Introduction - Hydro Boreas

- Fieldlab aiming at developing maintenance strategies for green H_2 installations.
- Until now, the focus has been on the engineering, design and construction of these assets, which are exponentially growing in size and capacity, while the maintenance has not received the same attention.
- The fieldlab scope is the entire supply chain: production, compression, storage and distribution of H_2 to industrial scale users.
- There is plenty of engineering and O&M experience with industrial H_2, but the new elements are
  - New technology for H_2 generation (elctrolysers instead of reformer furnances)
  - Fluctuating supply of electricity from renewable sources (“Dancing with the wind”)

Hydro Boreas Participants

Company	Sector
Equans	Service provider
Stork	Service provider
Spie	Service provider
Worley Consulting	Consultant
Douna Machinery	Machinery
ABB	OEM
HYCC	Asset owner
WCM	Knowledge Institute
Shell	Asset owner
Gasunie	Asset owner
IBM	Consultant/IT supplier
IJsseltechnologie	Consultant
Kiwa +	Certification
ITM +	OEM

+ Former participants, available for questions

Connectivity in the green H_2 supply chain

Hynetwork Services

- In order to achieve the agreements of the Paris Climate Agreement (2015), the government has drawn up the 'Cabinet Vision on Hydrogen' in which the need for a national hydrogen infrastructure is expressed.
- In June 2021, the government called on Gasunie to convert part of the natural gas network to hydrogen infrastructure.
- Hynetwork Services (a 100% subsidiary of Gasunie) is tackling this challenge with both hands and developing the Dutch hydrogen network.
- With this network the major industrial regions are connected with
  - each other,
  - hydrogen storage locations
  - import locations
  - abroad

Issues

- Very few suppliers
- Very few pipelines
- No buffer capacity
- Very few consumers

Phase 1: 2025-2027

- Hydrogen network
- Industry cluster
- Import
- Hydrogen storage (salt cavern)
- Import terminal

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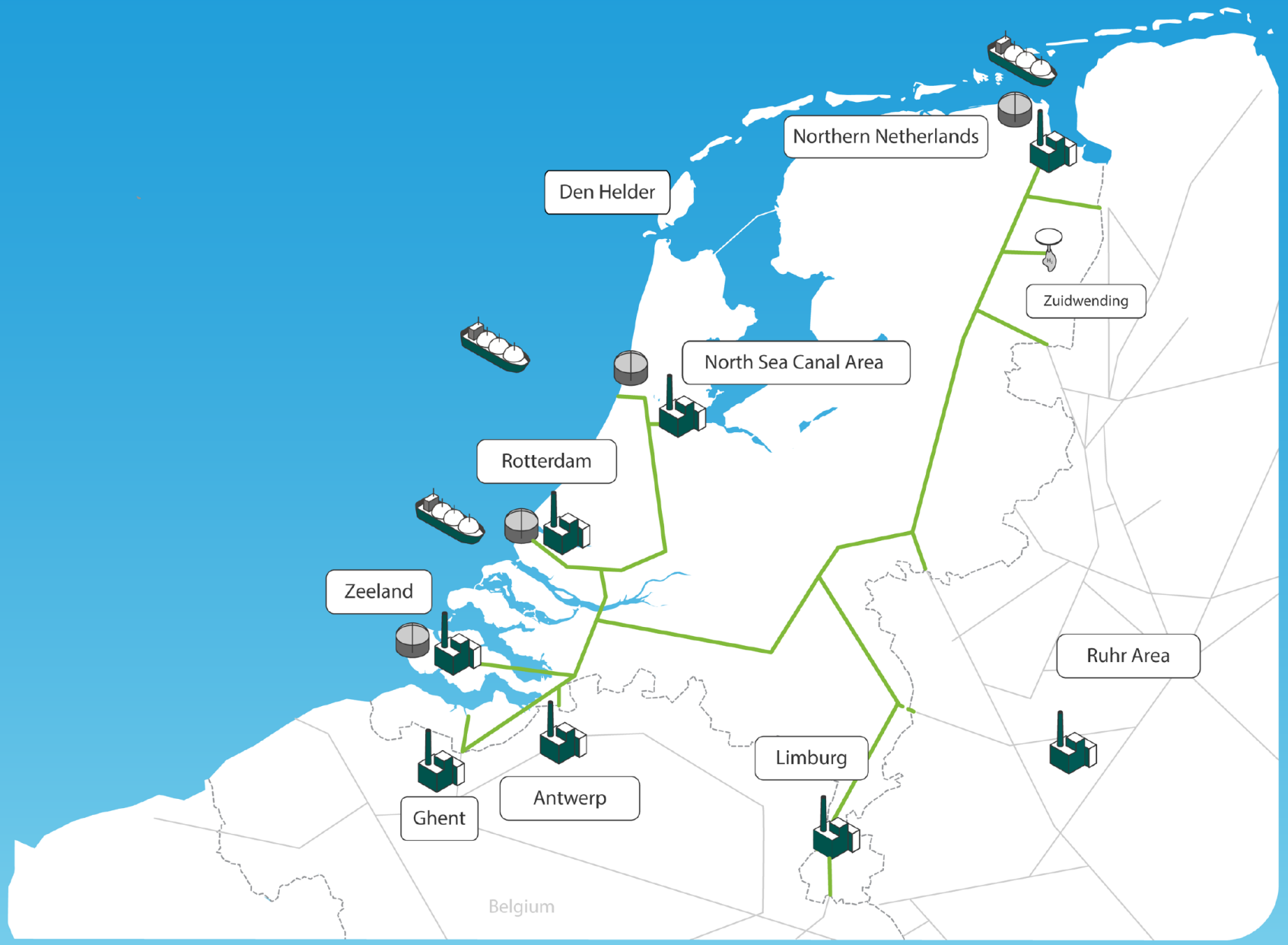
Phase 2: 2028-2029



