November 21st, 2024

9th Dutch Exploration Day

The role of offshore electrolysis pilots & Underground Hydrogen Storage projects in upscaling the offshore hydrogen system

Annemiek Asschert, Manager New Energies & Innovation

Painting the picture

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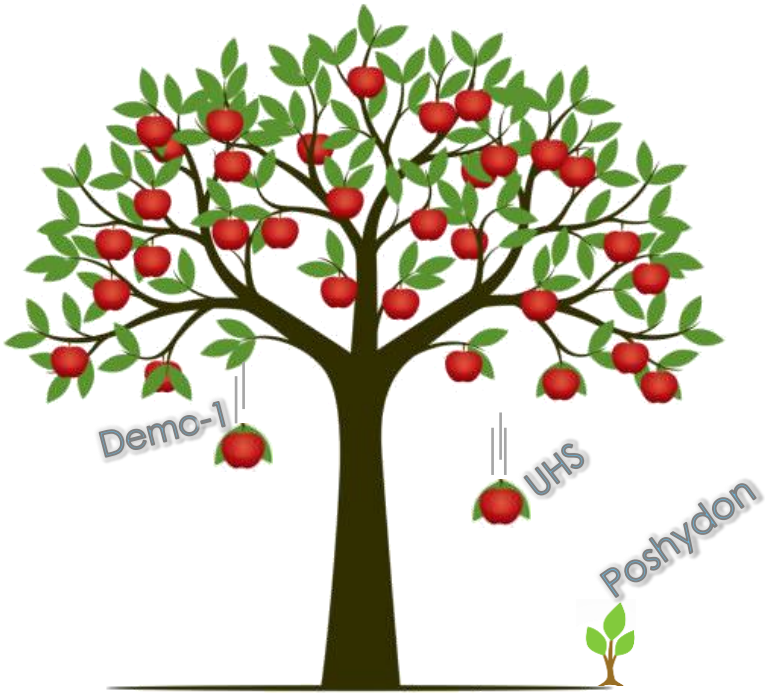
"A New Era of Energy in the North Sea"

Building blocks towards this new Era of Energy

- **Pilot projects for offshore hydrogen production**
  - **Poshydon**

- Underground Hydrogen Storage
  - Geode



Poshydon: From Onshore to Offshore

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Why hydrogen production at sea?

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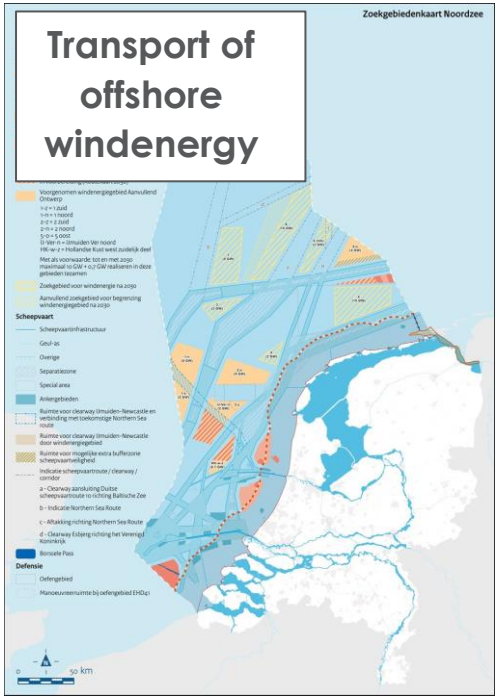
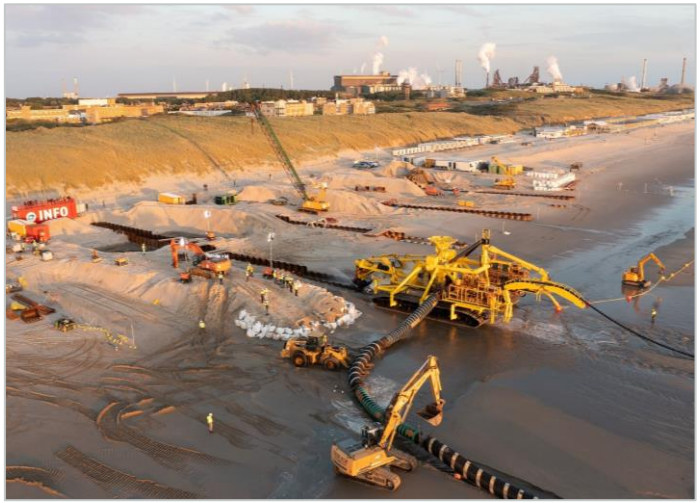
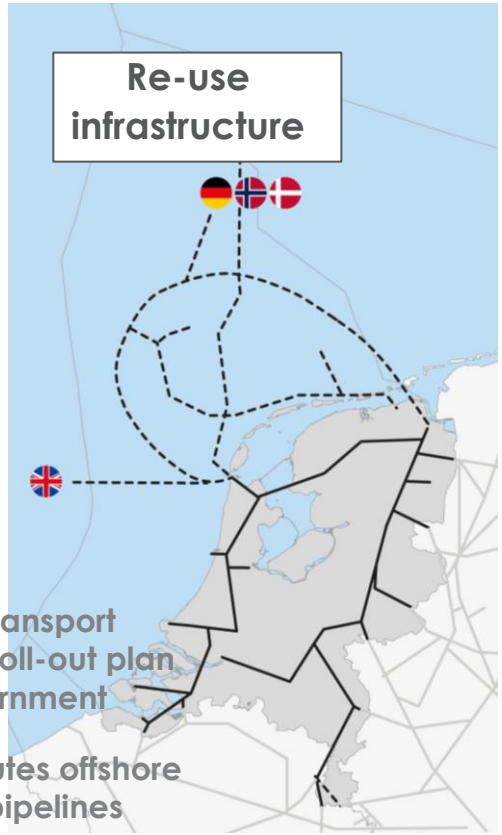
Transport of offshore windenergy





