Underground Hydrogen Storage (UHS)

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Takeaways of this presentation

- The demand for energy storage is growing rapidly
- Large-scale UHS in salt caverns and porous reservoirs is going to play an important role in the Netherlands from 2030 onwards

- Important topics for implementation and value creation of UHS in the Dutch onshore / offshore comprise:
  - Technical feasibility and availability of gas fields and existing gas storages
  - Synergy with CCS - production of Blue Hydrogen, CO2 as cushion gas
  - Re-use of offshore wells and platforms
  - Re-use of gas pipelines for transport of hydrogen from offshore production/storage to onshore

- Research programs and partnerships up and running, EBN focus on implementation
- Pilot(s) of UHS in porous reservoir required asap to establish technical feasibility in time

UHS in the Dutch subsurface could offer value for many parties and partners

Hydrogen projects in the Netherlands

Many projects in development, a few examples

Number of projects rapidly growing…

- Different wrt TRL, scale, part of the H2 value chain
- Examples H2opZee, PosHydon, RWE HKW VII (760 MW Green H2)
- For an overview see NWP and TKI/RVO websites

including a few infrastructure & storage projects

- Onshore H2 ‘backbone’ (Gasunie)
- Port of Rotterdam ‘European Hydrogen Hub’
- UHS cavern pilot Zuidwending (Gasunie & partners)

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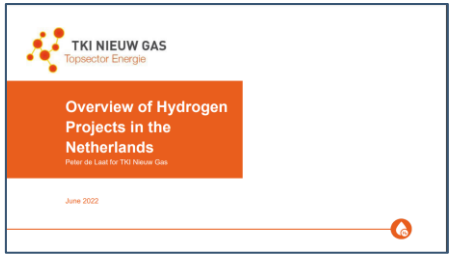
www.nationaalwaterstofprogramma.nl



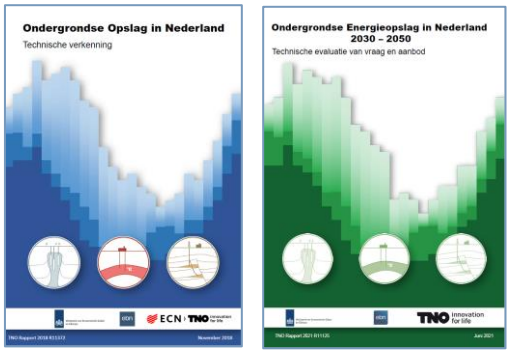
overview on RVO website

Why Underground Hydrogen Storage?

- Fast growing demand for energy storage to balance fluctuations in supply and demand of energy
- This includes H2 storage, development of UHS in the Netherlands towards 2050

	2030	2050
storage capacity	2-4 TWh	2-52 TWh
UHS in salt caverns	1-4	10-65
UHS in gas fields	0	up to 6

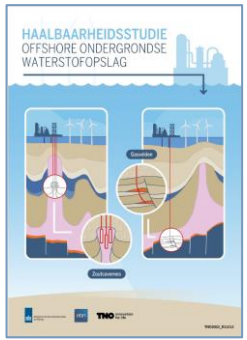
- These numbers have a large spread, depending on:
  - Uncertainties in scenarios for supply and demand
  - Choices regarding energy dependance, strategic reserves, …
  - Technical feasibility and speed of UHS project development
  - Societal acceptance and spatial planning (onshore / offshore)



UHS - where in the Dutch offshore?

Highlights of EBN/TNO *Haalbaarheidsstudie offshore UHS* (request MEAC)

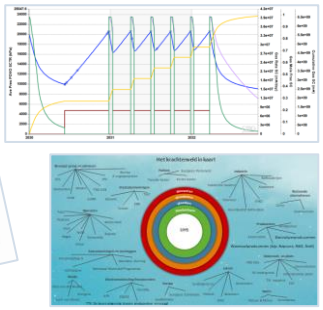
- Offshore development costs 1.5 – 2.5 times higher than onshore (excl. cushion gas)
- Development of projects could take up to 10+ years
- Potential for syenergy
- Enough storage potential:
  - UHS in salt caverns technically feasible, 12 structures could be used for UHS
  - 80 gas fields could be used for short cyclical, seasonal and/or strategic UHS.
  - Pilots required (asap) to establish technical feasibility

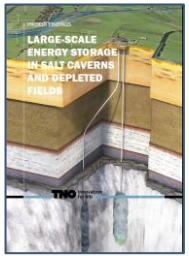


Challenges to address

By UHS research programs and partnerships of companies, research institutes and government organizations

