Dutch perspective on Knowledge Communities

GroenvermogenNL

2026

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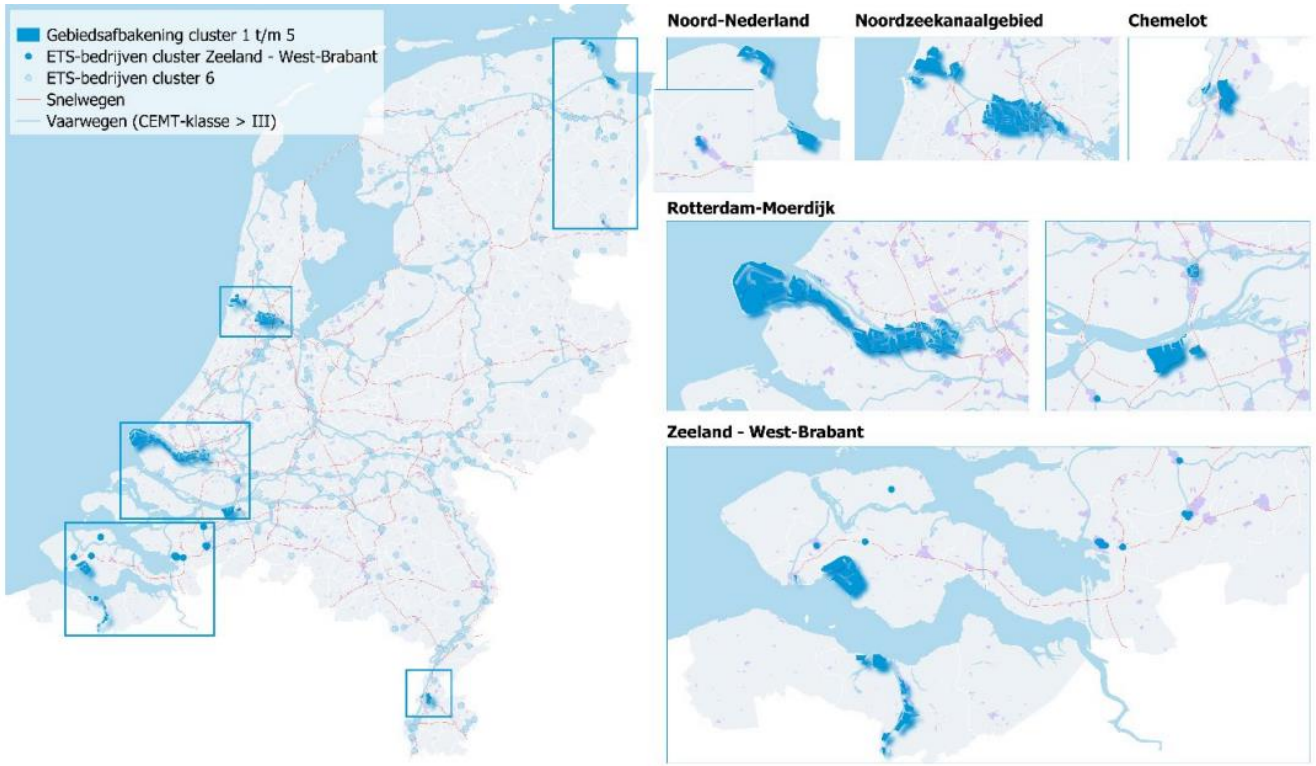
- Board member Knowledge and Innovation Center TKI New Gas
- Scientific Director 4TU.Energy collaboration

Hydrogen in the Netherlands – global and national context

Hydrogen as a pathway to maintain industrial activities

- **Relatively energy intensive economy** due to large refining and petrochemical sector which benefited from abundant natural gas
- **Industry mainly clustered** into five (highly) integrated ecosystems
- **Hydrogen already widely used commodity** in chemical, refining and fertilizer industry
- 1.5 million tonnes (180 PJ) grey hydrogen per year makes NL **second largest grey hydrogen producer in Europe** (second to Germany)

