East Midlands Storage (EMStor): Hydrogen storage solutions for the region

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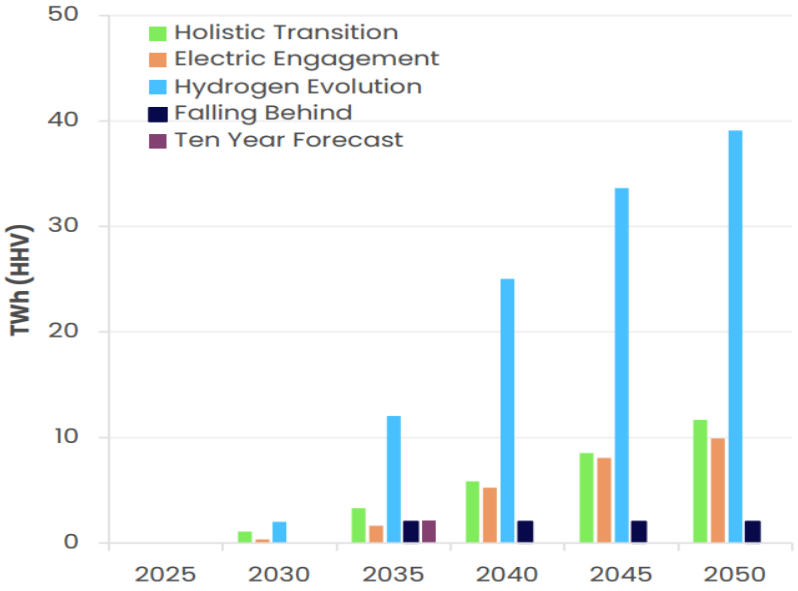
Hydrogen Energy Storage

NESO FES 2025
Hydrogen Storage Capacity Estimates



https://www.neso.energy/document/321041/download

The Government intends for the National Energy System Operator to consider hydrogen from the outset in its strategic planning, including hydrogen production and storage, and this is why we included it in our commission to the National Energy System Operator to develop the Strategic Spatial Energy Plan - due to be published by late 2026.

Hydrogen Update to the market (pp21, published July 2025)

Benefits of localised hydrogen storage in the East Midlands are significant

Benefit 1: Provide pipeline system resilience and:

- decarbonise local industry
- decarbonise flexible power generators

→ East Midlands Hydrogen saves 1.9Mt of CO_2 pa

→ Net Zero Power system by 2035

Benefit 2: Reducing overall system CAPEX costs → Integrated hydrogen and electricity system: 10% cheaper compared to all-electric scenario (Guidehouse, Mar '23)

Benefit 3: Make use of curtailed windpower → Remove curtailment charges: £3.5bn a year by 2030 =£200/yr household bills. Reduce customer costs

Benefit 4: New revenue streams, 'just transition' → Creates/protect 110k jobs; GVA £10Bn by 2050

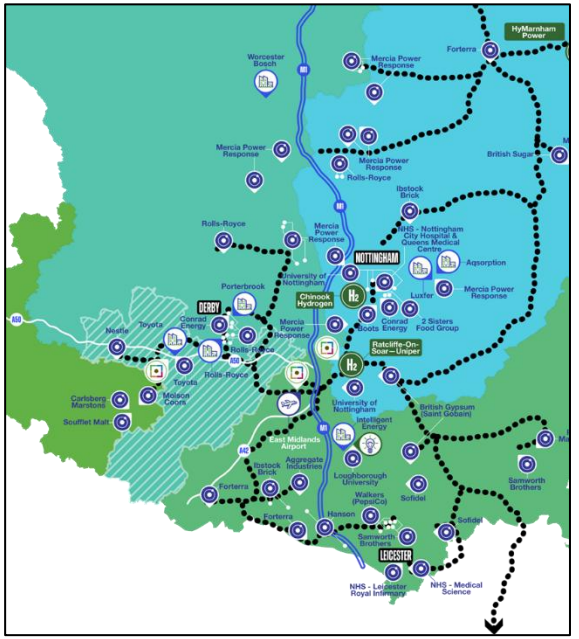
The EMStor project delivers deployment of hydrogen energy storage for industrial decarbonisation in the East Midlands….

