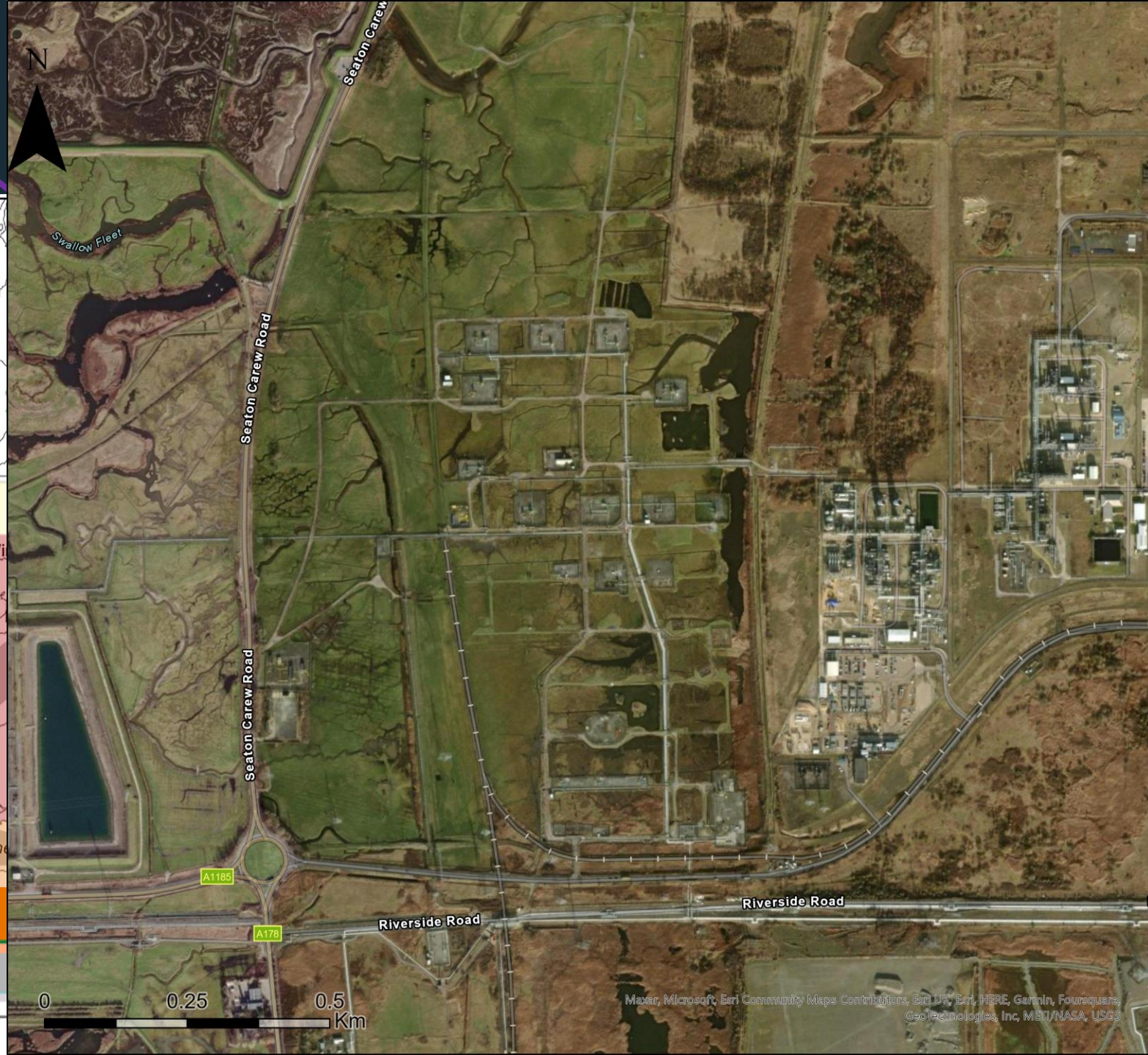

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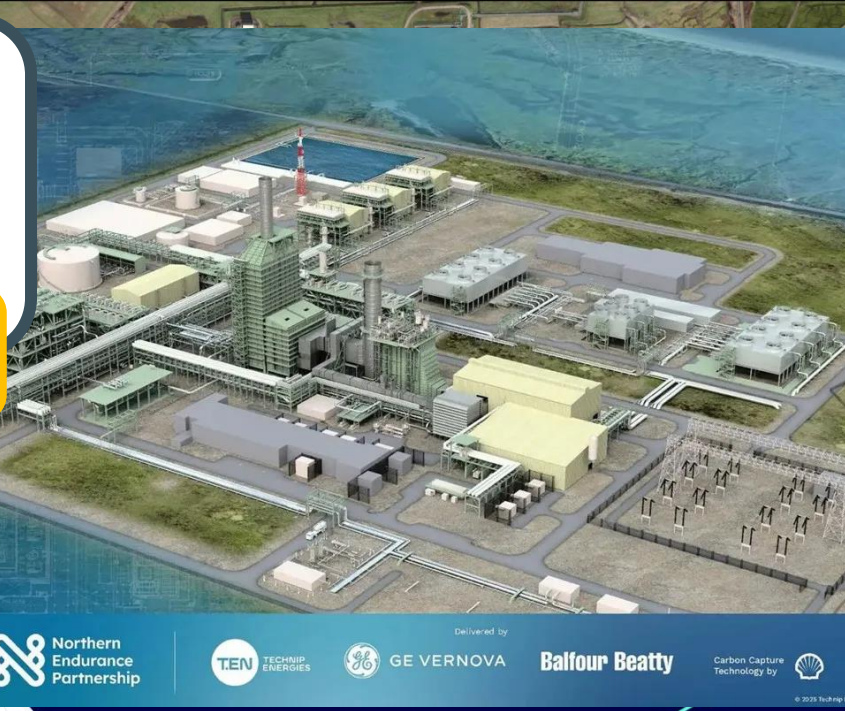
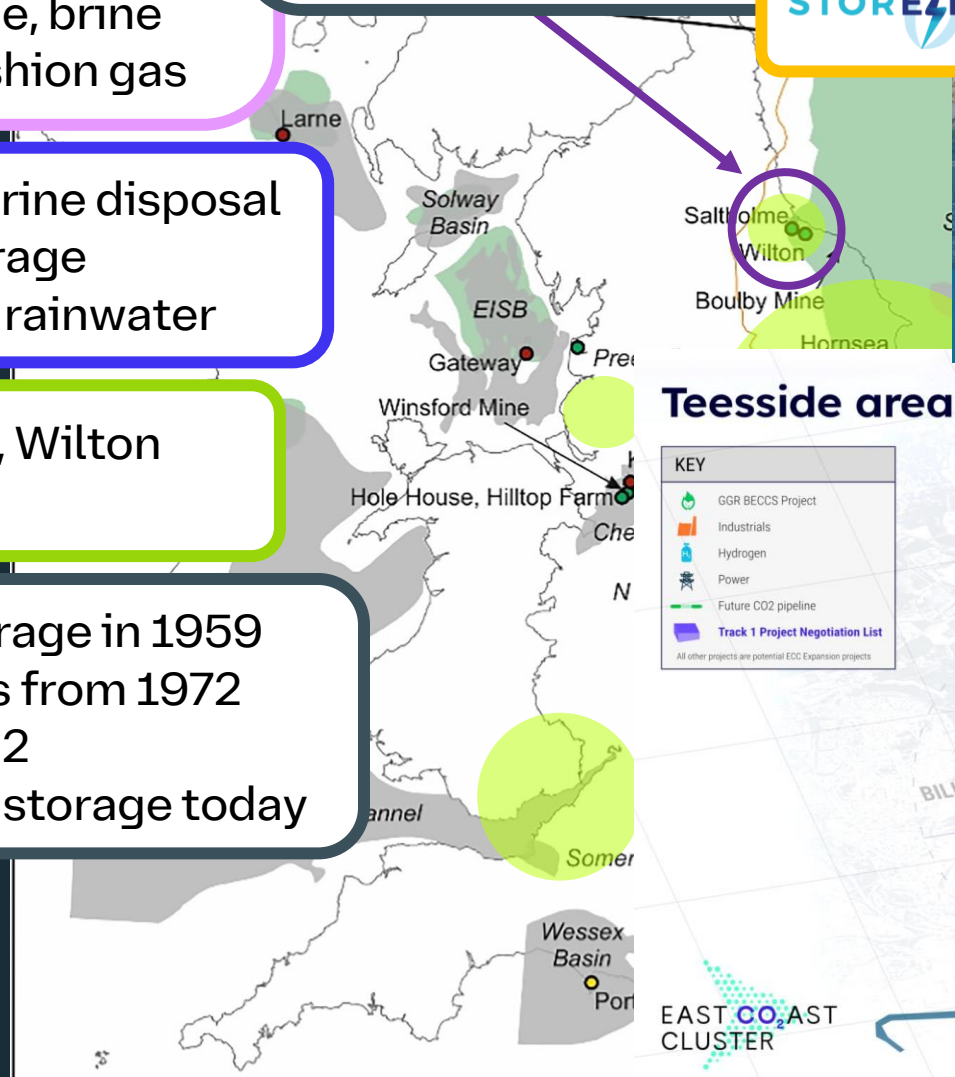
- Net Zero Teesside Project
- East CO_2ast Cluster
- Sabic UK → **Storelectric** – Long-Duration Energy Storage (LDES) projects