- Hydrogen network
- Industry cluster
- Import
- Hydrogen storage (salt cavern)
- Import terminal

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Phase 3: 2030 and beyond

- Hydrogen network
- Potential (offshore) hydrogen network
- Industry cluster
- Import
- Hydrogen Storage (salt cavern)
- Import terminal

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Problem Definition

- An H_2 system consists of several complex components in an energy system that must function well together, as an integrated value chain. There is no buffer (yet).
- The emphasis is therefore more on the reliability of the entire chain rather than on the reliability of a single factory or production unit.
  - Less controllable supply of H_2 due to variable production of solar and wind energy
  - Supply of blue hydrogen uncertain
  - Network will not yet have such a large filling level in the first few years, so buffering is only possible to a limited extent
  - No medium-pressure network, only high pressure (as opposed to natural gas)
  - Uncertainty about development in industrial and consumer use of H_2

- What information do you share with each other? It's about real-time data
- What do you want to share (can be very commercially sensitive)?
- What can you share (e.g. ACM's limitations)?
- Which parties in the supply chain play a role?
- Who's in charge?
- Implications for maintenance parties?
- How are planned and unplanned (opportunity-based) maintenance balanced?
- What would be the optimum interval for planned maintenance?
- What type of maintenance organization fits such a strategy?

Theorem 1

For optimal chain management, all parties involved must know timely when which component of the chain will be maintained

What is timely?

Theorem 2

Maintenance planning must be coordinated from a central party

Who should that be?

Theorem 3

Failure data from H_2 systems shall be shared with all stakeholders because of safety risk management

What would make it easier for stakeholders to share this information?

Theorem 4

Parties involved need to think less in terms of their individual business risks and cultivate more mutual trust to make the entire chain reliable

How do you build mutual trust?

Our Vision

- A learning community of all parties involved that jointly organises and runs the supply network in terms of M&O
- Transparency about all relevant aspects of the network
- Incentives that promote the functioning of the chain as a whole, not just individual parts, and in the longer term, not just the short term
  - Legal: Government Guidelines
  - Economic: market mechanisms, incentives
  - Technical: a "control tower" for H_2 Supply Chain control