Demand

Over 60 TWh
identified industrial, commercial, power and aviation hydrogen demand by 2037

Production

Over 80 TWh
current planned hydrogen production by 2037 in the East Coast region



- Awarded Strategic Innovation Fund (SIF) an Ofgem fund, managed by Innovate UK.
- Discovery and Alpha phases complete

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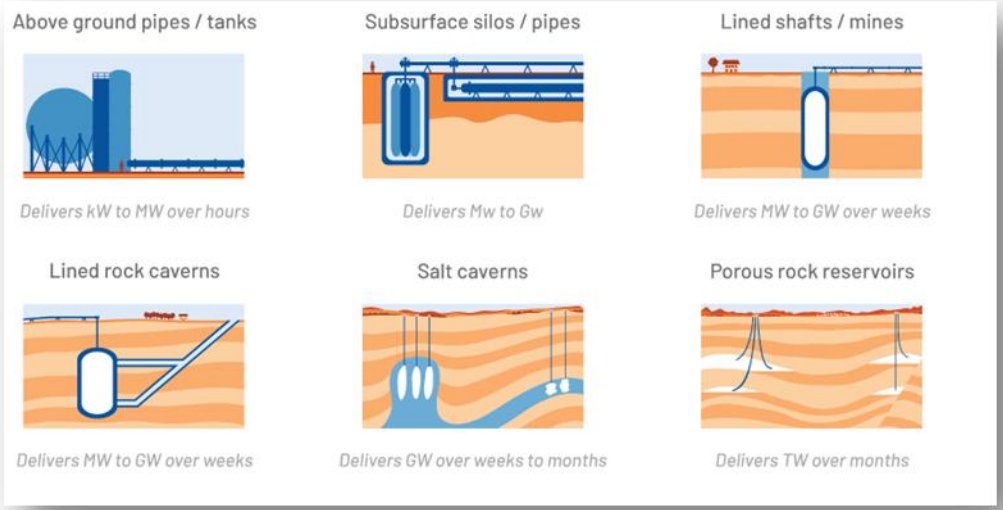
EMStor SIF Discovery phase: Evaluated hydrogen storage opportunities, mapped to hydrogen infrastructure production and demand.

Parameters assessed

- Storage capacity
- Injection and withdrawal rate
- Cost per GWh stored
- Potential for upscaling
- Implementation time
- Geological suitability
- Technology readiness level
- Proximity to production centers
- Proximity to end users
- Proximity to future H_2 pipelines

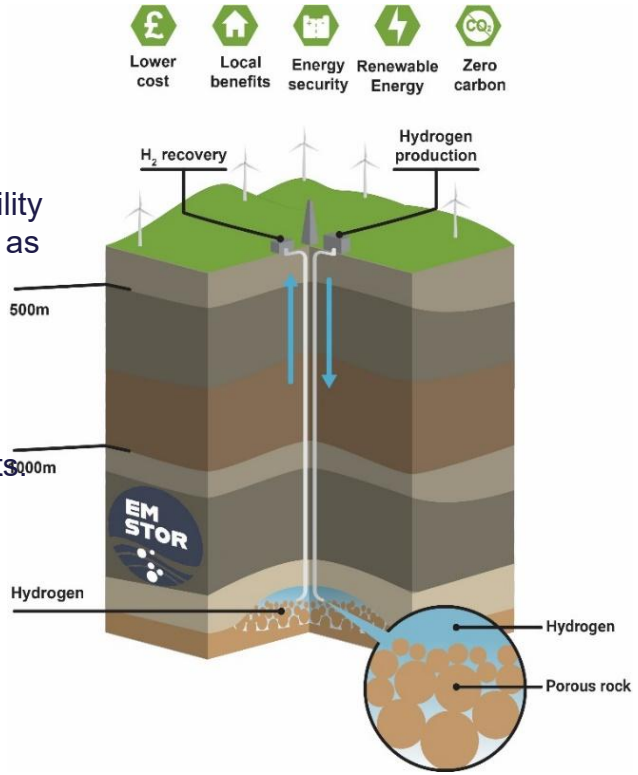


Storage in depleted hydrocarbon fields was identified as most suitable option and taken forward into the SIF Alpha phase work program.