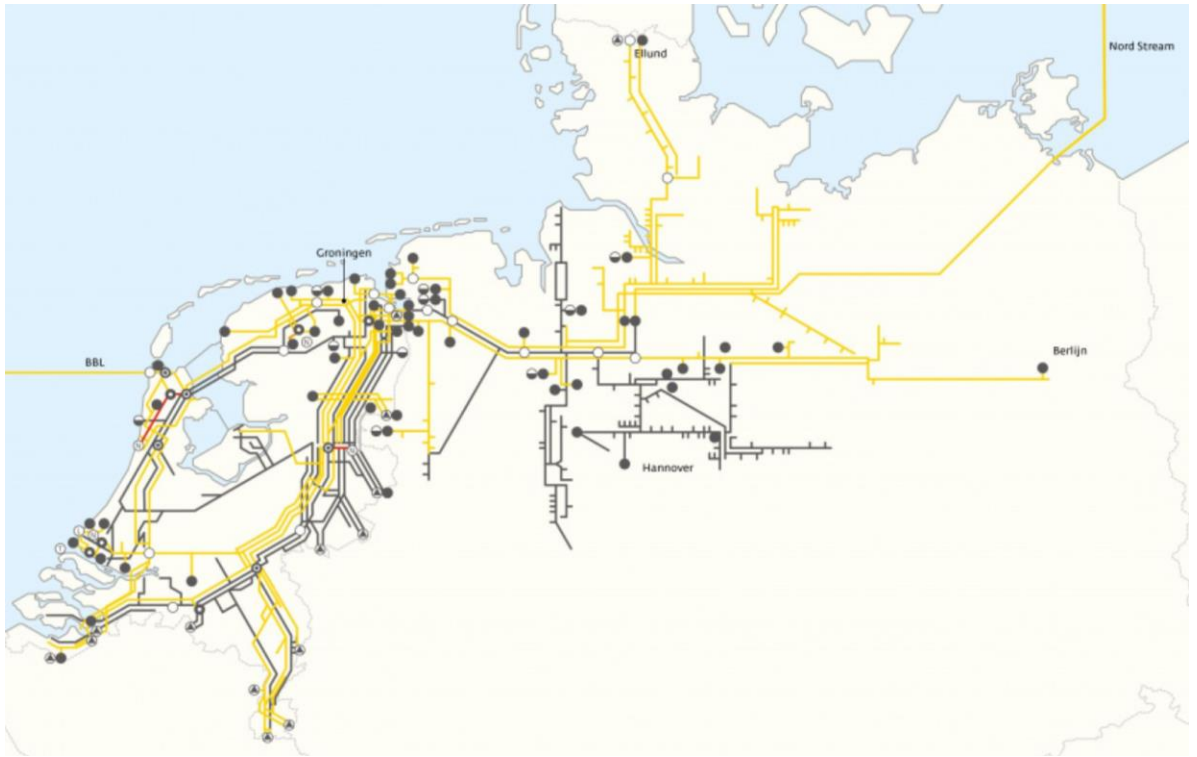


Stec Groep (2025) - (link)

Hydrogen in the Netherlands – global and national context

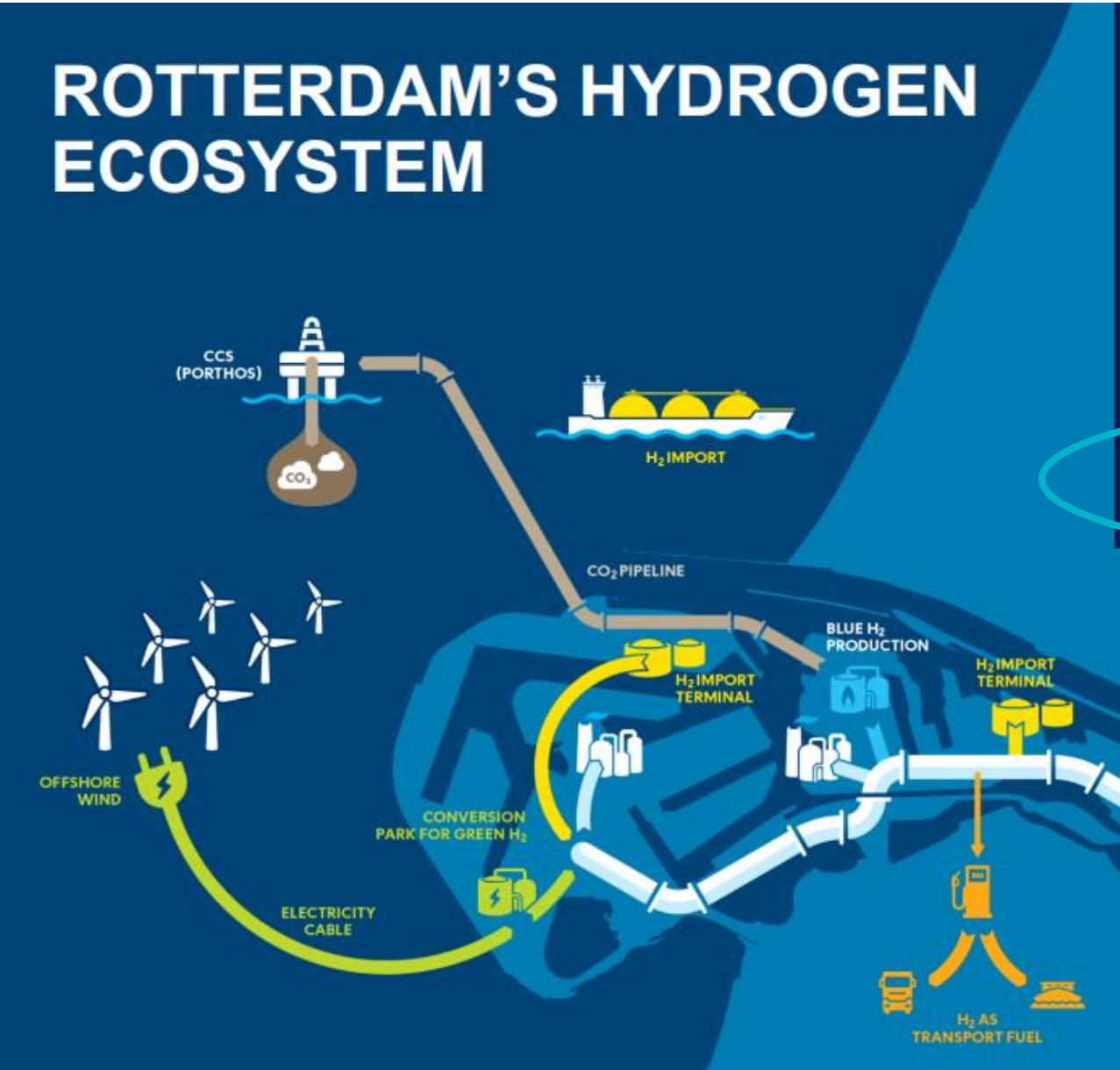
Opportunities/motivations for integrating hydrogen into the Energy System