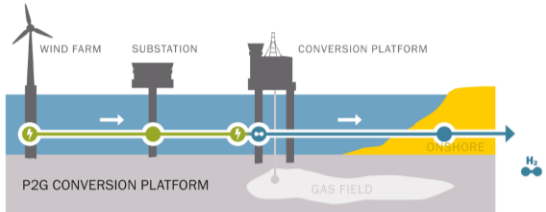
Landingpoints sea cables

Re-use infrastructure



Hydrogen transport network in roll-out plan Dutch government

Possible routes offshore hydrogen pipelines



Poshydon

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We had a dream, that one day…we could produce hydrogen offshore from wind power and seawater…

Nexstep Re-use Workgroup
Concept development

22 July 2021
DEI+ subsidy was granted

22 July 2021
The consortium of 14 parties kicked-off

18 December 2023
Dutch State joined the consortium via EBN

2024
Part of pilot HyXchange / Green Hydrogen Guarantees of Origin

2019 2020 2021 2022 2023 2024 2025

04 July 2019
Q13a-A was selected as host platform

25 Augustus 2022
His Majesty the King Willem-Alexander visited PosHYdon

11 April 2023
Visit Prime Minister Mark Rutte

End of 2024
Offshore installation and start of PosHYdon

May 2024
Today
Onshore test of complete system kicks off

Poshydon

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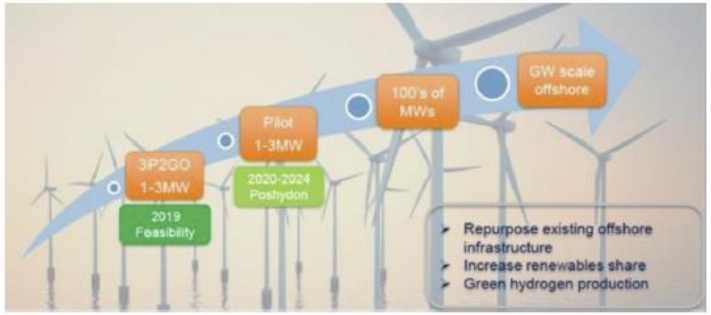
Why & What

- 1 year **Offshore pilot** project
- **1MW electrolyzer** on Q13a platform
- **Project goals**:
  - Feasibility **offshore hydrogen production**
  - **Combination** of E&P activities and hydrogen production
  - Demonstrate re-use of infrastructure
  - Testing of **impact offshore conditions** (windprofiles)
  - Research & system performance outputs
    Support economic assessment of large-scale offshore H2 production
- Consortium with **15 partners**



This project is supported by the Decarbonisation Energy and Climate Innovation (DEI+) scheme that the Netherlands Enterprise Agency (RVO) carries out on behalf of the Ministry of Economic Affairs & Climate Policy.