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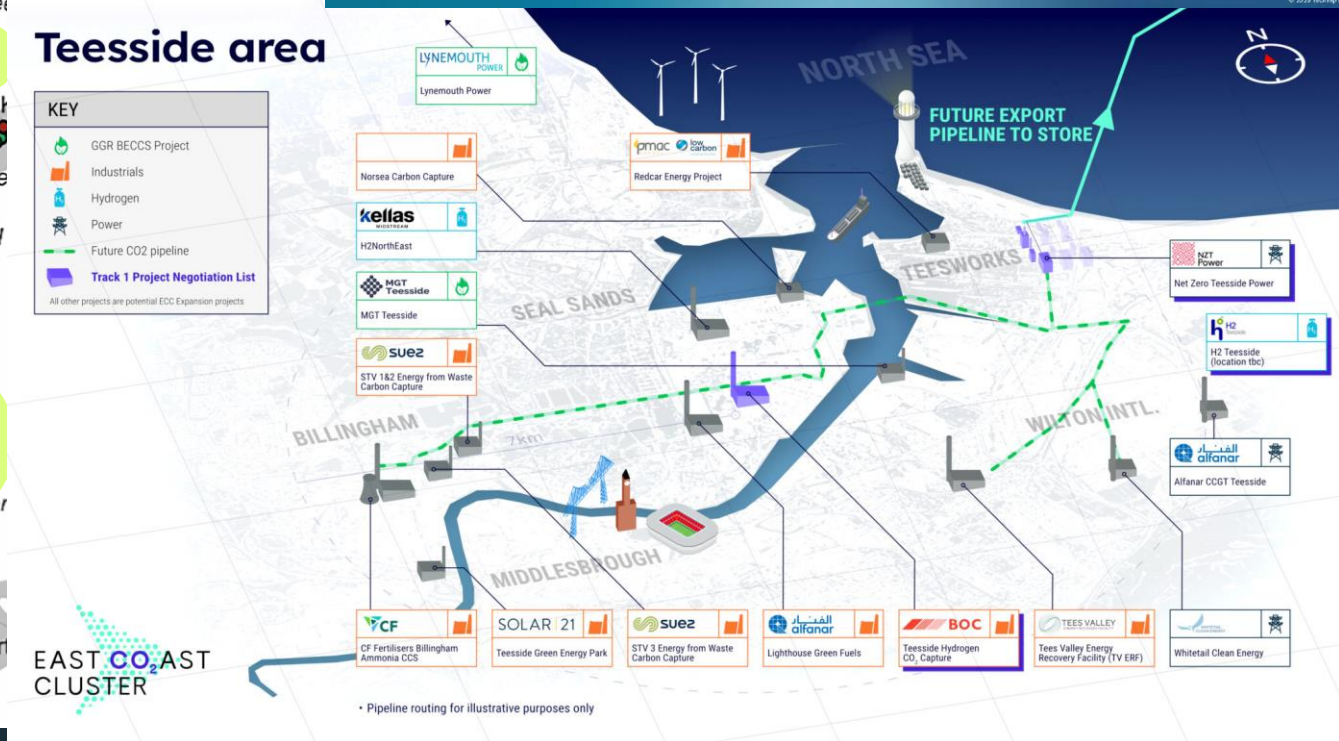
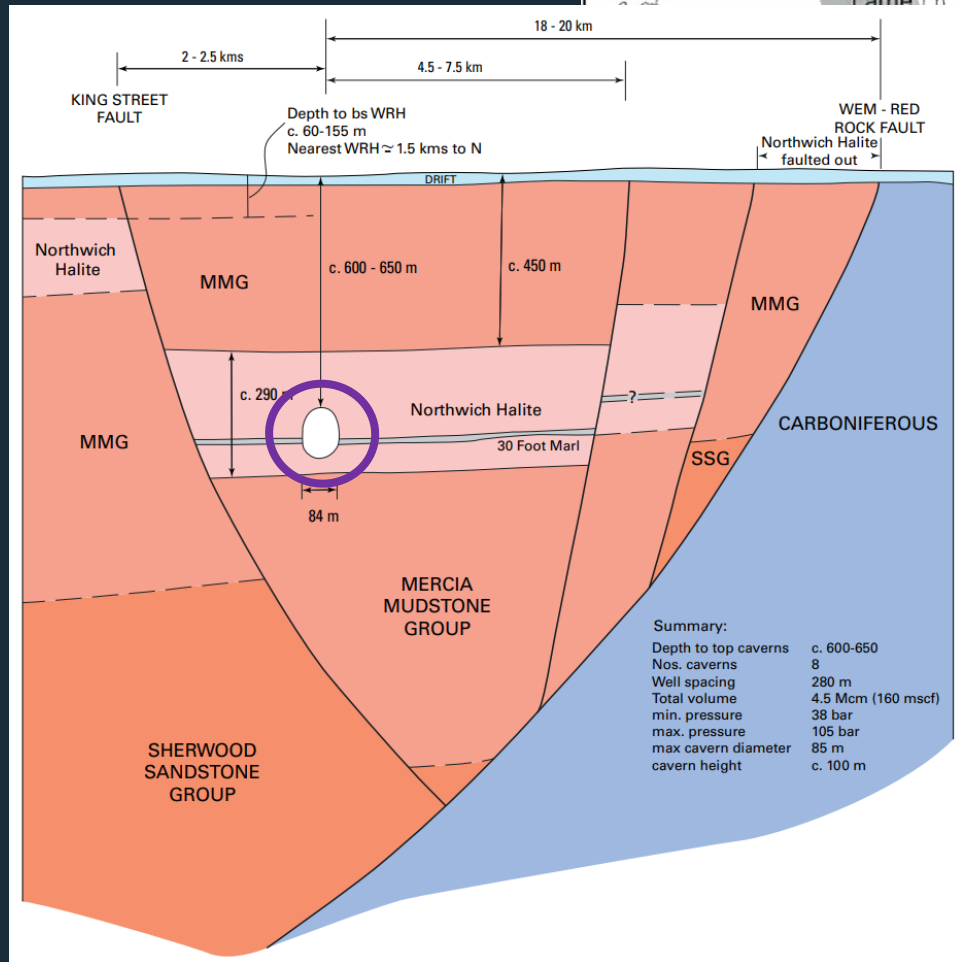
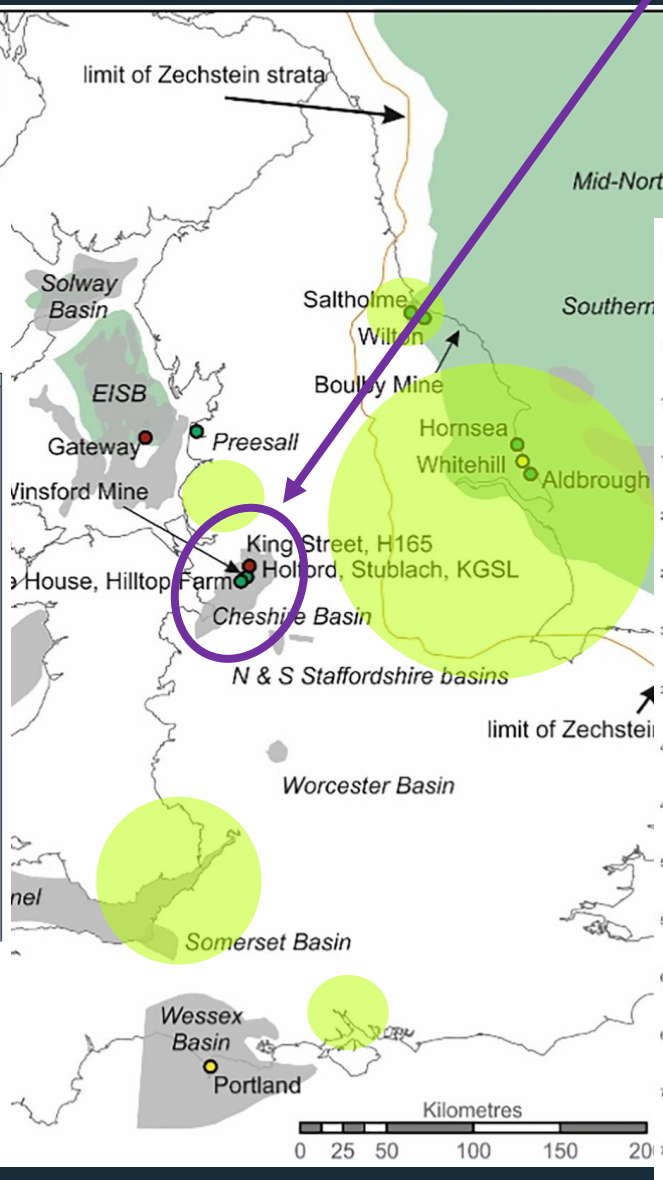
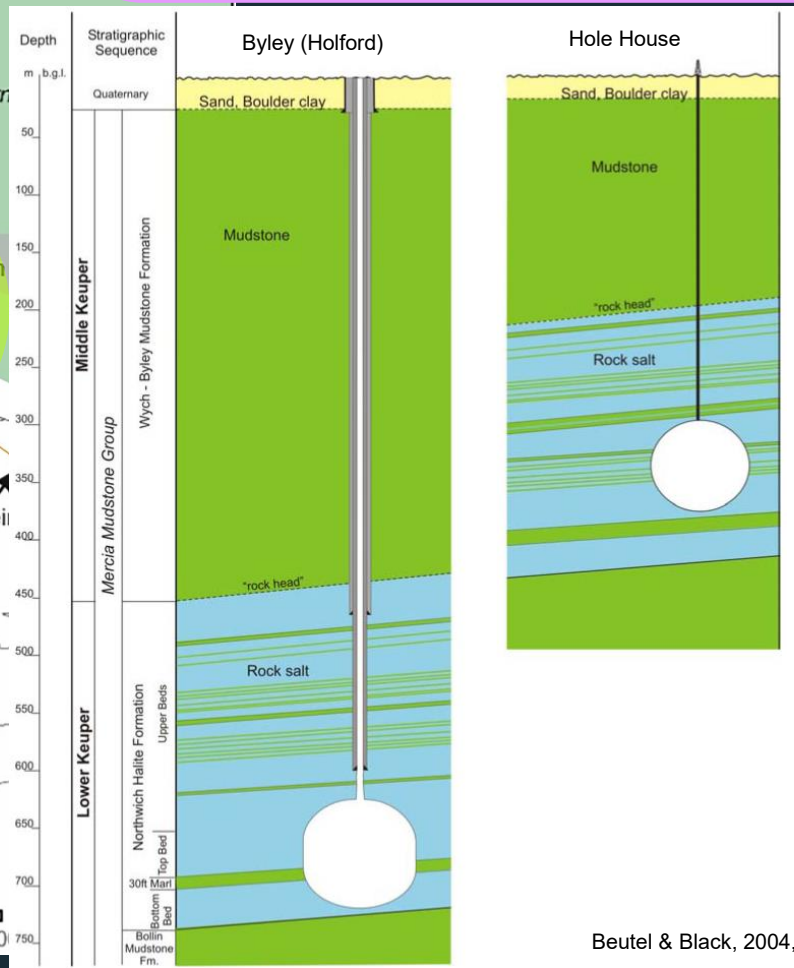


Cheshire

- Younger Triassic Basin
- Salt depth ~200 – 600+ mbgl
- Salt thickness ~220 – 290 m
- Non-halite layers, insoluble content, solution mining
- Faults – King Street







Beutel & Black, 2004, SMRI Berlin

1996 Salt Union Weston Point – Terry Callaghan – Flickr

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BRITISH SALT
A TATA Enterprise

Cheshire

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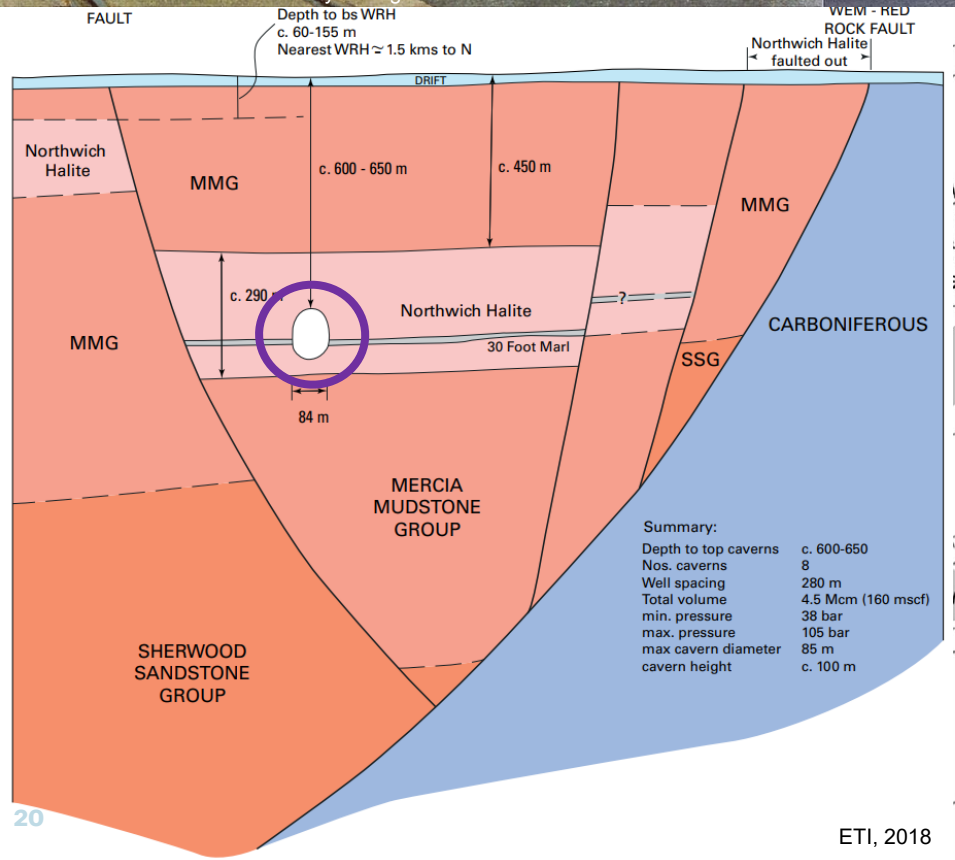
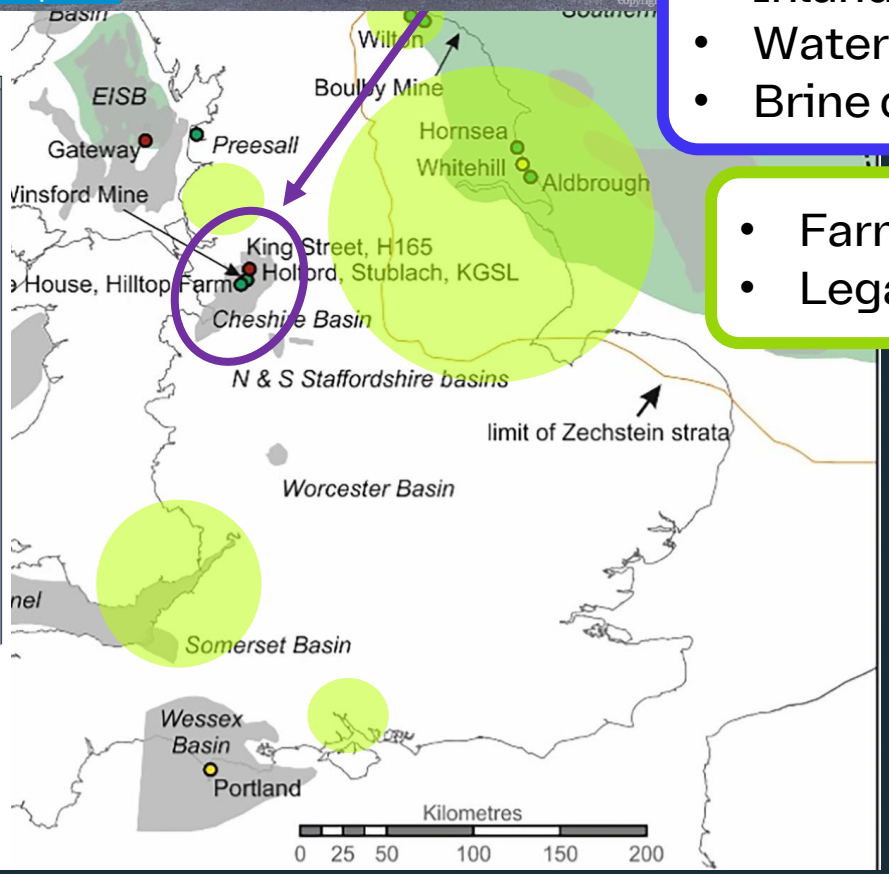
- Faults – King Street