EMStor Alpha Phase Work Packages

The EMStor Alpha Phase had the following aims and objectives;

- WP 1: Understand public perception towards hydrogen.
- WP 2: Undertake a series of technical investigations (including geochemical, microbial and modelling assessments) to look at applicability of hydrocarbon fields to store hydrogen and appraisal of saline aquifers as a secondary technology.
- WP 3: Understand the ‘hydrogen readiness’ of a hydrocarbon field.
- WP 4&5: Understand regulatory permitting and compliance requirements.
- WP 6: Identify risks and then attribute risks for management.
- WP 7: Development of an initial business case.
- WP 8: Decisions on next steps for the project, based on Alpha Phase outcomes.



WP1 – Stakeholder Consultation

- Knowledge of Geological H2 storage is very low → a little information has a big impact!
- Video created was positively evaluated → could be a good educational/outreach resource
- There is a **sense** that local development would be positively received by communities
- People see there are **climate** and economic benefits, but have some local safety concerns
- Trust in developers is fairly high and industry representatives are fairly trusted as a source of information **BUT** academics are most trusted.
- **A (tentative) GOOD NEWS story**
- **Findings are PROVISIONAL and must be treated with caution at this stage.**

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WP2 – Technical Investigations

2.1 And 3.1

Identify if any **geochemical reactions** between the rock, *well cements*, fluids, cushion gas and hydrogen could compromise storage integrity and efficiency.

Negligible geochemical reactivity (rock samples) & no H_2S generation.
Limited evidence of redox reactions (rocks/well cement)

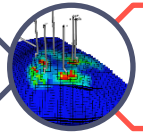
2.2

Identify if any **microbial reactions** between the rock, fluids, cushion gas and hydrogen could compromise storage integrity and efficiency.

Likely presence of sulphur reducer and methanogens

2.3

Reservoir simulations to evaluate **the cushion gas requirements and production profiles** to ensure the required hydrogen demand can be supplied.



Connectivity across layers in the reservoir, meaning more cushion gas (4:1 ratio)
Maximum working capacity (in Chatworth B) of 10GWh over 20 years of simulation

2.4

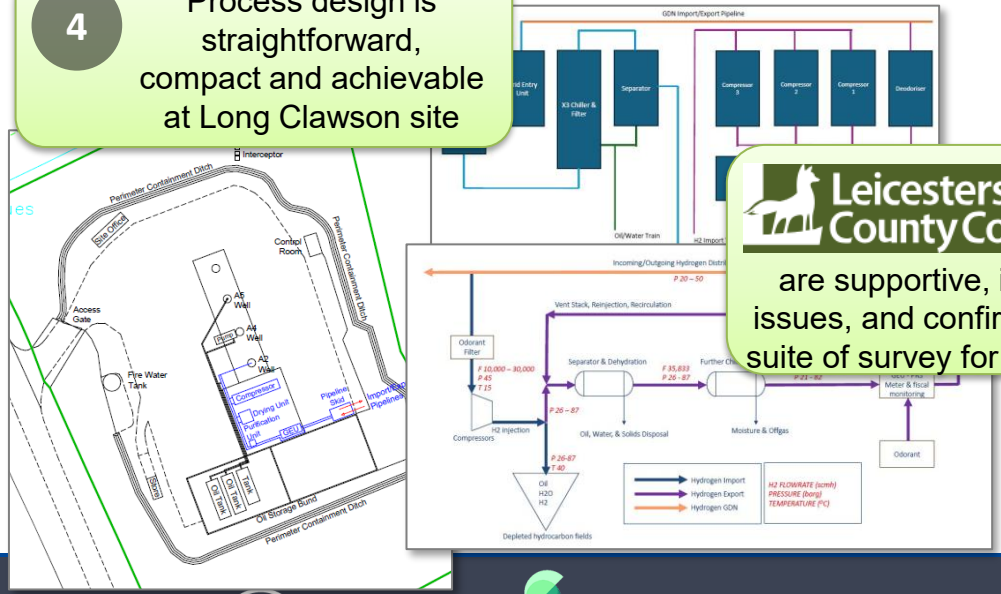
Identify and categorise **saline aquifers** in the area that may provide an alternative option for underground hydrogen storage.