Towards large scale offshore electrolysis

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- Accelerate far offshore wind deployment
- Produce green hydrogen at scale
- Integrate offshore wind & hydrogen
- Transport hydrogen via existing & new pipelines
- Store intermittent wind energy in hydrogen

3P2GO
1 MW
2019
Feasibility

PosHYdon
1 MW
2020-2025
Demonstration

BLPH / N-05
2,5 – 5 MW
2025-2027
Upscaling

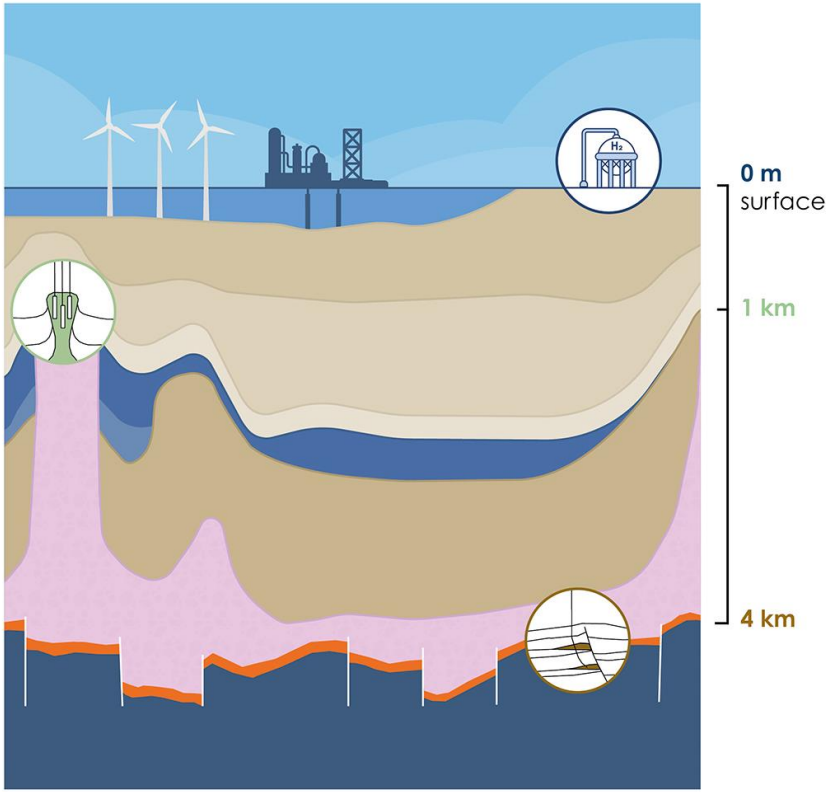
DEMO-1
50-100 MW
2027-2030
Demonstration