- Historical status as ‘’**Gas roundabout**’’ of Europe, facilitated by Groningen gas field and subsequent extensive high-class natural gas infrastructure
- **Offshore wind** potential in Dutch seawaters acts as important enabler for low-carbon hydrogen production
- **Major ports;** particularly Rotterdam and Amsterdam as international energy import and distribution hubs



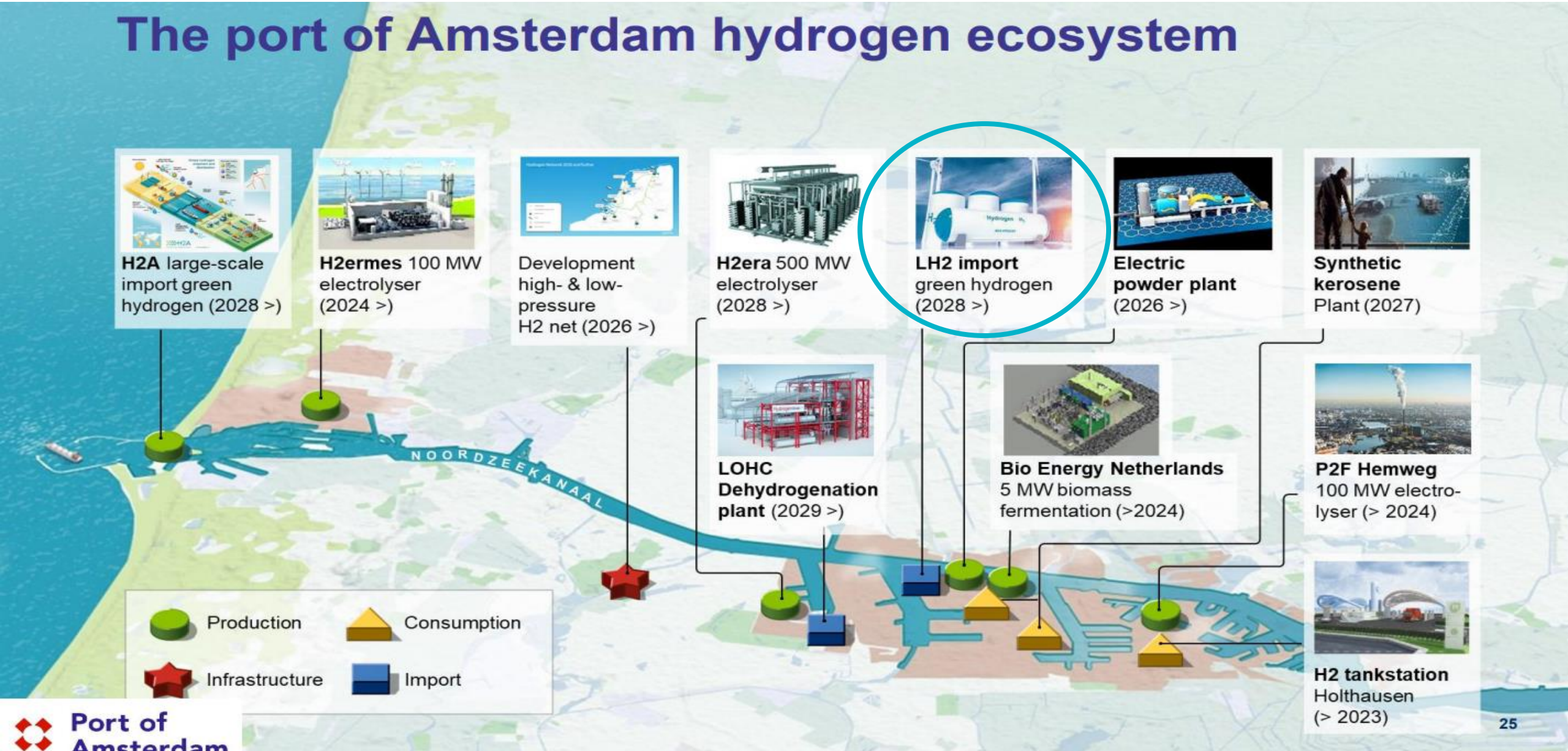
Gasunie link

Import ambitions Port of Rotterdam



- Offshore wind farms connected to Rotterdam: 7.4 GW in 2030.
- Production of green hydrogen (first 200 MW electrolyser under construction): 2-2.5 GW in 2030.
- Construction of open access Hydrogen pipeline across the port has started, connecting production, imports & use (part of an international hydrogen network; Delta Rhine Corridor).
- CCS to decarbonize grey hydrogen production.
- CCS to decarbonize refinery gasses.
- Massive import of hydrogen and its deriviates: 90% will be imported in 2050, only 10% produced locally.

Import ambitions Port of Amsterdam



Dutch Hydrogen Import Declaration

Enabling CO_2 reduction through importing renewable and low carbon hydrogen, essential for a secure and affordable energy transition

NH_3 Dedicated funds to support upscaling of ammonia cracking facilities in port areas

CH_3OH Policies that drive the demand for green methanol in eg. aviation fuel and shipping

LH_2 Liquid Hydrogen: Dedicated funds for new import facilities and the allowance for inland transportation to supply Europe

LOHC Liquid Organic Hydrogen Carrier: Realistic domestic safety requirements

GRONINGEN SEAPORTS
Deltalinqs
vtti Energy to move tomorrow
LBC
H_2 Chile
NPRC
smart delta resources
ADVARIO Partners for progress
EVOS
North Sea Port
Port of Rotterdam
NVB
VEMOBIN
vemw
chane
Port of Amsterdam
AIR PRODUCTS
NLHydrogen
VOTOB
vereniging van Nederlandse tankopslagbedrijven
Norwegian Hydrogen Forum
Vopak
VESTA

Wasserstoff-Kernnetz* 2025

*gem. Genehmigung vom 22.10.2024

Hydrogen core network - FNB Gas