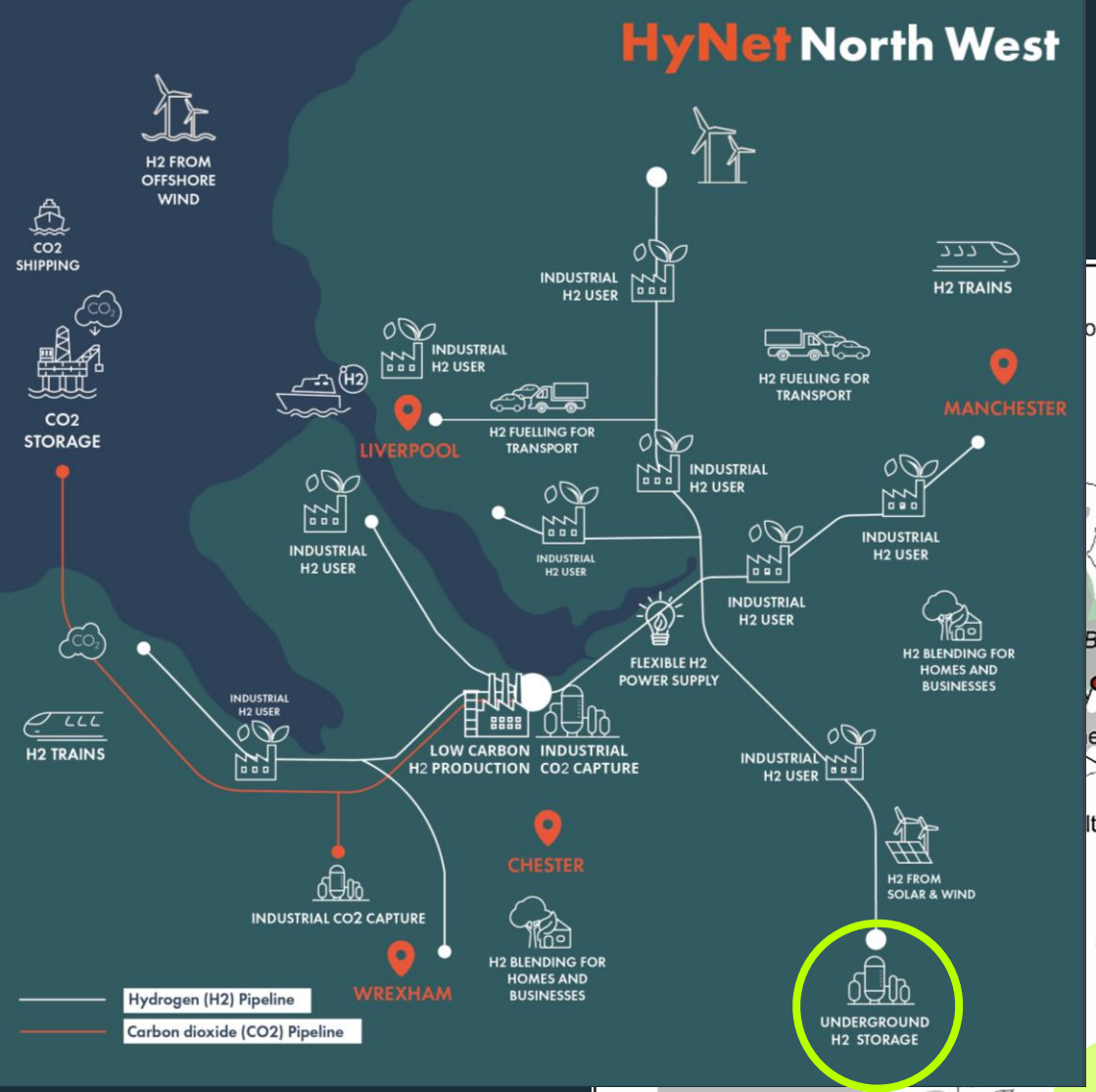
- Inland, >20 km from Mersey
- Water source → rivers
- Brine disposal → off-takers

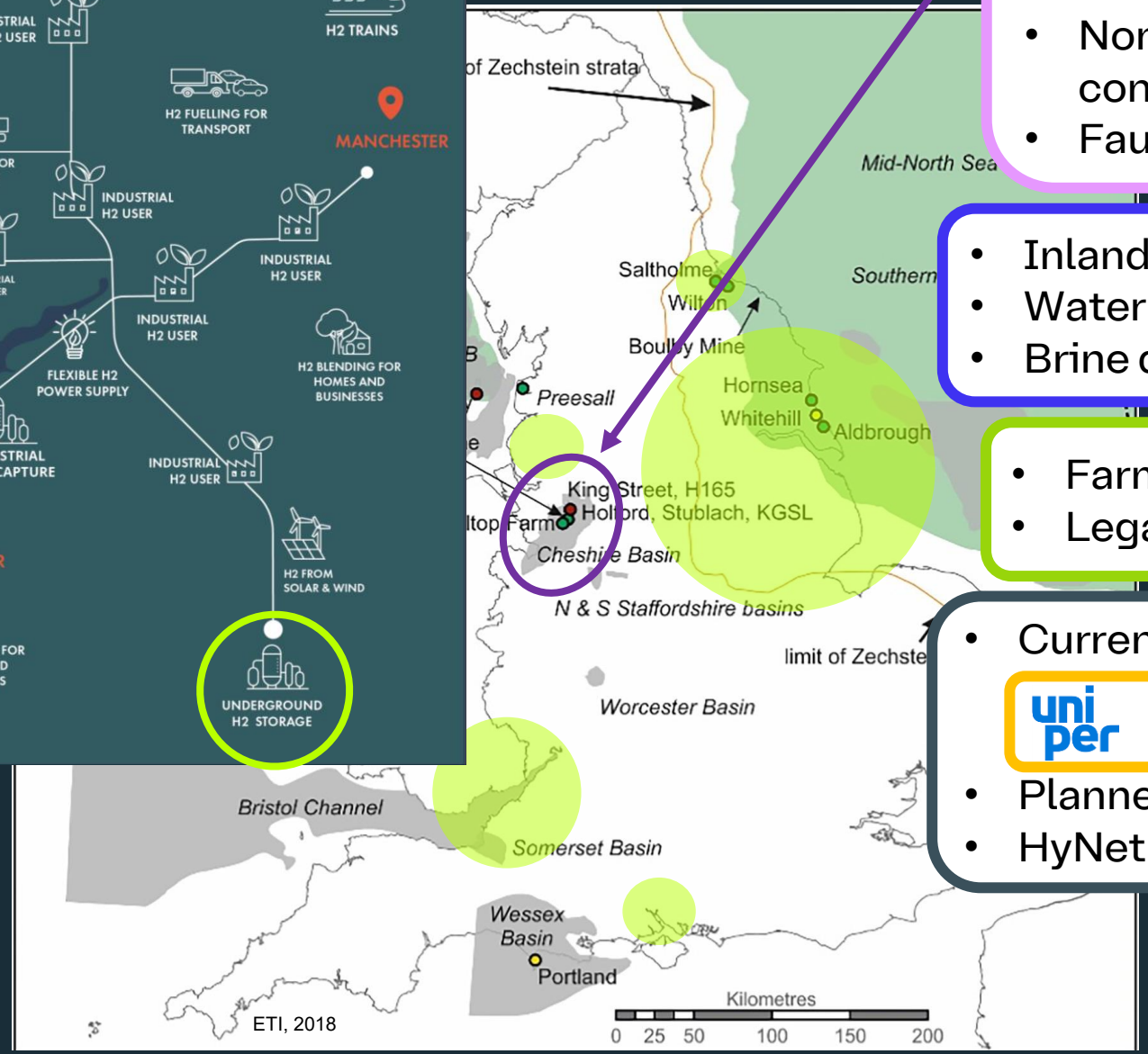
- Farmlands, towns
- Legacy of salt works, -wich towns



ETI, 2018







ETI, 2018

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- Farmlands, towns
- Legacy of salt works, -wich towns

- Current gas storage operators

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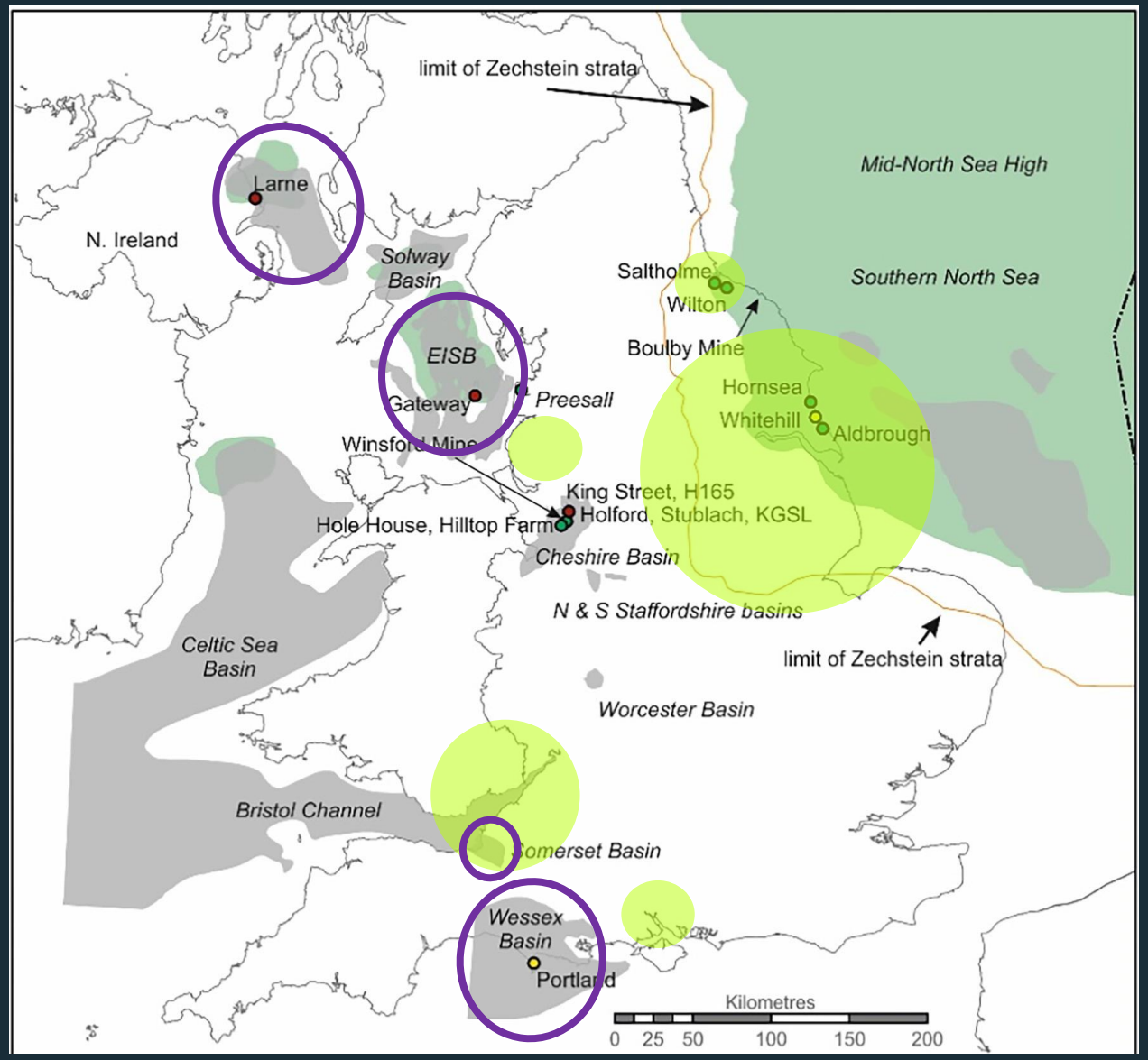
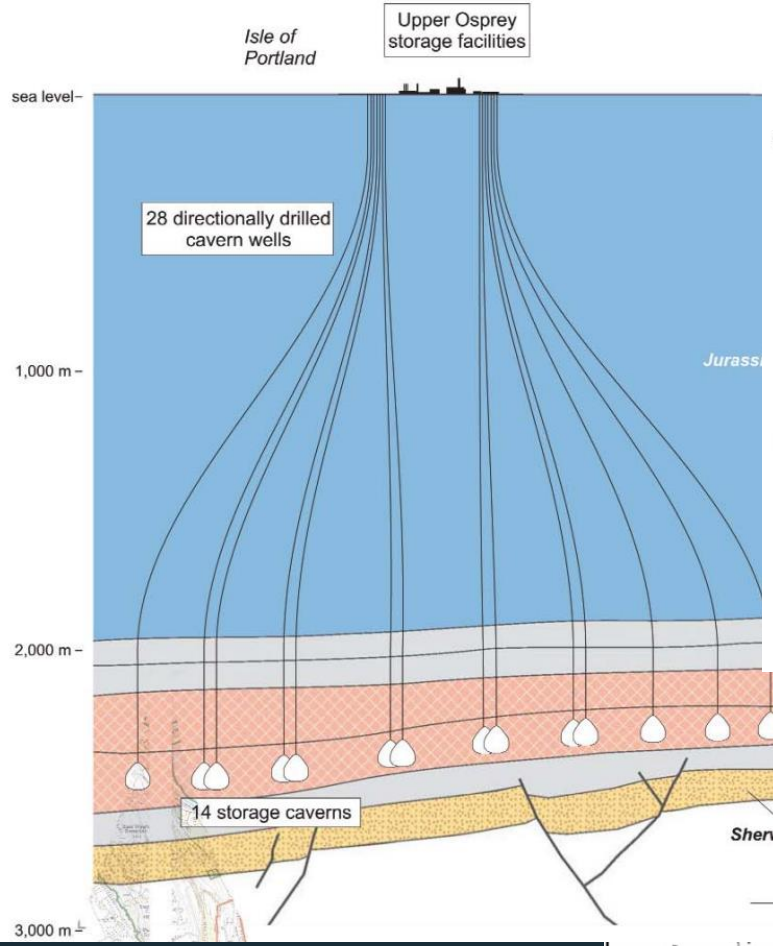
- Planned H2 storage projects
- HyNet North West Cluster