- **Technical challenges**
  - Operations: performance, safety, integrity, deblending
  - Reservoir: performance, containment, seismicity
  - Hydrogen: conversion & contamination, cushion gas
- **Non-technical challenges**
  - Societal embedding and spatial planning
  - Economics & system integration





HyDelta

HyUSPRe

HyStoreReact

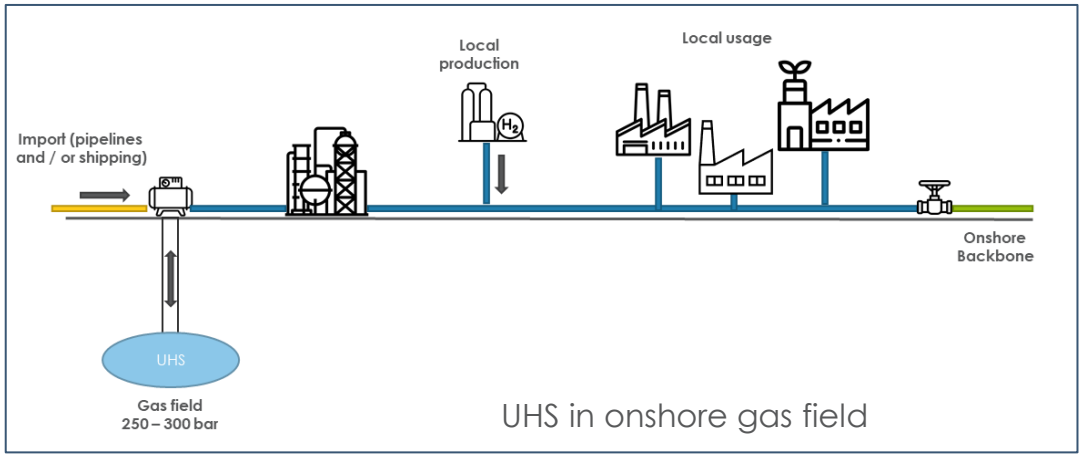
Release

Hydrogen TCP

and more...

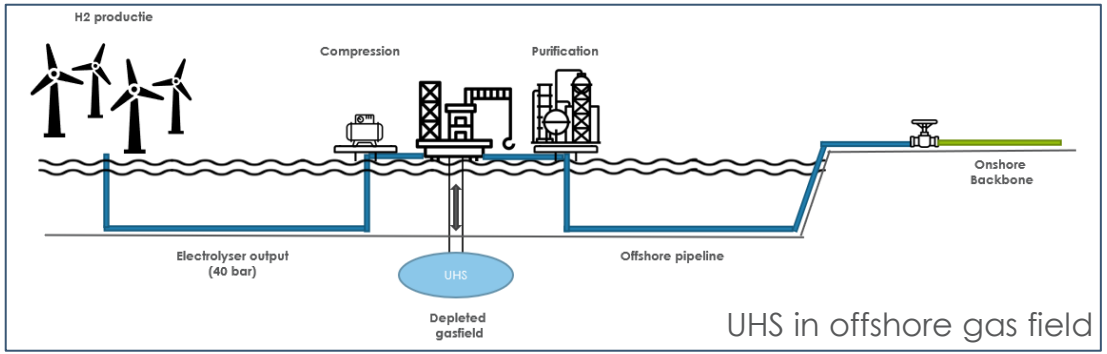
EBN Notional development study (end Dec '22)

3 development scenarios for different functions of UHS in gas fields

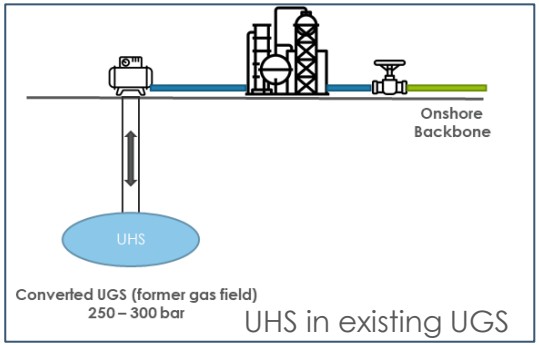


UHS in onshore gas field

- Analyzing 3 development scenarios for Short cyclical, Seasonal, Strategic UHS, looking at the same technical and non-technical aspects
- Learnings will be input to pilot projects
- In cooperation with



UHS in offshore gas field



UHS in existing UGS

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Questions?

Thanks for your attention and interest!
More info (incl. TNO/EBN reports) on www.ebn.nl/energieopslag

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