H2 infrastructure development

Hydrogen backbone Gasunie

GroenvermogenNL

- GroenvermogenNL is an innovation program, funded by the Dutch National Growth Fund
- Initiated by 3 Dutch Top Sectors:
  1. Holland HighTech
  2. ChemistryNL
  3. Top Sector Energy
- Program duration until 2032
- 838 million Euros budget in total

Objectives GroenvermogenNL

1. **Fight climate change**
   achieve net-zero in 2050 by reducing greenhouse emissions in non-electrifiable applications using green H_2
2. **Boost earnings power**
   become a significant international player in the green H_2 & chemistry economy, unlocking potential of NL high-tech sector
3. **Retain key industries**
   within the Netherlands by facilitating their transition to net-zero in a sustainable way using green H_2 & chemistry
4. **Improve business climate and energy security**
   by creating national green H_2 production capacity in parallel with import infrastructure

Knowledge Communities

- Universities
- Universities of Applied Sciences
- Research organizations
- Industrial partners

Programs overview

R&D

TRL 2-6 projects throughout the value chains

1. HyPRO - Making carbon neutral H_2
2. HyTROS - Transport & storage of H_2
3. HyUSE - Direct use of H_2
4. HyCARB - Green H_2 & e^- for C-based chemistry
5. HyNITRO & e^- for N-based chemistry
6. HyFINE & e^- for specialties
7. HySUCCES - Socio-economic aspects & H2 implementation

177 M€

Pilots and small demonstrations

TRL 6-8 projects throughout the value chains of production, transport, storage and industrial use of green hydrogen (carriers):

1. Regional testing facilities (TRL 6)
2. Small scale demonstration (DEI+ subsidy) (TRL 7-8)

100 M€

Scaling up

TRL 8-9 projects throughout the value chains of production, transport, storage and industrial use of green hydrogen (carriers):

1. Support for the manufacturing industry (IMKE)
2. Demonstrating value chain projects (VEKI)
3. Feasibility/FEED - TSE Industry Studies
4. National endurance testing facility
5. Hydrogen Hubs