Multiple potential saline aquifers identified in the region.

WP3, 4 & 5 – Hydrogen Readiness and Regulatory Findings

3 It is highly likely that well heads are not suitable for hydrogen injection/production
Casing connections are not H2-tight
It is difficult to confirm in some instances the reservoir intervals that the wells connect to

4 Process design is straightforward, compact and achievable at Long Clawson site



Leicestershire County Council are supportive, identified no issues, and confirmed standard suite of survey for an application

5 There is no legislative route to regulate and permit the storage (in groundwater reservoirs)

Environment Agency

A commercial store could not operated

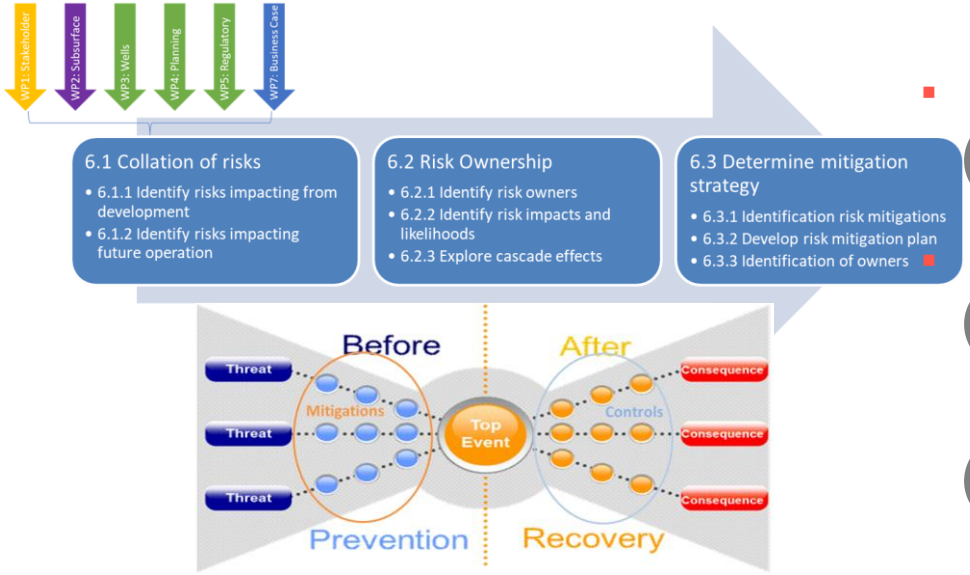
Scientific purpose exemption clause does not apply

Environment Agency

A Beta pilot could not be trialled

A change of law is needed
…but the EA are willing to engage

WP6 – Risk Assessment



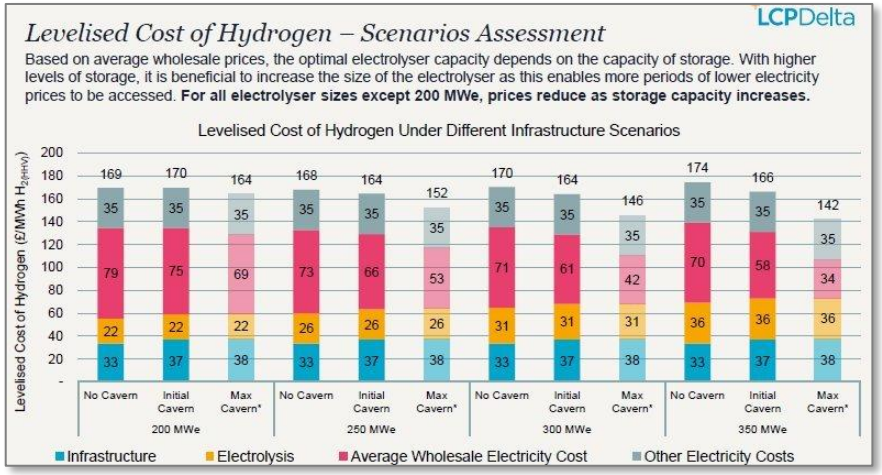
- Clearly the main area of concern;
  - **WP5** Regulatory risk is a show-stopper until a legislative framework and permitting authority is established
    - → Engage with EA, politicians and stakeholders