Four More Regions





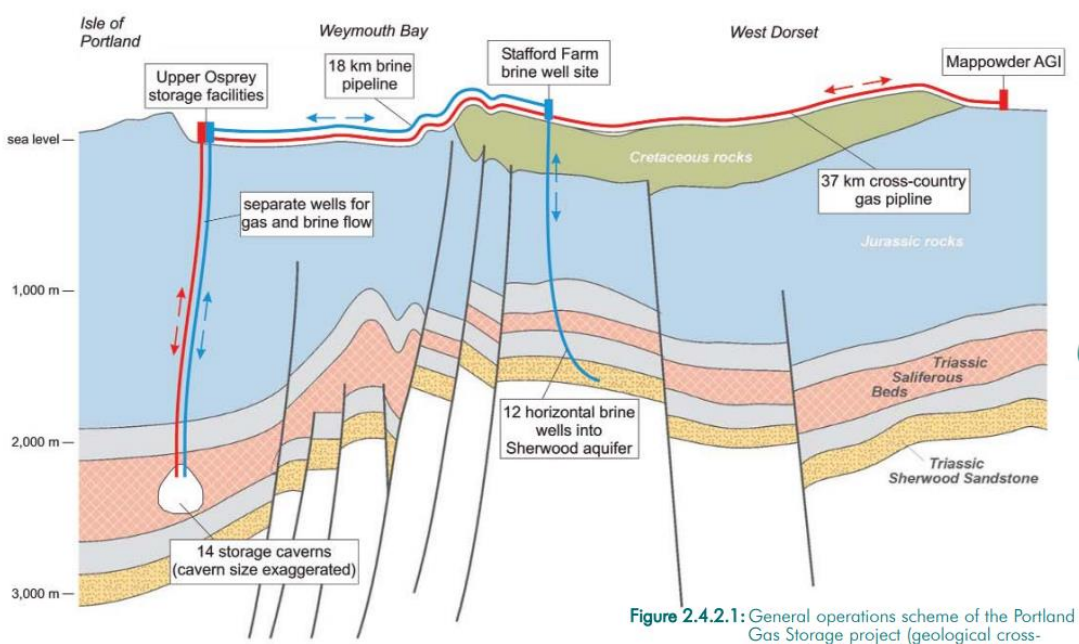


Figure 2.4.2.1: General operations scheme of the Portland Gas Storage project (geological cross-section has 6 x vertical exaggeration)

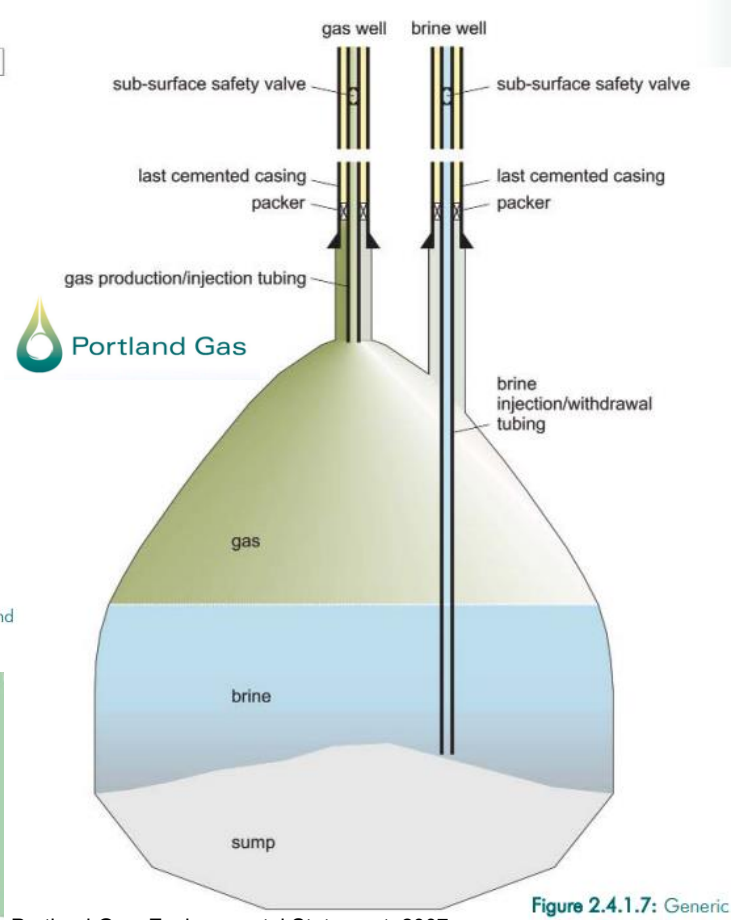
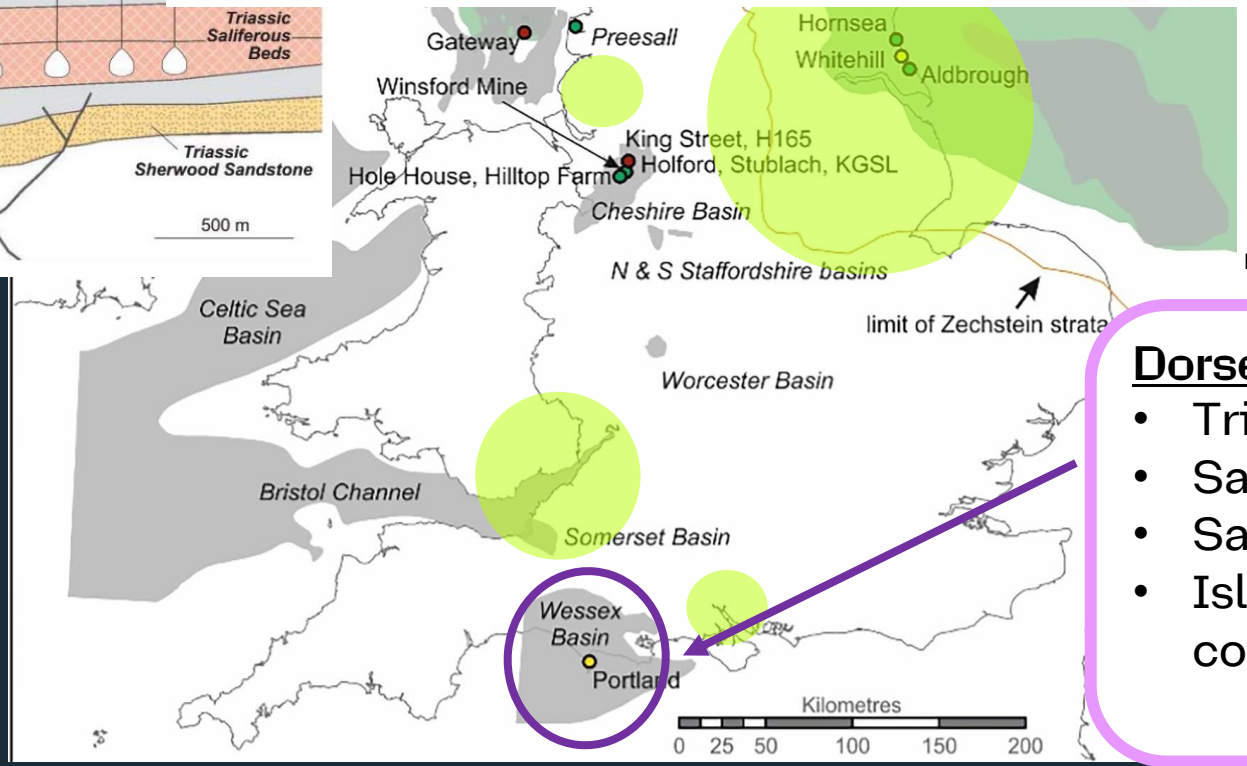


Figure 2.4.1.7: Generic

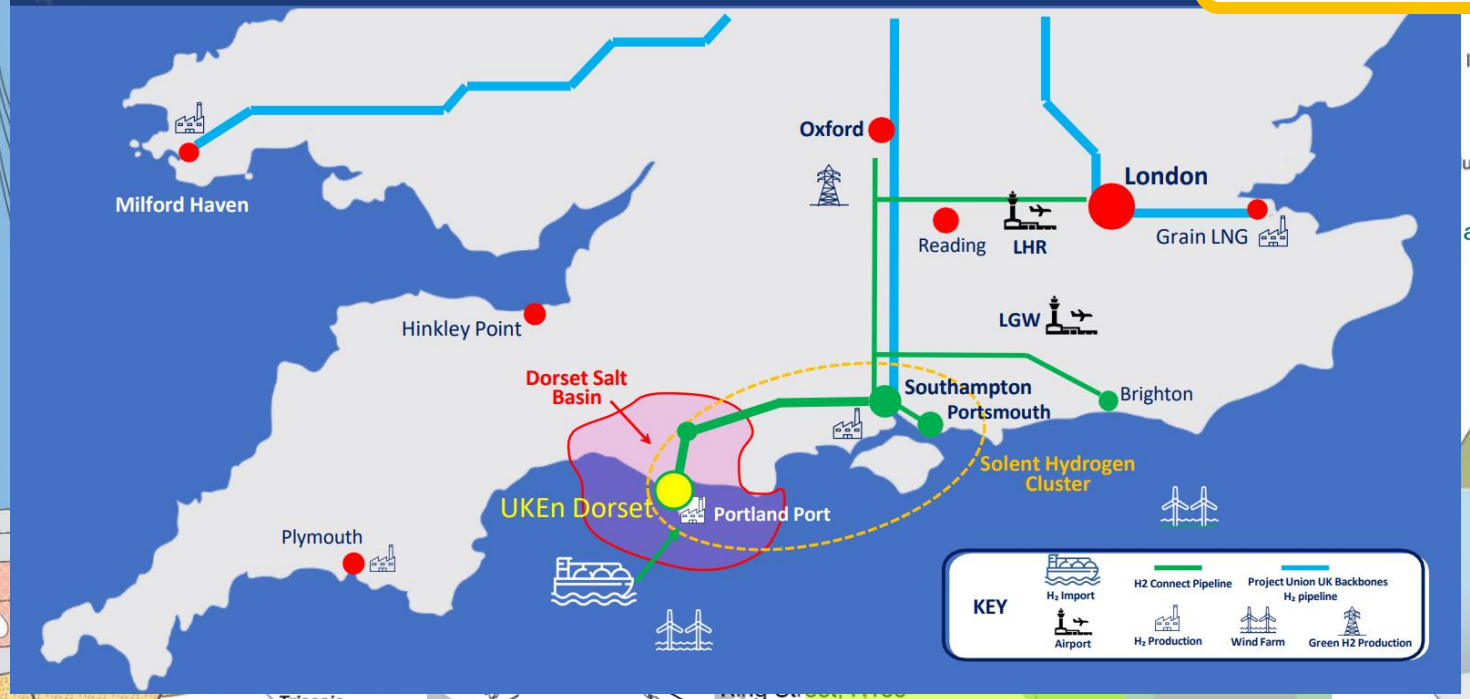
Portland Gas, Environmental Statement, 2007

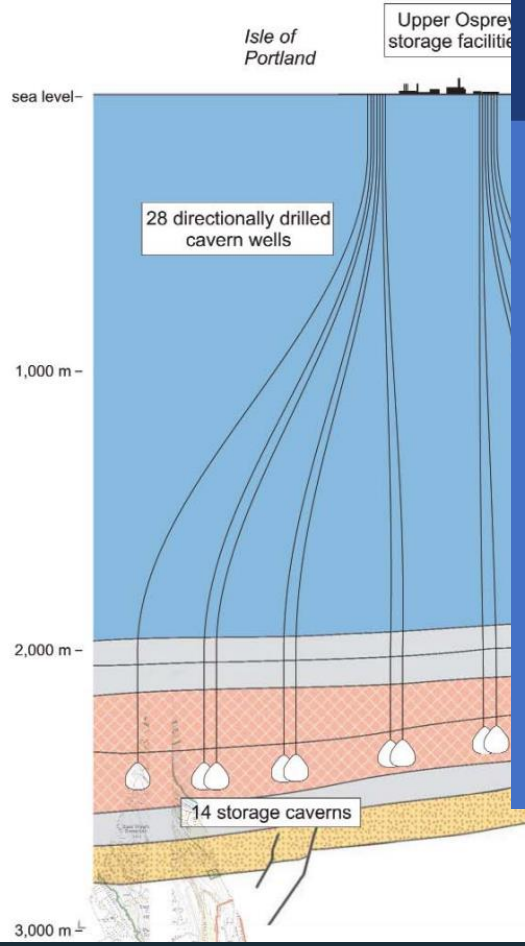


Dorset

- Triassic Dorset Halite Member
- Salt depth ~400 – 2,400 m bgl
- Salt thickness ~130 – 200 m
- Isle of Portland project – brine compensation due to depth