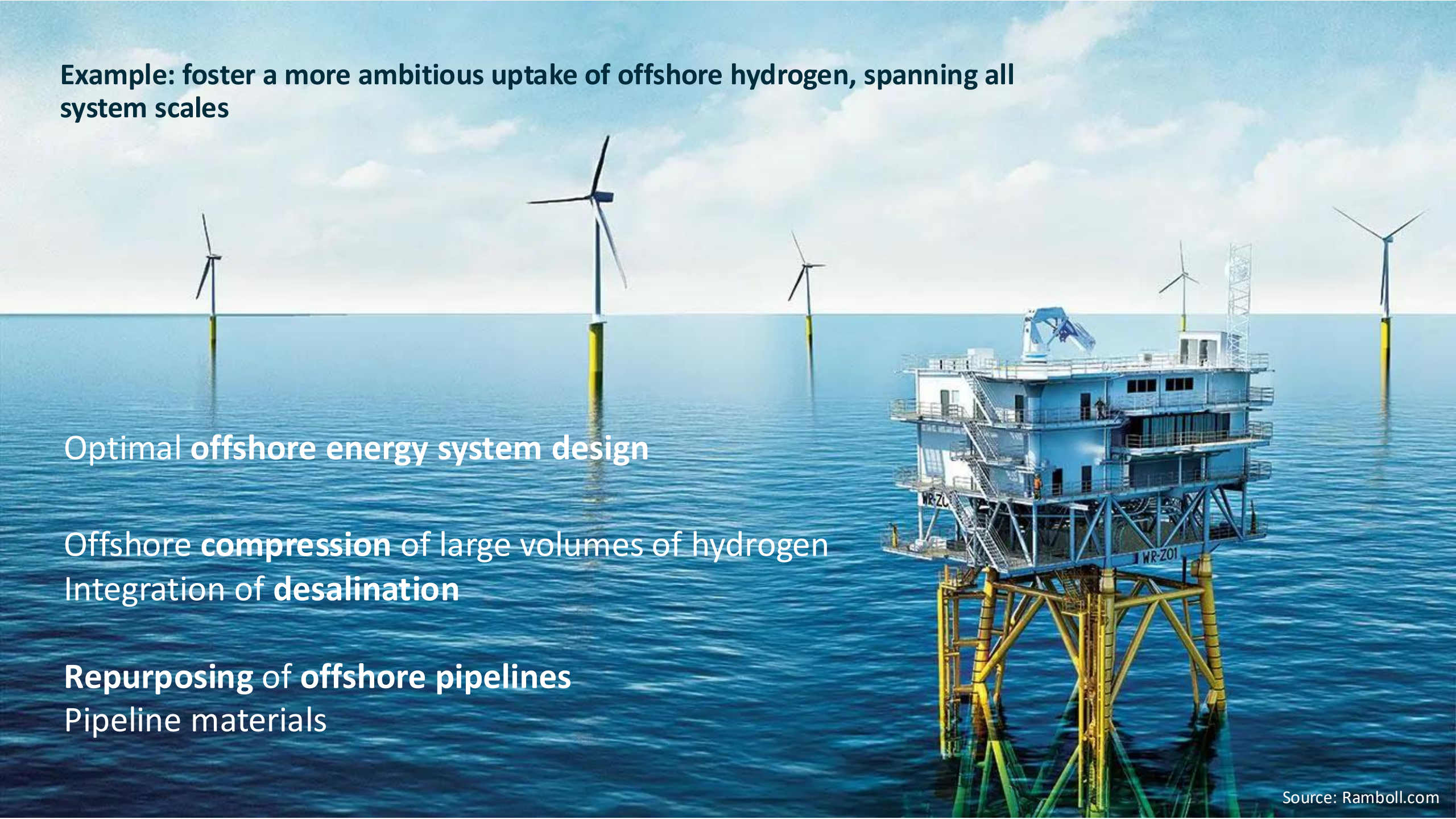
500 M€

Human Capital

Program line 1: Knowledge areas
Program line 2: Regional liasons and working communities
Program line 3: National Knowledge Platform Hydrogen
Program line 4: National education and training package
Program line 5: Innovation and business development impulse

50 M€

Example: foster a more ambitious uptake of offshore hydrogen, spanning all system scales



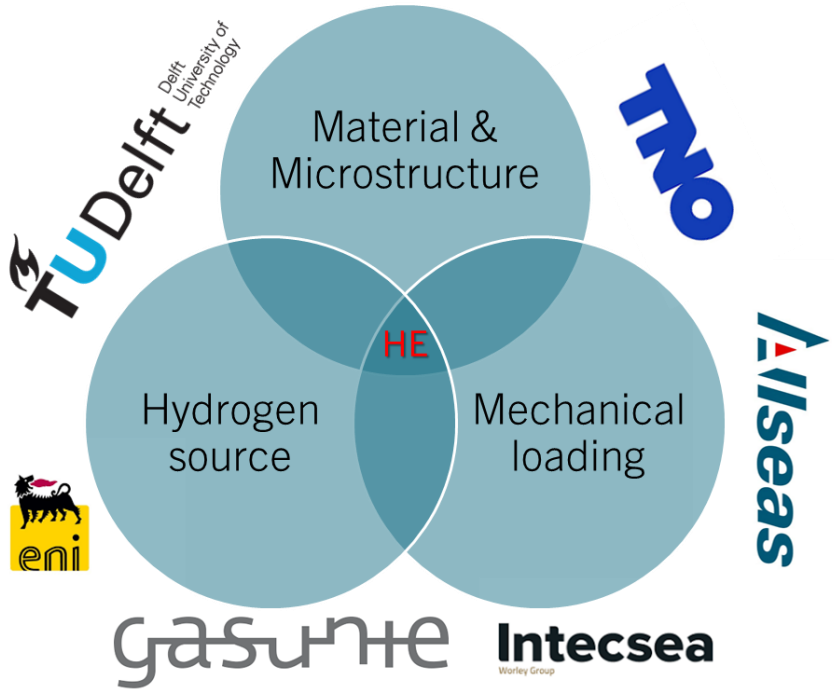
Optimal **offshore energy system design**