DEMO-2
500 MW
2030-2035
Commercialisation

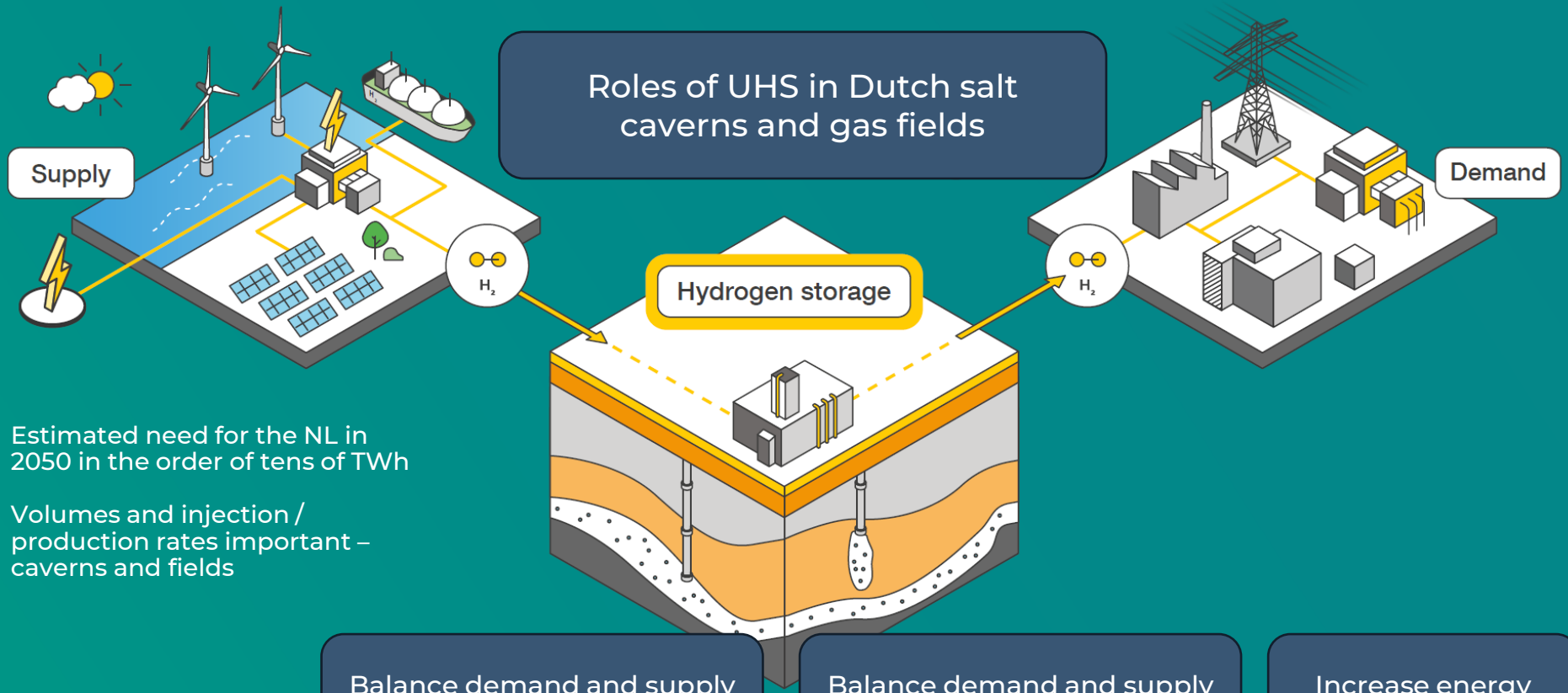
Building blocks towards this new Era of Energy

- Pilot projects for offshore hydrogen production
  - Poshydon
- **Underground Hydrogen Storage**
  - **Geode Atlas**

GEODE



Roles of UHS in Dutch salt caverns and gas fields



Estimated need for the NL in 2050 in the order of tens of TWh

Volumes and injection / production rates important – caverns and fields

Balance demand and supply of hydrogen

Balance demand and supply of sustainable energy

Increase energy independence

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Underground Hydrogen Storage

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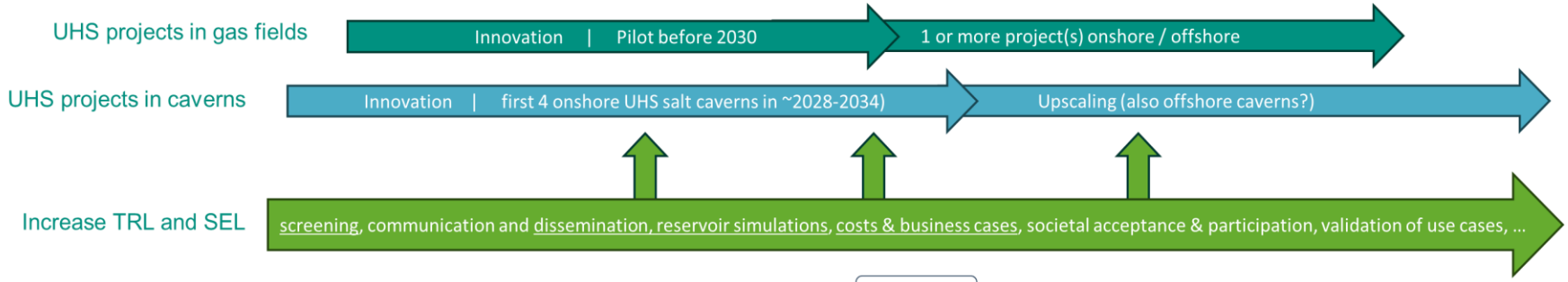
Challenge and opportunities Salt caverns and gasfields

- Immature H2 market, high costs and long lead times - insufficient incentives to invest
- Uncertainties in UHS needs – volumes and capacities (through time)
- Low to medium TRL and SEL (pilot needed)
- Planning in space and time challenging
- Public acceptance not a given