UKEn Dorset: A key element of S. UK H_2 infrastructure





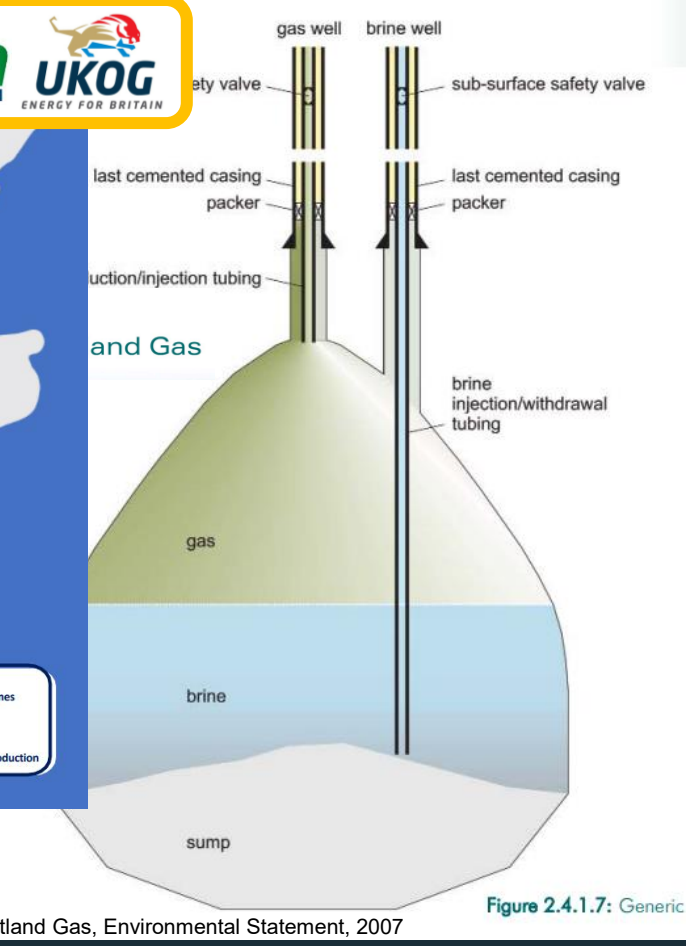
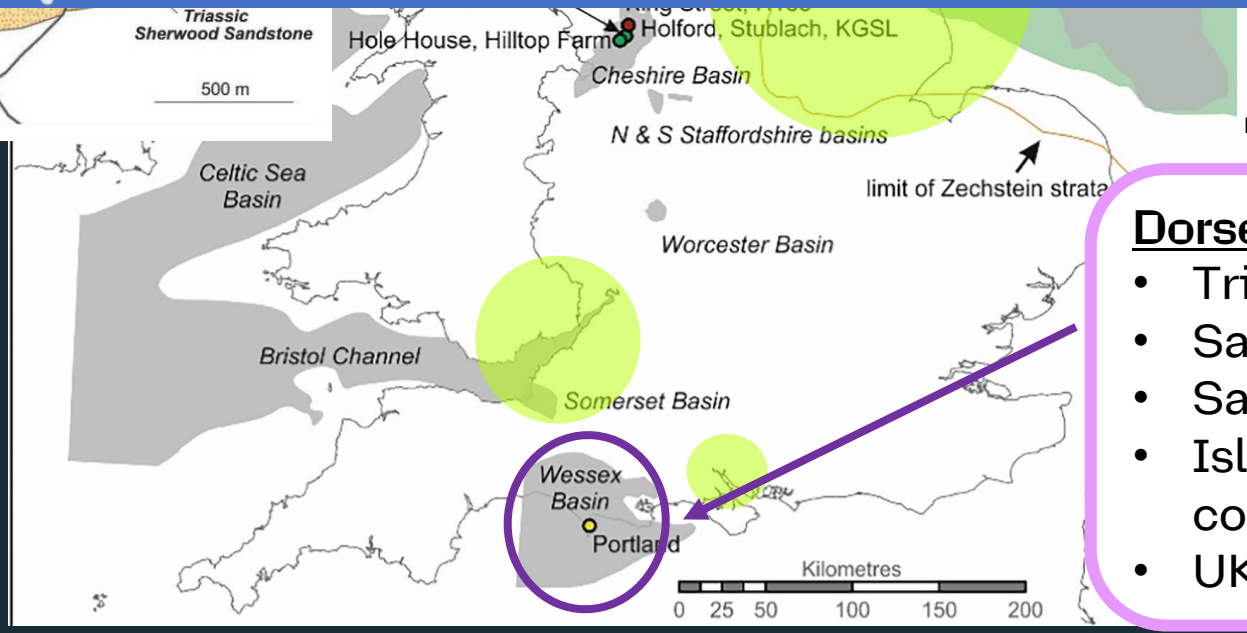


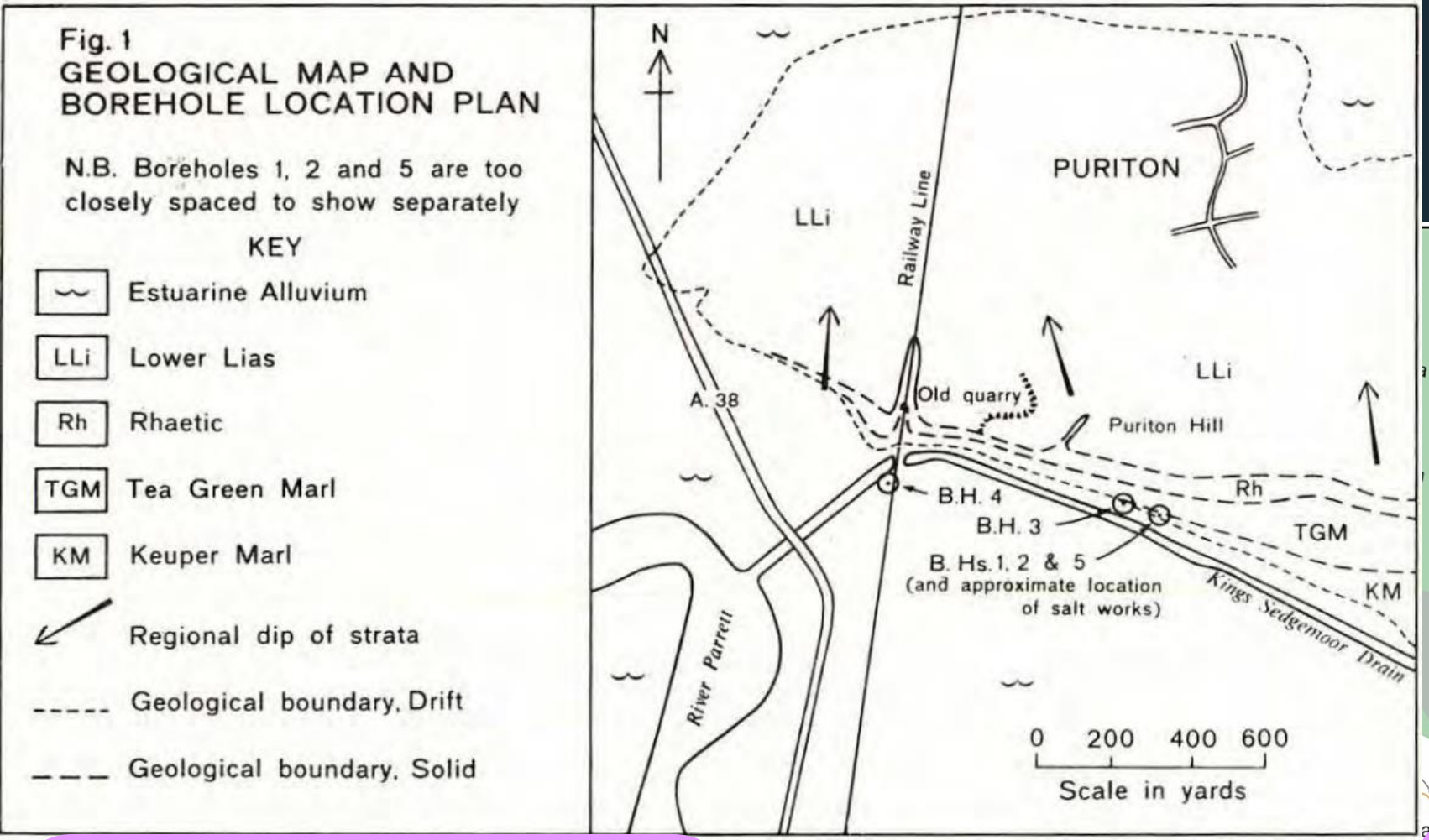
Figure 2.4.1.7: Generic

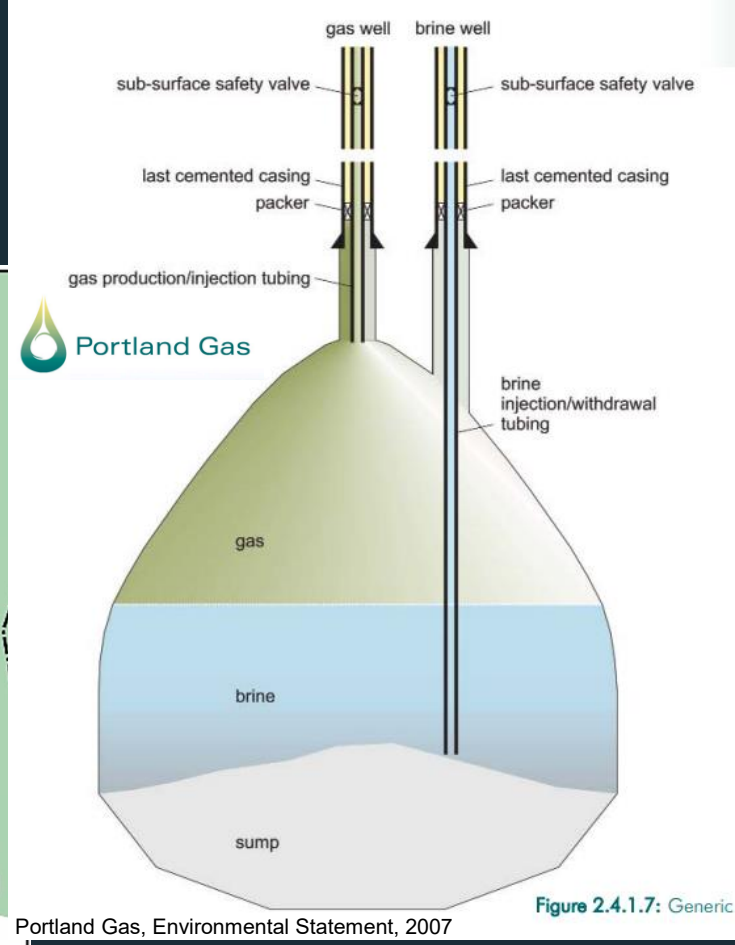
Portland Gas, Environmental Statement, 2007



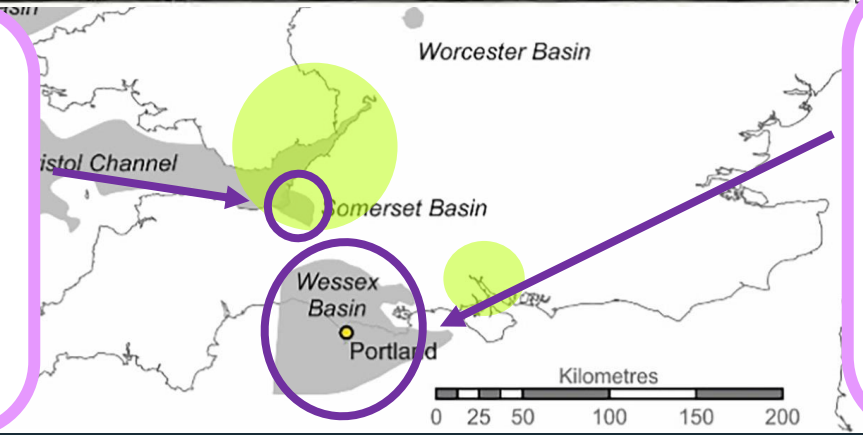
Dorset

- Triassic Dorset Halite Member
- Salt depth ~400 – 2,400 m bgl
- Salt thickness ~130 – 200 m
- Isle of Portland project – brine compensation due to depth
- UKEn – further North, ~1,330 m bgl





Portland Gas, Environmental Statement, 2007



Somerset

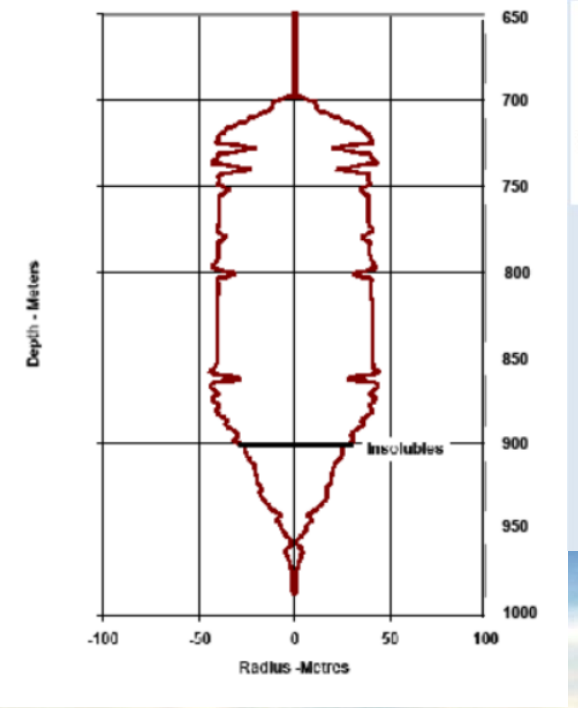
- Triassic Somerset Halite Member
- Salt bands / intervals (gross ~ 40 m thick, ~180 and 690 m bgl deep)
- Data very sparse (two wells)
- Legacy salt works at Puriton, 1911 – 1922