Offshore **compression** of large volumes of hydrogen
Integration of **desalination**

Repurposing of **offshore pipelines**
Pipeline materials

Source: Ramboll.com

Repurposing of offshore pipelines & pipeline materials



Predictive Modeling

- Predict **hydrogen embrittlement** (HE) behavior & **guide materials design** by simulating long-term pipeline material performance
- Influencing factors
  - Microstructures
  - Loading
  - Oxidation
  - Gas mixtures

Experimental Simulation

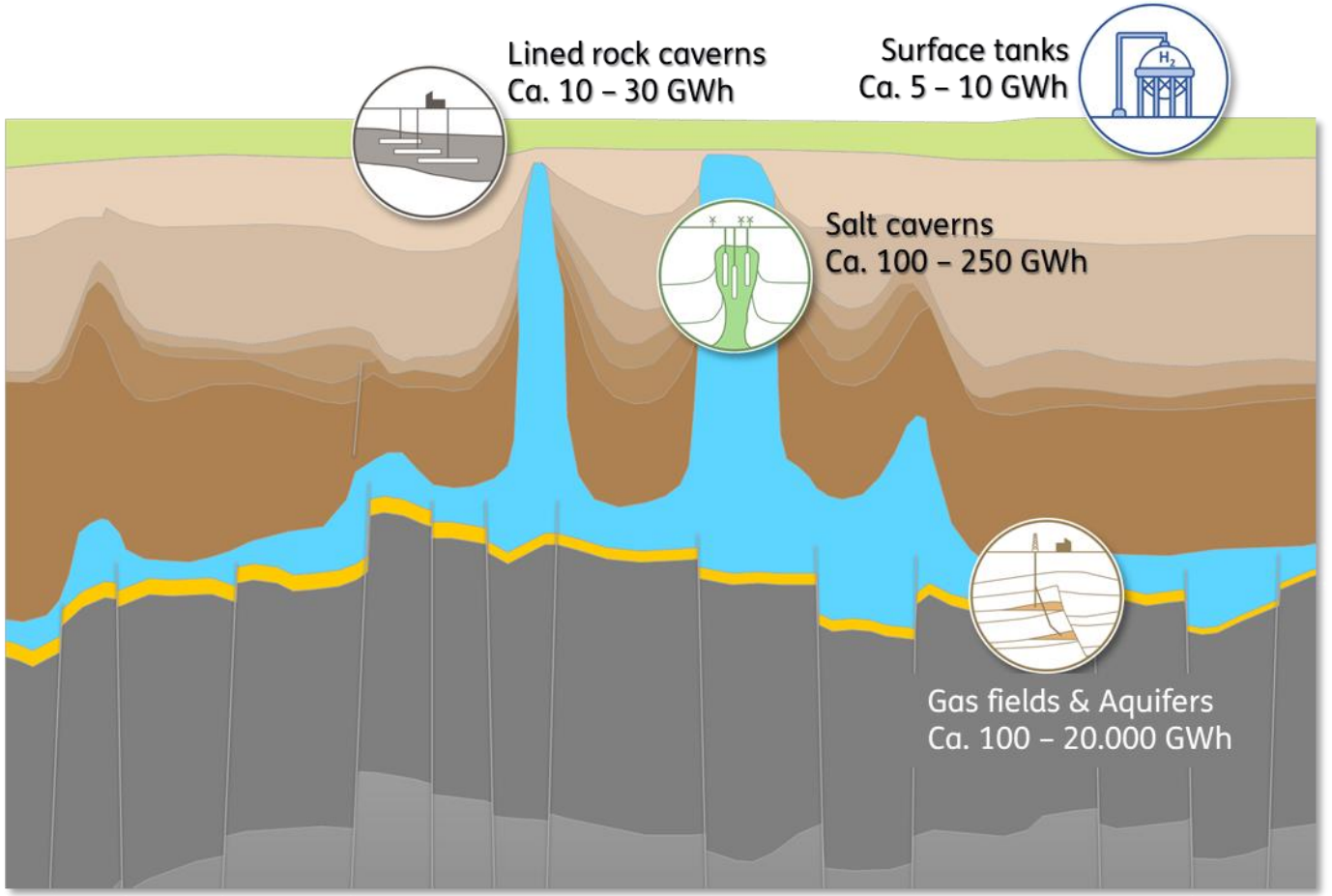
- Studying material and welds cyclic loading in hydrogen-rich environments under offshore conditions
- Fatigue initiation
- Fatigue growth