- Dutch subsurface, infrastructure and seaports offer potential for national and international storage of H2
- Governmental support (NL, EU)
- Strong R&D, workforce and international network
- Tradition of corporation between public and private companies

Pros and Cons of the UHS options must be clear for timely development of (pilot) projects



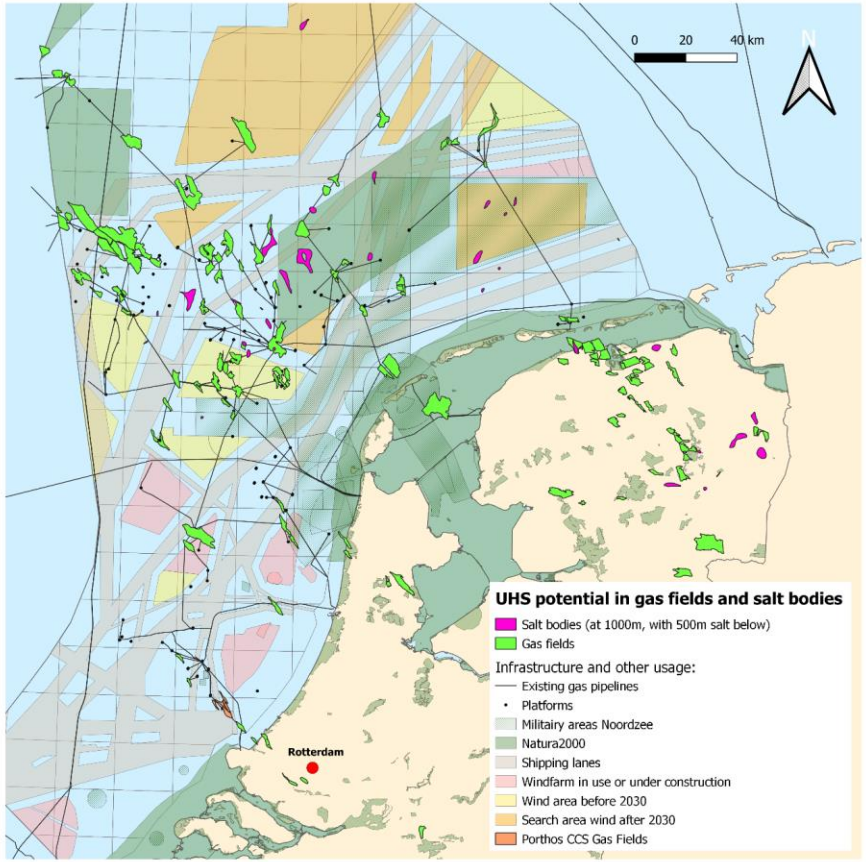
groen vermogen nl | Innovation engine for the green hydrogen economy

EU STARS H2

Screening the Dutch subsurface for UHS potential

- **Dutch subsurface offers large potential for storing energy in new salt caverns and in existing gas fields**
- **Two-phase screening approach on multiple criteria:**
  - High-level screening portfolio
  - Case-by-case analysis linked to future hydrogen valleys / use cases onshore and offshore and linked with advising of government

* TNO/EBN (2019, 2021,2022)