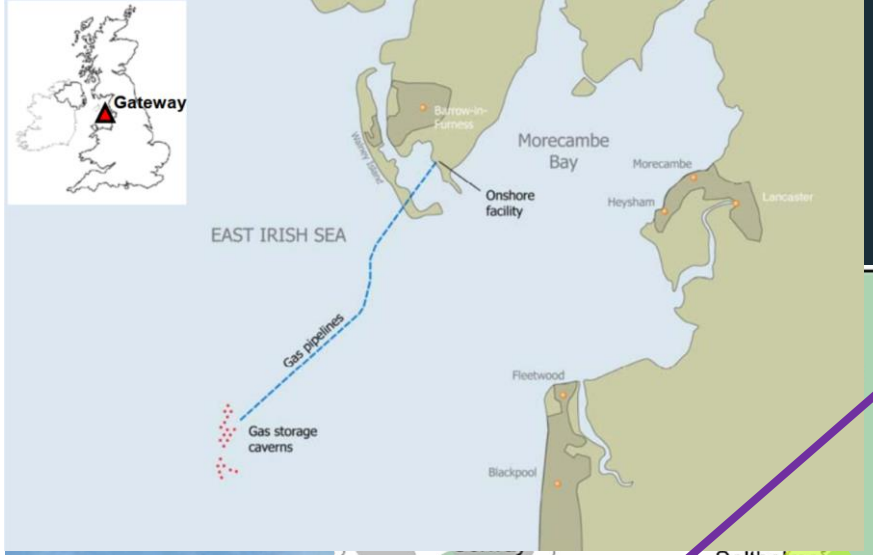
Dorset

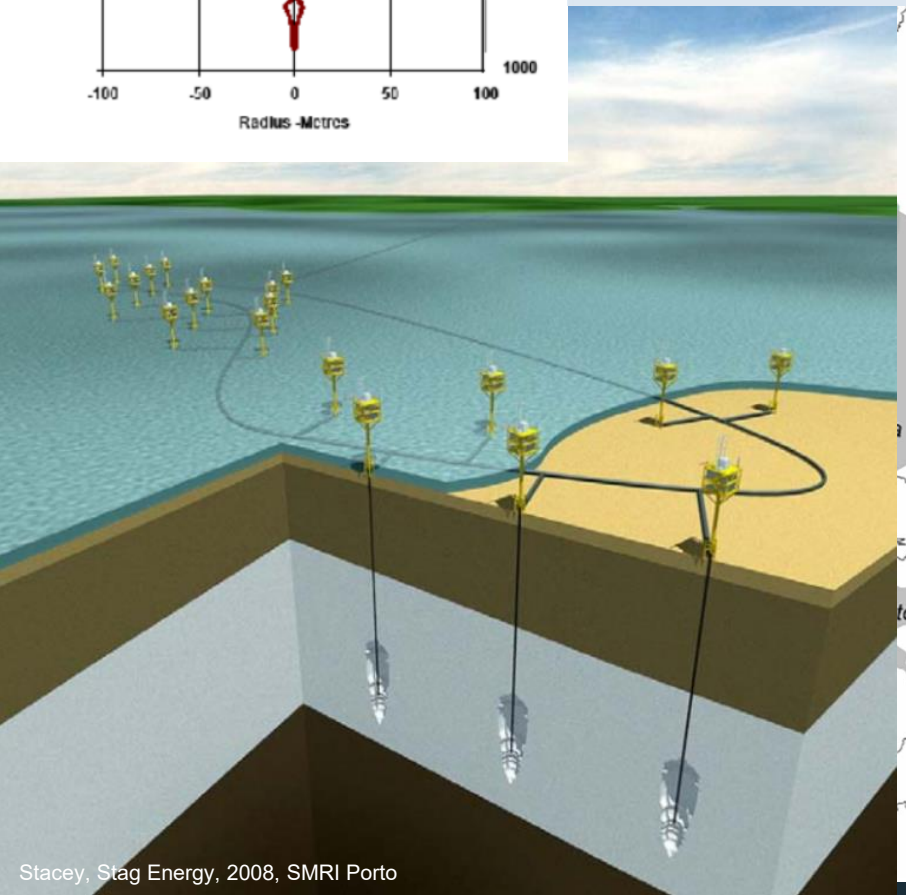
- Triassic Dorset Halite Member
- Salt depth ~400 – 2,400 m bgl
- Salt thickness ~130 – 200 m
- Isle of Portland project – brine compensation due to depth
- UKEn – further North, ~1,330 m bgl

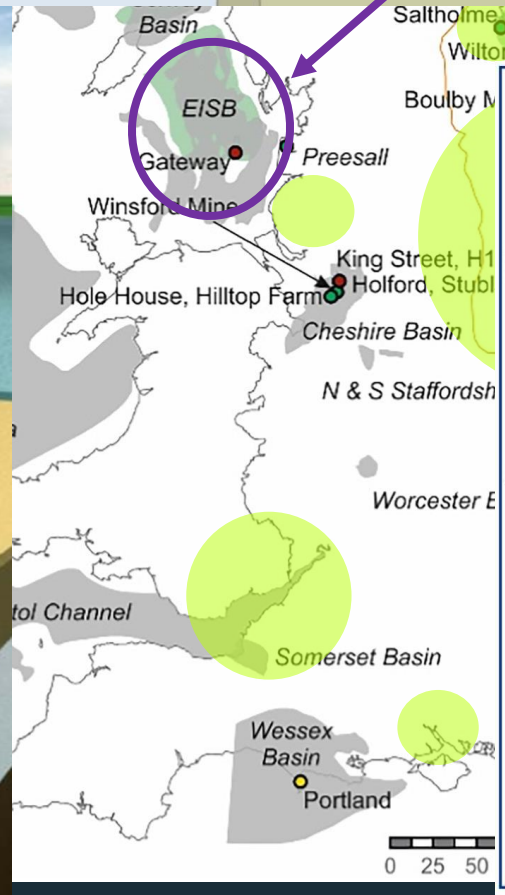
East Irish Sea Basin

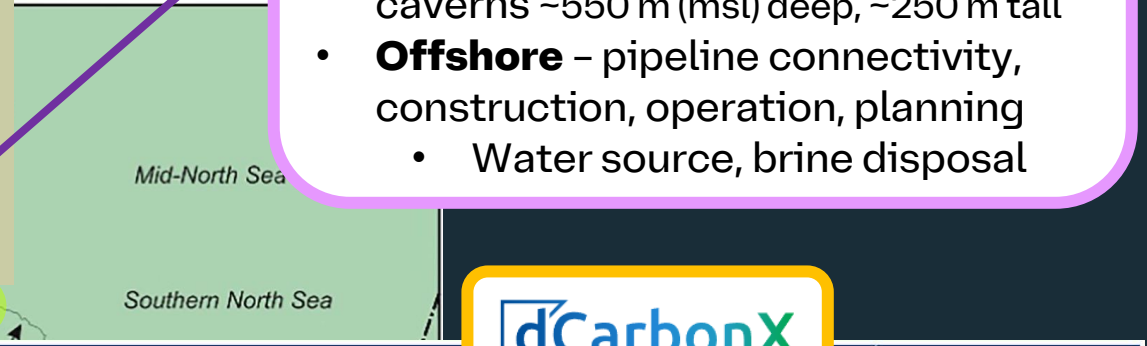
- Triassic Preesall Halite Fm. – most favourable on UKCS (Smith et al., 2005)
- Gateway Gas Storage project – caverns ~550 m (msl) deep, ~250 m tall
- **Offshore** – pipeline connectivity, construction, operation, planning
  - Water source, brine disposal