Vera Popovich
TU Delft

Casper Versteylen
TNO

Example: Large Scale Hydroge Storage

- **Derisk H_2 injection pilots** in **porous reservoirs**, and **prepare for a pilot**
- **Optimize efficiency** to implement UHS in reservoirs **safely**, **affordably**, and with **support from society**
- **Evaluate options** for **storing** and **transporting hydrogen** in **liquid form**
- **Advance TRL** for **retrofitting LNG import terminals** for **storing LH_2**



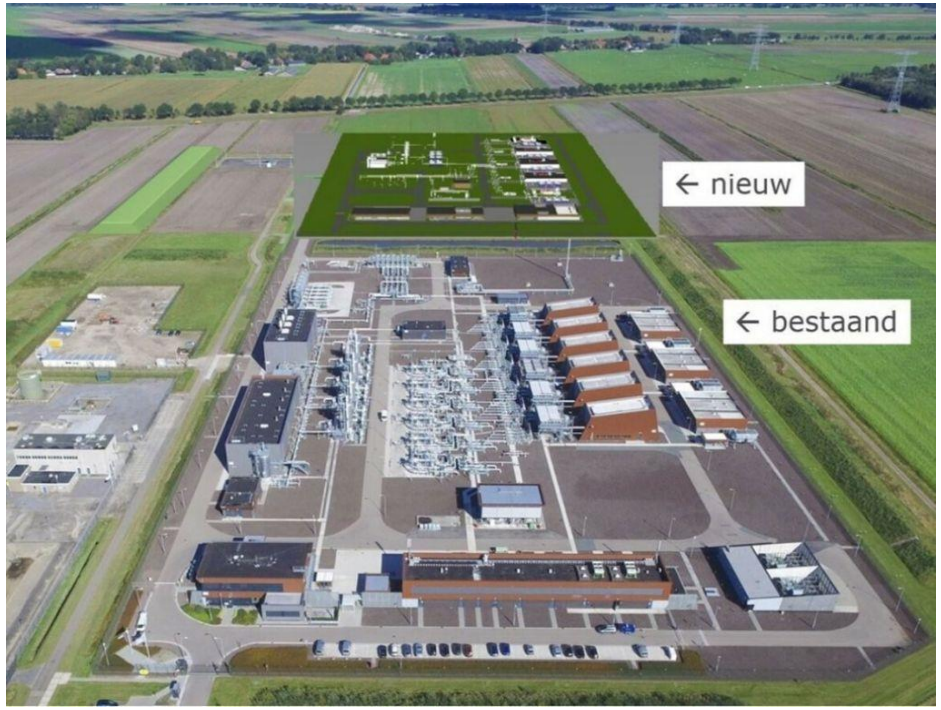
Hydrogen TCP
Underground Storage

Hydrogen in the Netherlands – Storage of H_2

Developing large-scale storage facilities to solve supply/demand mismatches

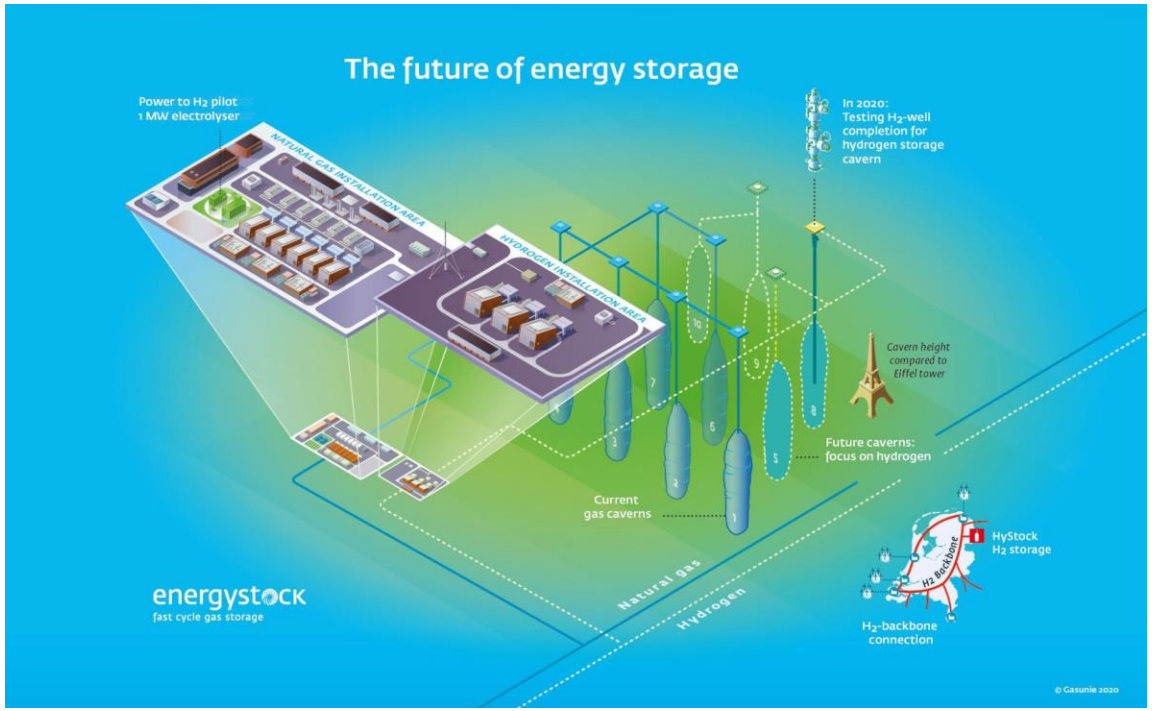
1. Salt Caverns at Zuidwending (Northern NL)