Other risks and mitigants/controls

- **WP7** Commercial/Business case: Assumption sets evolved in a different direction to the geological base
  - → End-to-end modelling to link assumptions
- **WP3** Well integrity and Hydrogen Readiness: could not be assured in the event of repurposing existing well stock
  - → Plug and abandon or wells on field and drill from new
  - But; Plug and Abandonment of wells generates potential leak path to surface
    - → Abandonment design will have to be done to ensure integrity across barriers so no hydrogen path

WP7 Business Case

In most cases, having storage sat between production and demand reduces the Levelised Cost of Hydrogen, but real benefit only comes with Max Cavern and largest H2 production.



- There is a relative benefit in having storage sat alongside production (up to 18% potential discount for Max Cavern with 350MWe electrolyser).
- Limitations to our confidence of geology (focus on single layer) severely limits the size of the initial facility. This reduces the value of having storage.
- Ignoring the Hydrogen to Power demand (a demand that needs storage to make economic sense) is a weakness. Hydrogen to Power is currently being reviewed by government and is seen as being overall beneficial to the UK's power system operation.
- The lower levelised costs of hydrogen which are shown can only be realised following a fundamental change to the pass-through indexation under the Hydrogen Production Business Model (currently CPI, need UK power price).

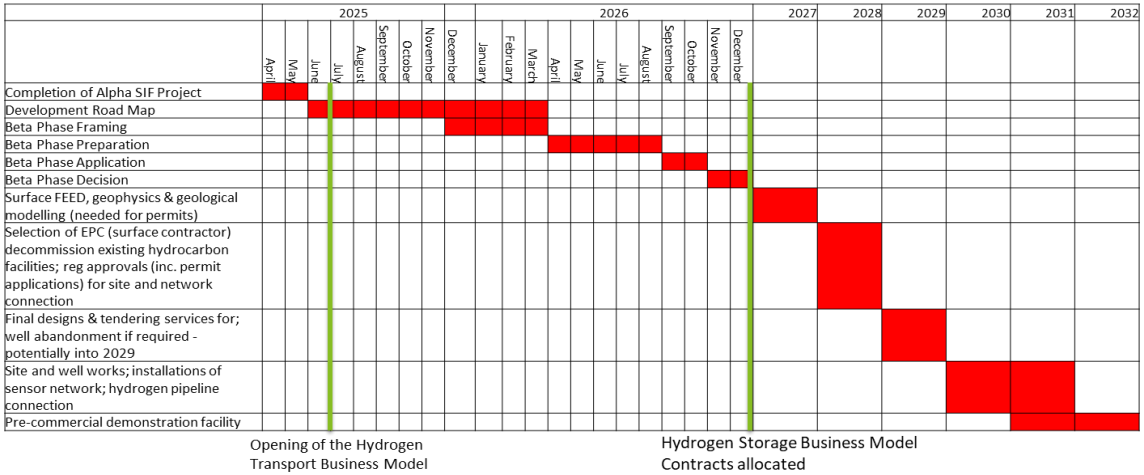
WP8 - EMStor In-person dissemination event

28th March, BGS, Keyworth

- BGS hosted the dissemination event at their site in Keyworth, Nottinghamshire
- c.85 attendees in total from across industry
- Presentations on technical, social, regulatory and business case aspects
- A panel session chaired by Cadent and included representation from Heidelberg Materials, RWE, UoE, Star Energy and Centrica Energy Storage
- Event was well received by those that attended

We will continue the journey…

- Look to create a full Development Roadmap for hydrogen storage in the disused hydrocarbon fields in advance of a future Beta application
- The Development Roadmap will look to assess the pathway from where we are today to commercial deployment of a hydrocarbon field to store hydrogen, with a focus on the East Midlands and to clarify the legislative pathway to permitting an onshore hydrogen storage facility in depleted oil-fields
- The mid-term ambition remains a demonstrator facility that sets the pre-cursor for a field to be operated commercially
- Work with UK Government to demonstrate progress, align with future policy and create investor confidence



Thank you

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