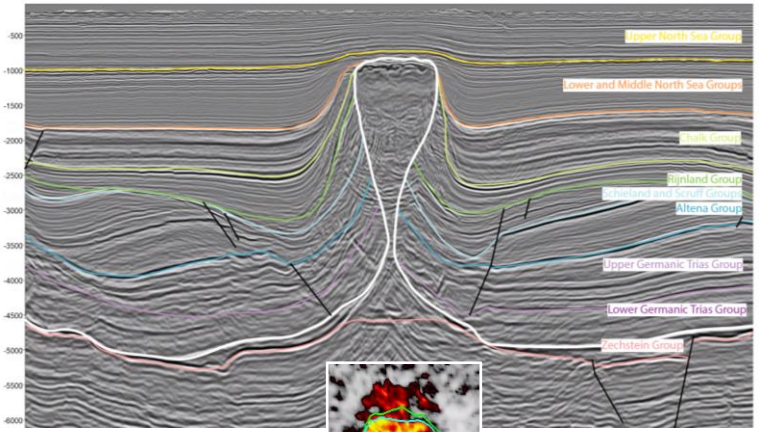


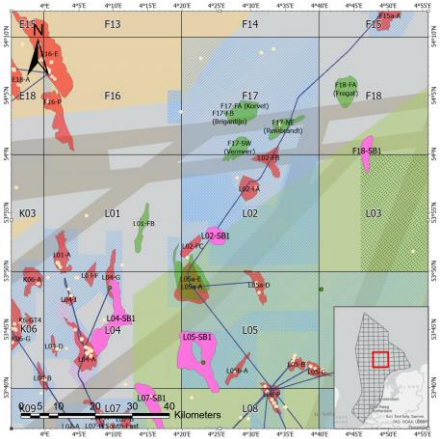
GEODE Atlas

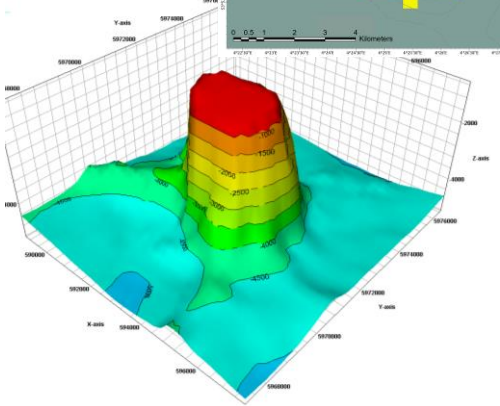
www.geodeatlas.nl

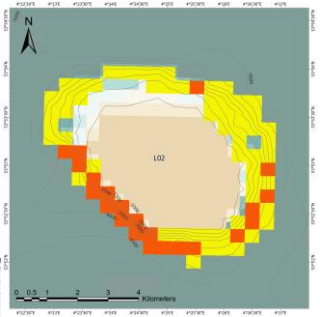
UHS Zechstein salt caverns – Sneak Preview

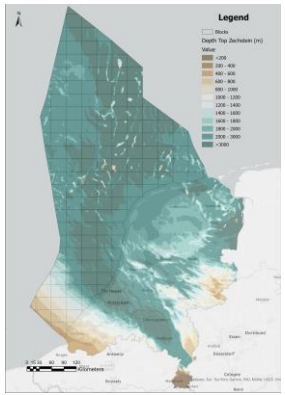
- **Maps**: salt structure outlines, wells, temperature, depth, thickness, faults, stress, potential overhang, seismic data presence (RTM), drilling events etc.
- **Factsheets** of 12 offshore salt structures
- **Online** from EBN's Dutch Exploration Day onward, 21st November – *i.e.* TODAY!

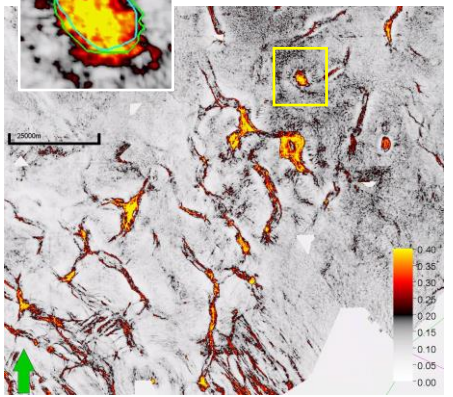












UHS Cost estimates & Business cases

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- Generic parametric cost model for UHS systems (caverns and gas fields)
- Facilitate analyses and decision making on (pilot) projects, yield insights on cost drivers and impact of design choice

Design Requirements

- ☐ Injection rate
- ☐ Production rate
- ☐ H2 purity (input/output)
- ☐ Reservoir specifications
- ☐ H2 color
- ☐ Etc…

→

Technical Plant Design

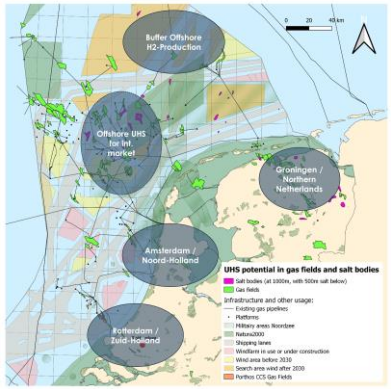
- ☐ # of wells
- ☐ Compressor specs
- ☐ PSA specs
- ☐ Etc…

→

Cost Estimation

- ☐ Cost of individual scope items
- ☐ Total cost
- ☐ Upper/lower bound
- ☐ Etc…

- Next:
  - Business case model for use cases with raw (uncertain) inputs.
  - Get insights in feasibility and comparison between use cases, LCOHS, parameters for commercial projects, sensitivities.