- Total of storage 4 caverns planned for hydrogen
- Total storage capacity of 4 million m^3 (20kton) H_2

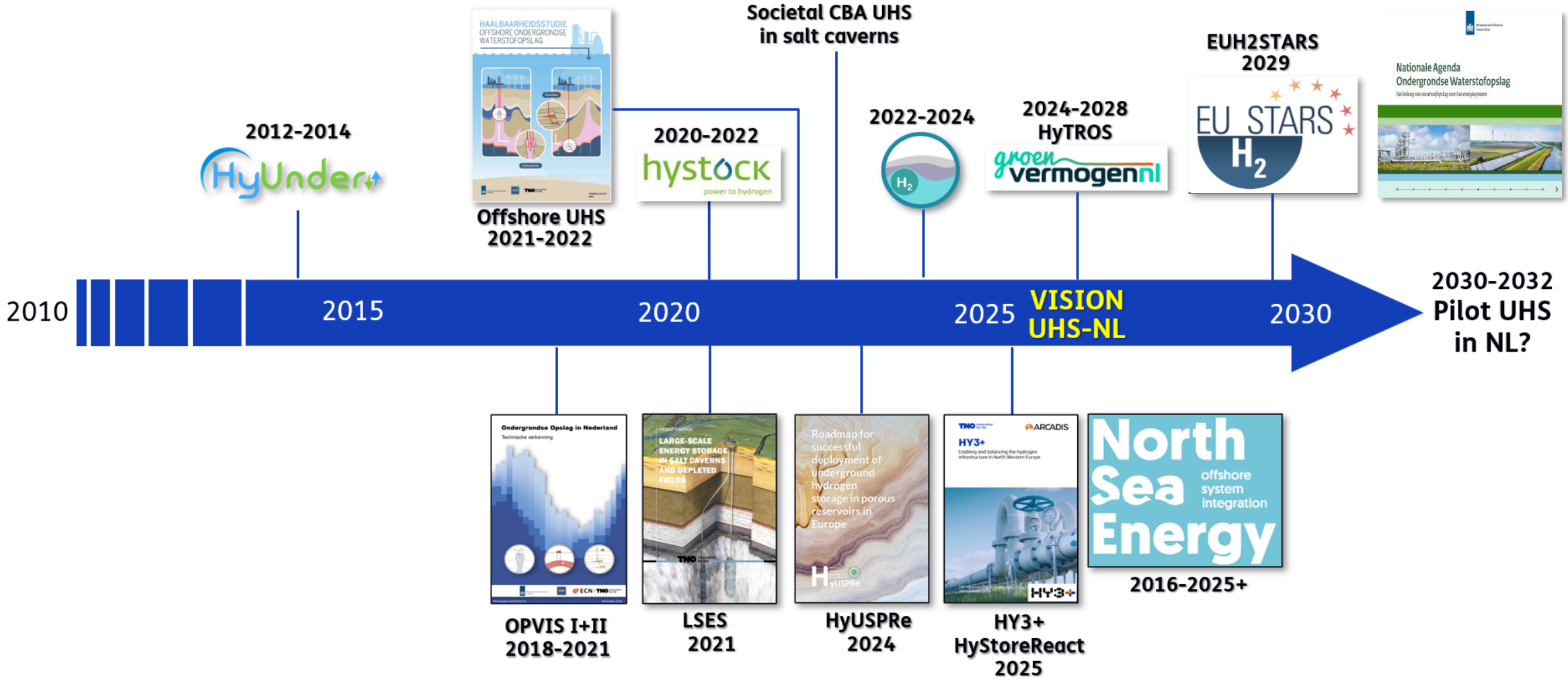


2. Deployment timeline

- Expected FID in 2028
- First hydrogen storage cavern in operation by 2031



Long term development of Large Scale Hydrogen storage towards pilot



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