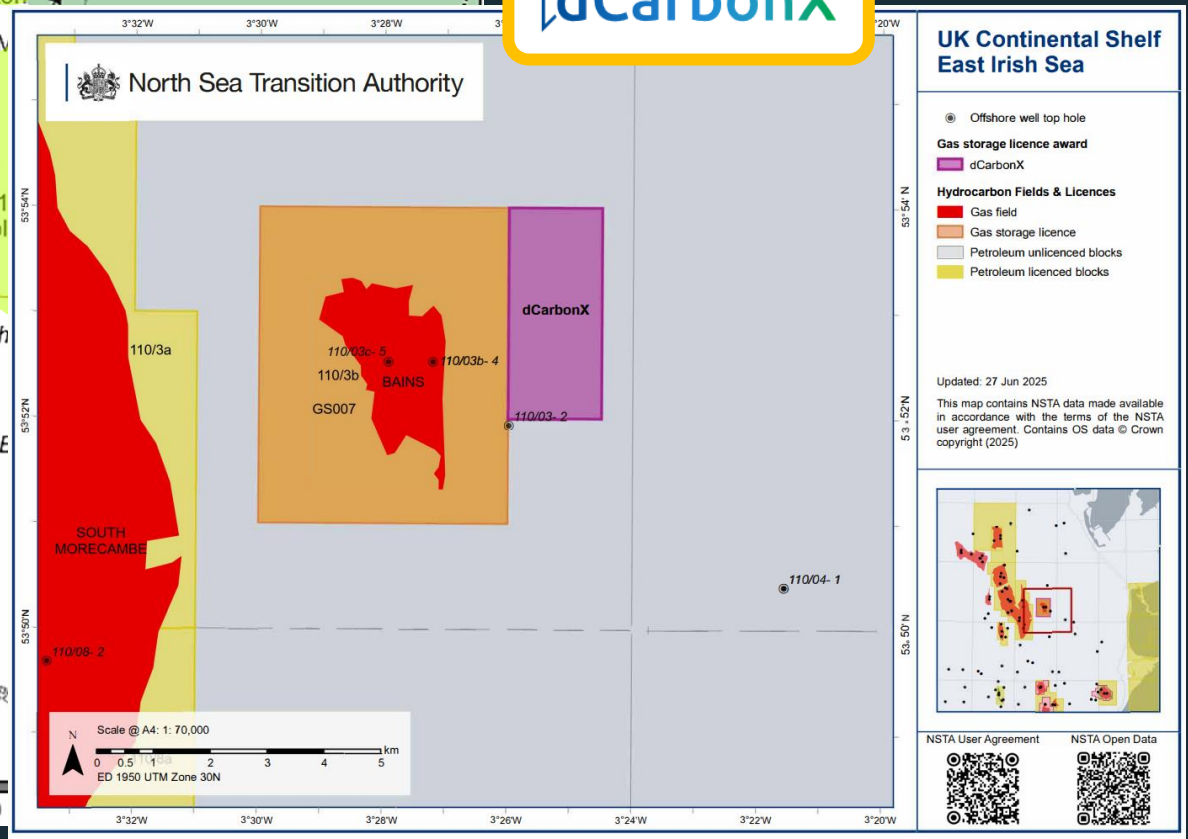






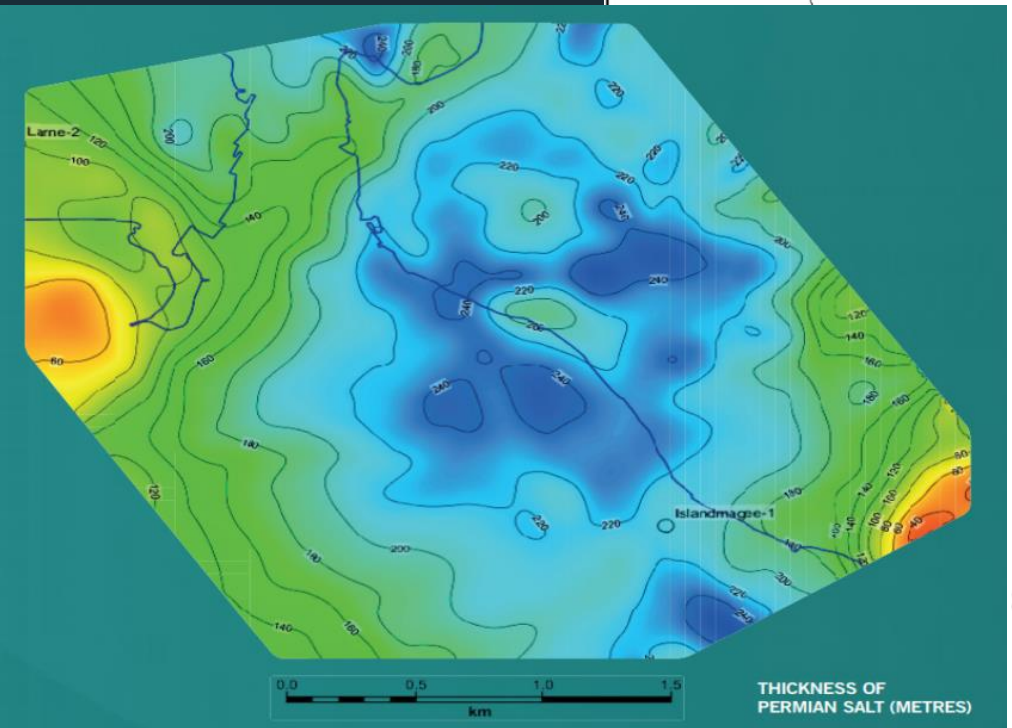


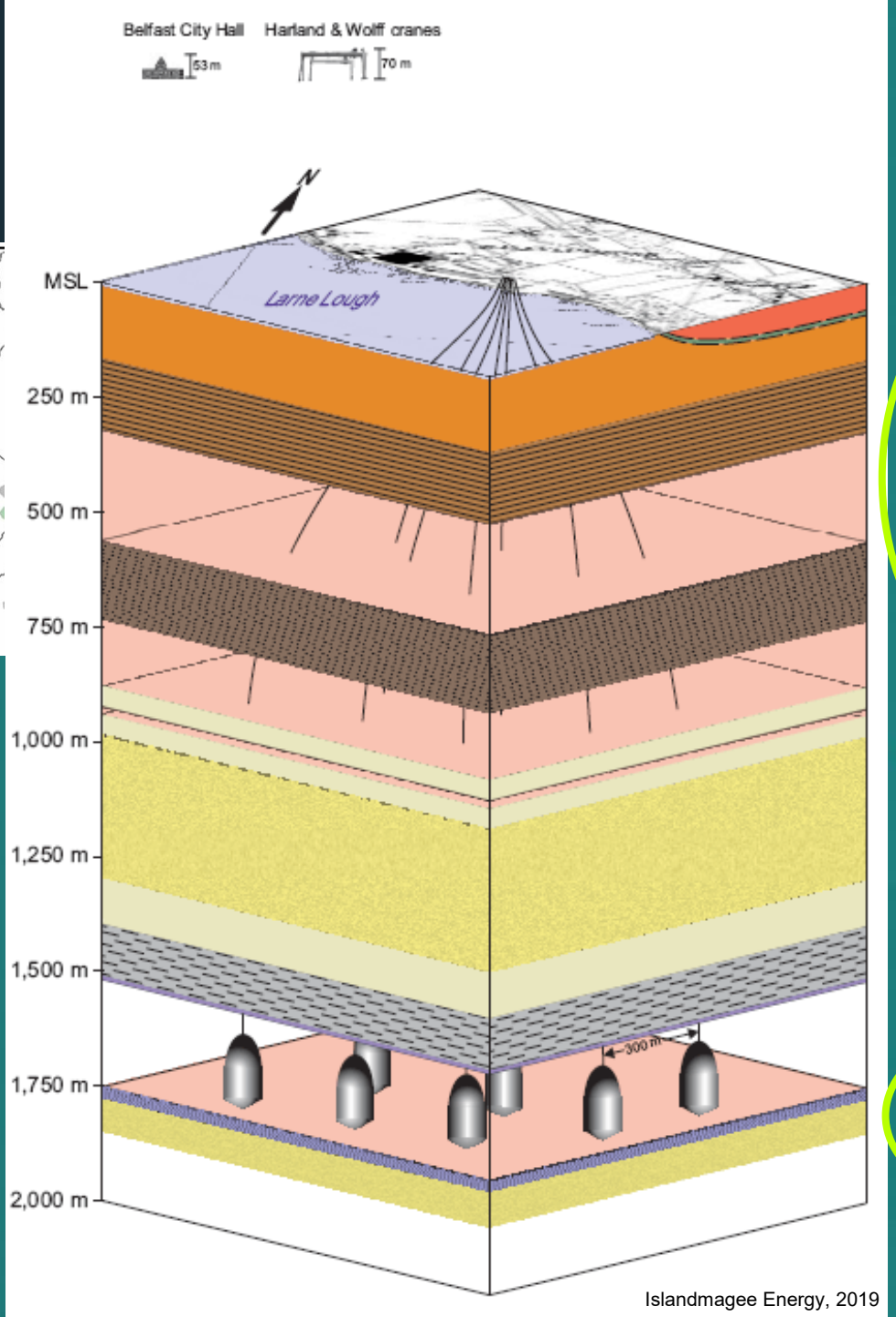
dCarbonX



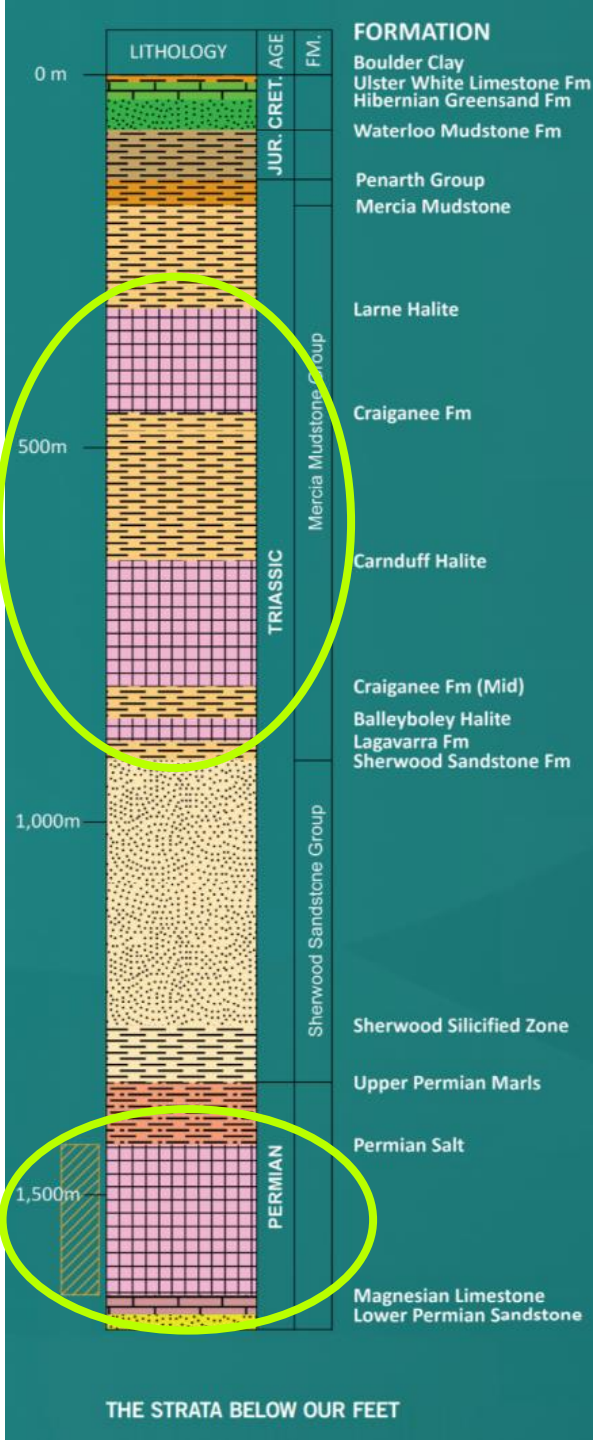
Northern Ireland

- Triassic Halite on top of Permian
- Larne Lough – Islandmagee
- Directional drilling – onshore
- Marine license and permitting





Islandmagee Energy, 2019



THE STRATA BELOW OUR FEET

Further Considerations

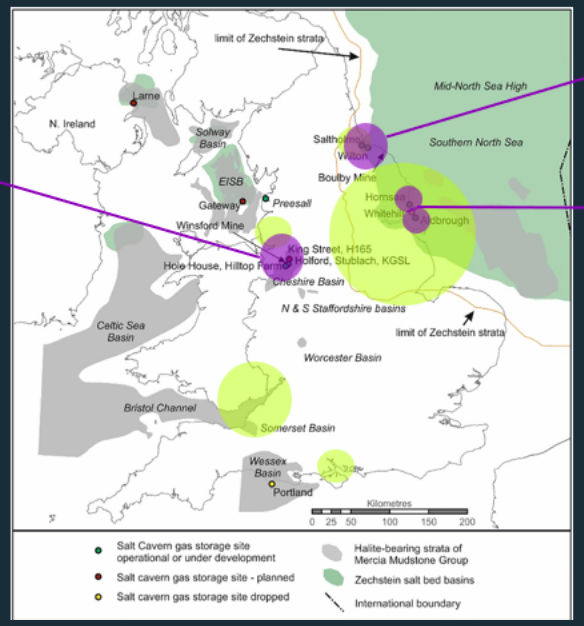
- New vs Existing Caverns
  - Developing a salt cavern → 10–12 years.
  - **Why not convert existing caverns?**
    - Asset already in place – quicker deployment
    - Lower water and brine disposal requirements
    - Existing surface infrastructure
    - Public acceptance?

Cheshire

Stublach (storengy)
20 caverns
Working gas: 400 MSm³
Salt thickness: 220-230 m

Hill Top (KISTOS)
5 Caverns
Working gas: 63 MSm³
Salt thickness: 220-230 m

Holford (uniper)
8 Caverns
Working gas: 237 MSm³
Salt thickness: 220-230 m



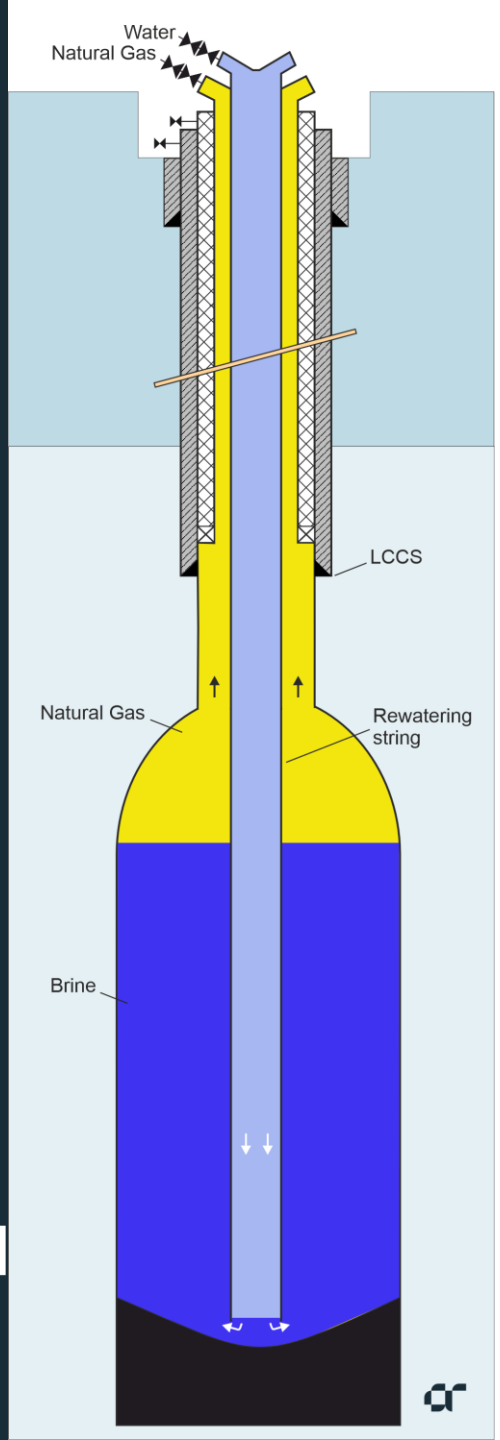
Teesside (STORELECTRIC)
Wet caverns – brine compensation
Salt thickness: 30 - 45 m

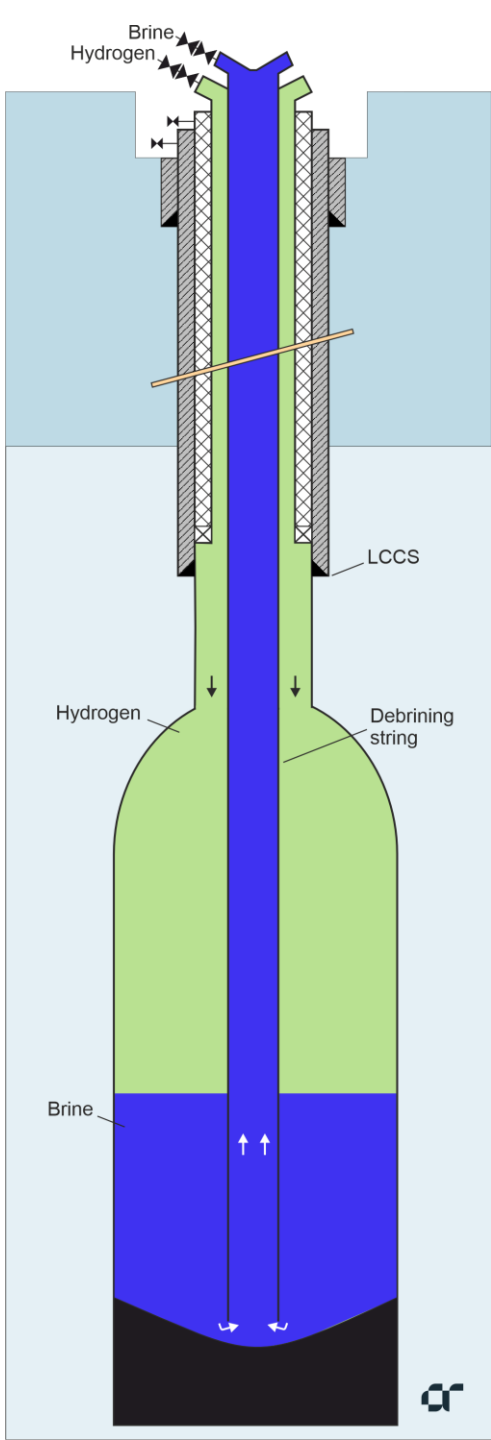
East Yorkshire Coast

Atwick Gas Storage (sse Thermal)
9 caverns
Working gas: 309 MSm³
Salt thickness: 170 m

Aldbrough Gas Storage (sse Thermal, equinor)
9 Caverns
Working gas: ~330 MSm³
Salt thickness: 170 m