UHS in short

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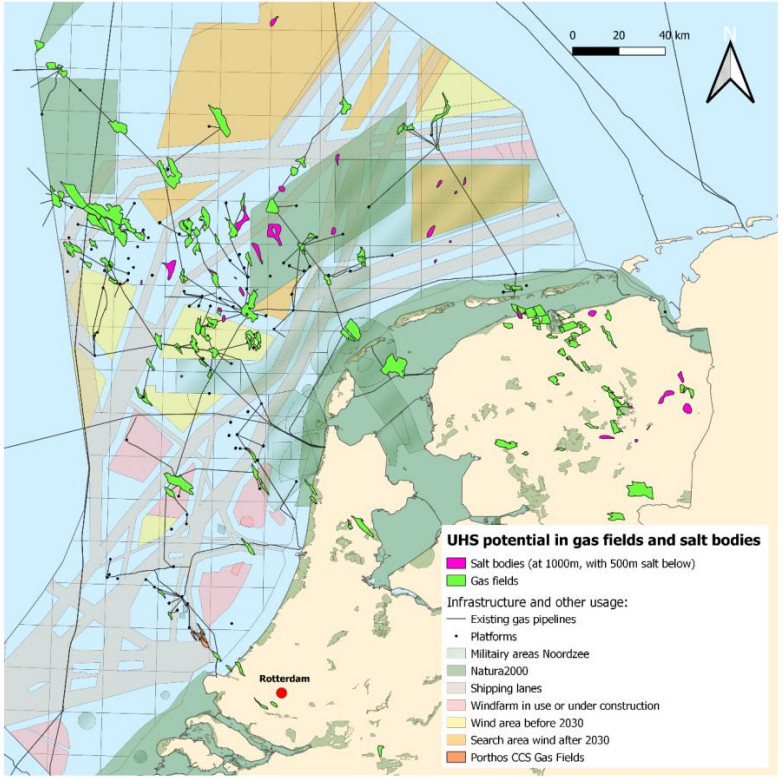
- UHS will play key role in the Netherlands with multiple functions
- There are challenges for timely development of UHS
- There are opportunities for UHS in the Netherlands
- Pros and cons of the options for UHS must be clear for <u>timely</u> development of (pilot) projects, requiring
  - Focused studies and pilot(s)
  - Government support



Salt body contours are based on TNO DGMv5.
Gas fields based on selection in TNO-EBN (2022).

Building blocks towards this new Era of Energy

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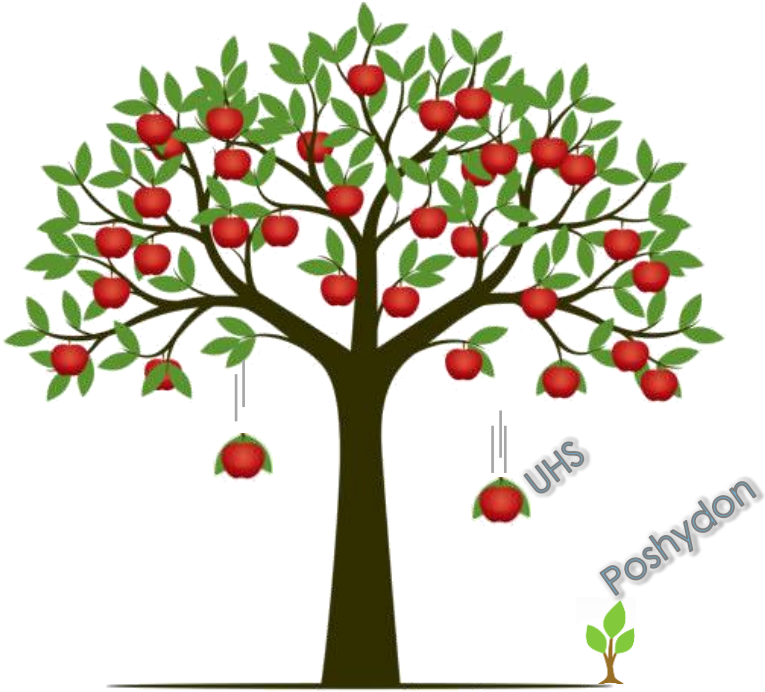
Summary

Underground Hydrogen Storage

Offshore green hydrogen



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