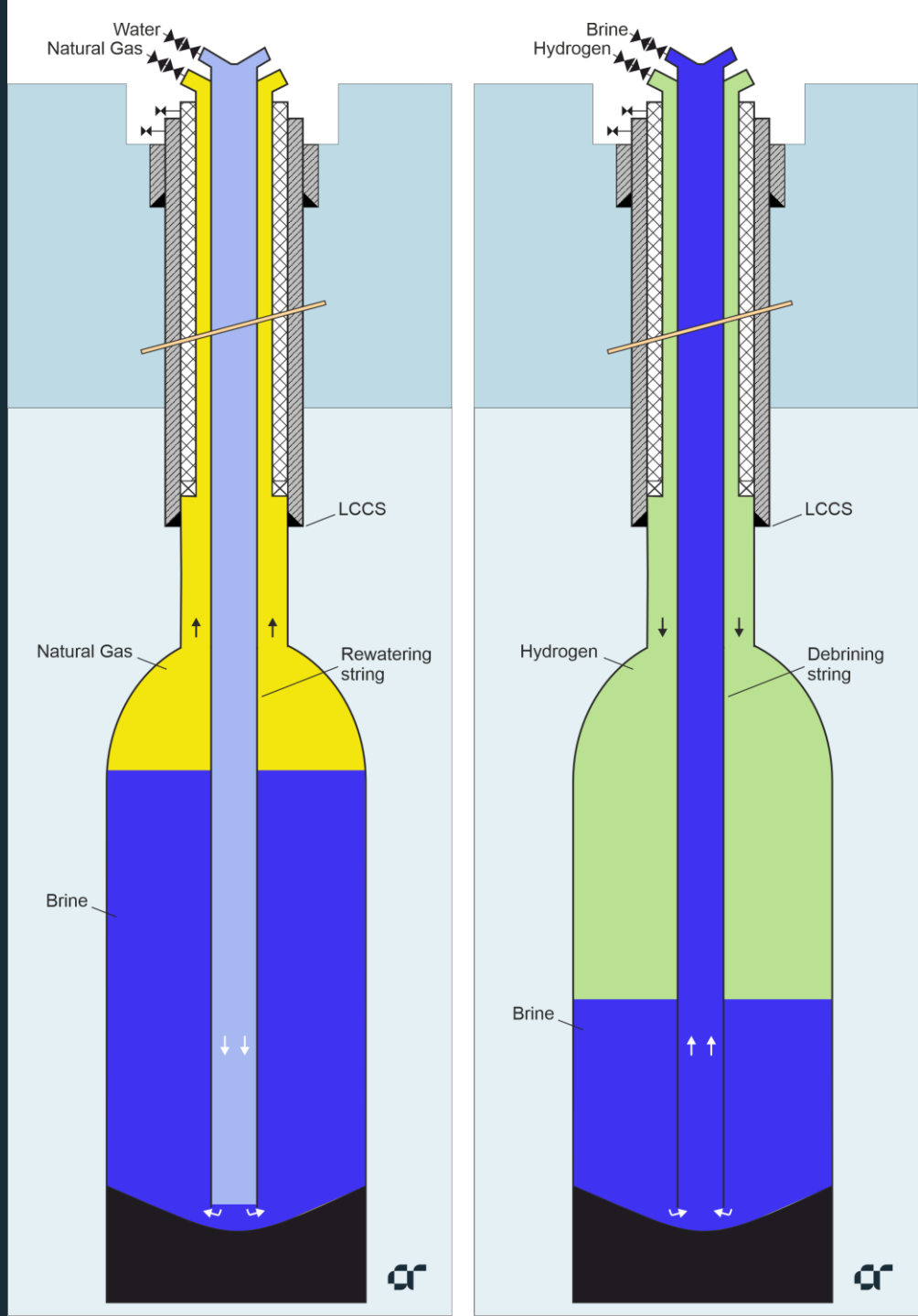
Industrial Clusters





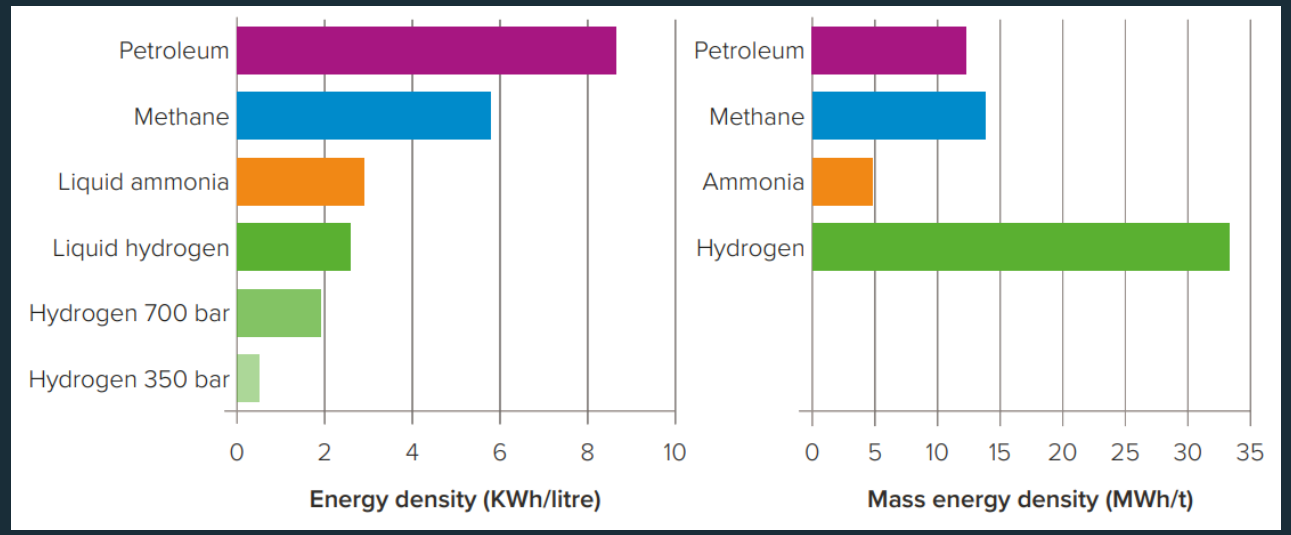
Further Considerations

- New vs Existing Caverns
  - Developing a salt cavern → 10–12 years.
  - **<u>Why not convert existing caverns?</u>**
    - Asset already in place – quicker deployment
    - Lower water and brine disposal requirements
    - Existing surface infrastructure
    - Public acceptance?
  - **But:**
    - Asset records may be incomplete
    - Geometry (e.g. neck length), asset life cycle
    - Integrity of the steel and cement
    - Equipment H_2 compatibility
    - Contamination
    - Loss of existing assets / capacity

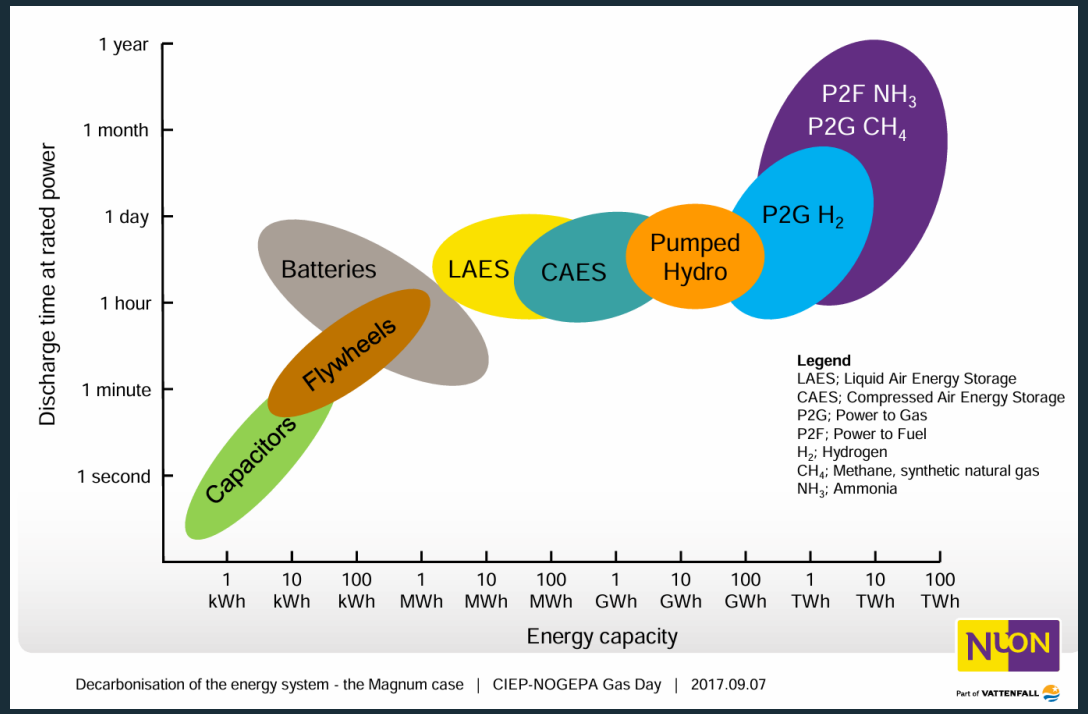


Further Considerations

- New vs Existing Caverns
- Different Storage Media
  - **H_2**
    - Cyclicity (vs Natural Gas)
    - Potential purity requirements
    - Material selection
    - Microbial & geochemical reactions
  - **CAES** (Compressed Air Energy Storage)
    - Depth limitations – pressure, well dimensions
    - Thermal cycling, high-frequency (+ flowrates)
    - Corrosion
  - **NH_3** (Ammonia)
    - Toxicity
    - Material selection
  - **NH_3** and **CO_2** – phase management (e.g. liquid / vapour / supercritical)

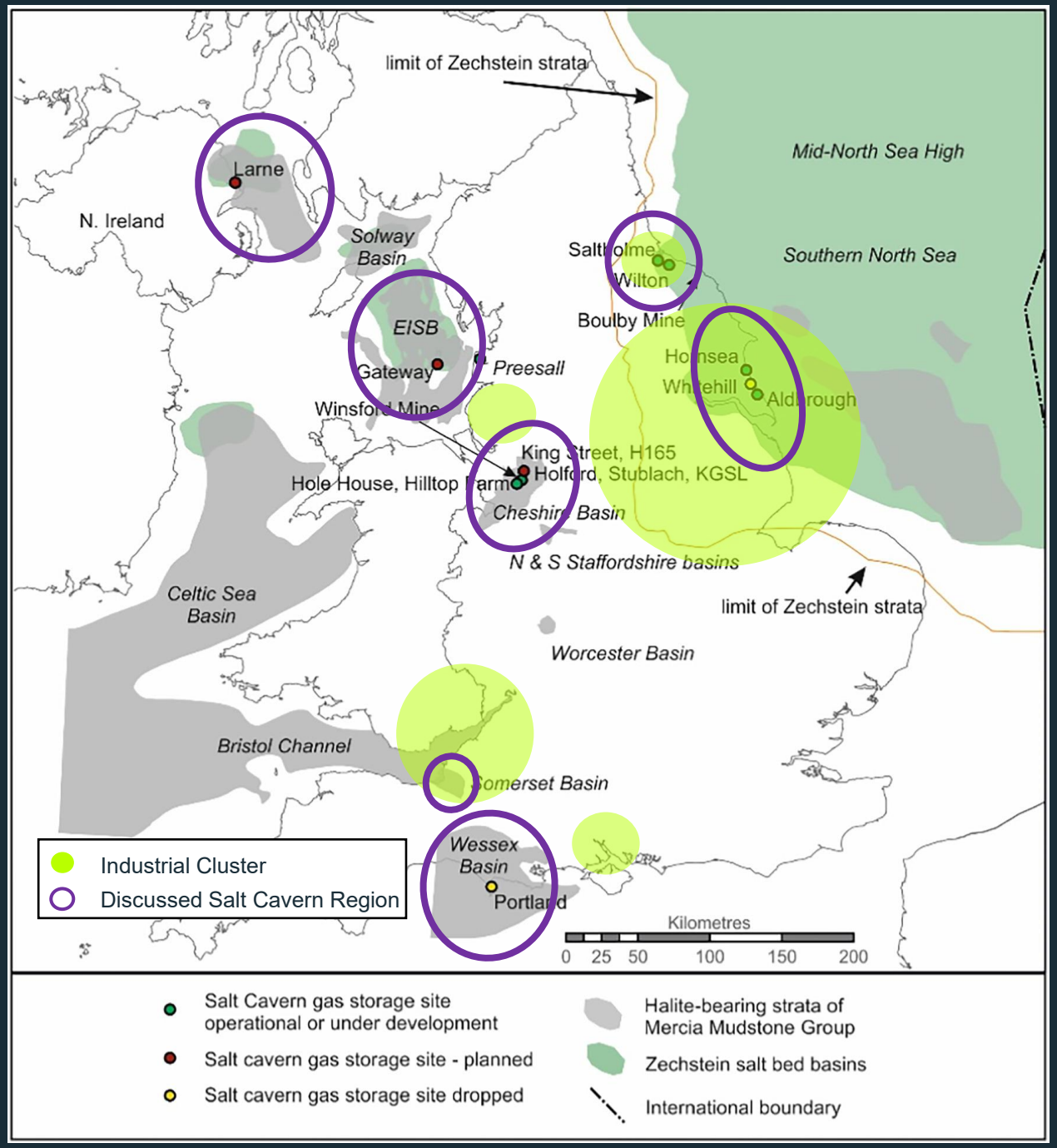


The Royal Society, 2023



Summary

- **Considerations for Salt Caverns**
  - Geology, Water Source, Brine Disposal, Surface Constraints, Connectivity
- **UK Salt Caverns – 7 Regions**
  - East Yorkshire Coast
  - Teesside
  - Cheshire
  - Dorset
  - Somerset
  - East Irish Sea
  - Northern Ireland
- **Further Considerations**
  - New vs Existing Caverns
  - Storage Types



thank you

Patryk Tomaszewski
Senior Geologist & Cavern Engineer
Patryk.Tomaszewski@atkinsrealis.com

AtkinsRéalis