



# Development of **Offshore** H<sub>2</sub> production from Wind

Ecology workshop EBN

9 Feb 2023

# RWE and Neptune Energy wish to demonstrate 300-500MW offshore green hydrogen, and possibly reuse an existing natural gas pipeline

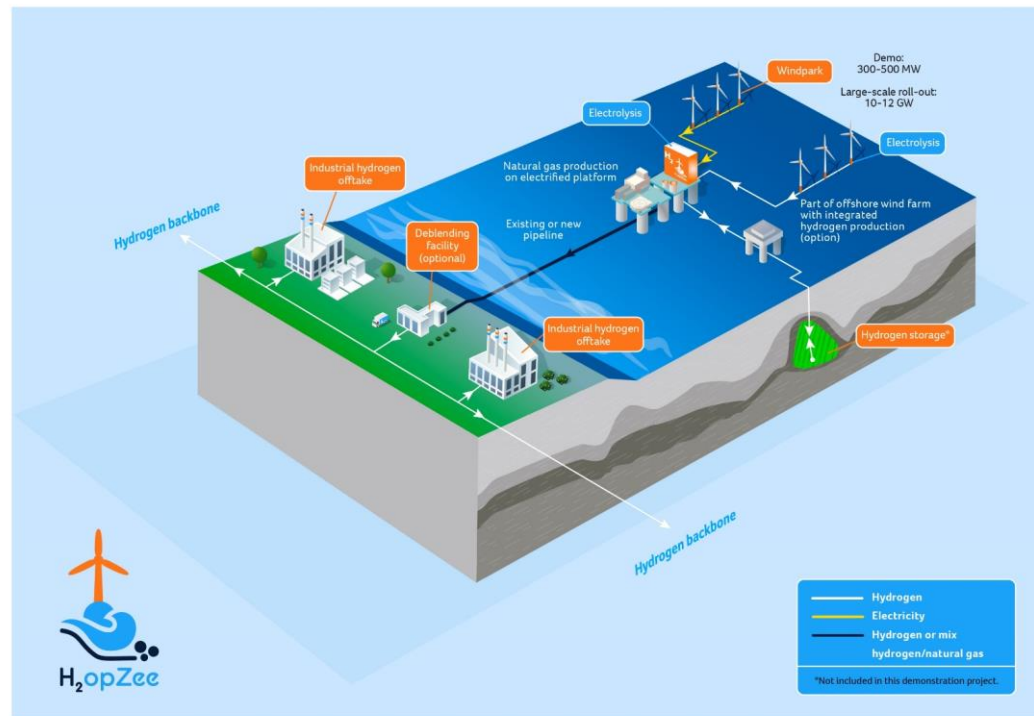
## TARGETS

### LONGER TERM, AFTER 2030:

- 10-12GW offshore wind (scalable)
- Conversion of electricity to green hydrogen
- Transport to shore via an (existing) pipeline (TSO principle)
- Hydrogen storage in offshore salt cavern or empty gas fields to cover fluctuations in wind energy generation and provide a stable blend for offtakers.

### DEMONSTRATION PRIOR TO 2030:

- 300-500MW offshore off grid wind farm
- Electricity conversion to green hydrogen
- Transport to shore via either 10-12GW new pipeline or (mixed with natural gas) in existing pipeline
- Stepping stone for further roll-out of hydrogen at sea

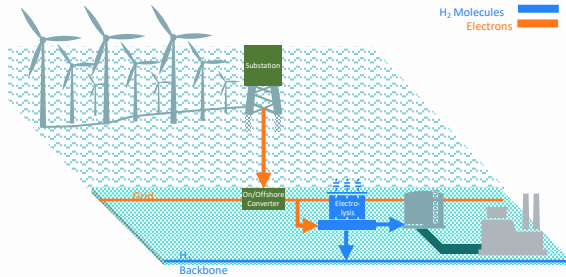


# H<sub>2</sub> from Offshore Wind – Examples of Sector Development Models

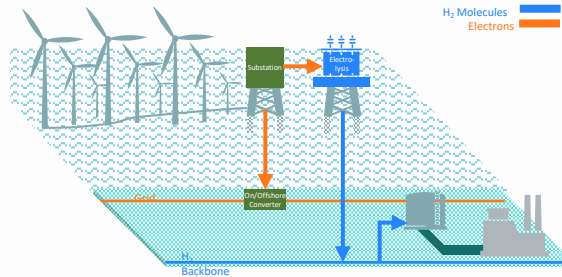
## Green H<sub>2</sub> from Offshore Wind

Direct connection from the wind park to the hydrogen platform.

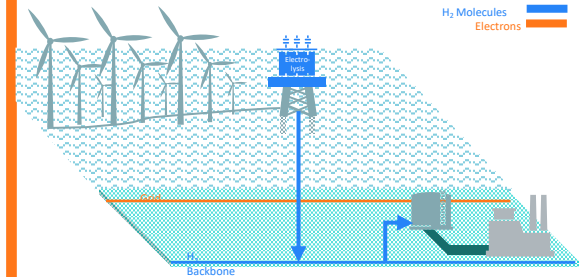
Offshore Wind Park (E-Grid Connected)  
**Onshore** H<sub>2</sub> Production



Offshore Wind Park (E-Grid Connected)  
**Offshore** H<sub>2</sub> Production



Offshore Wind Park (**NOT** E-Grid Connected)  
**Offshore** H<sub>2</sub> Production



Illustrative Examples



# Offshore hydrogen has many advantages: cable vs (existing) pipeline



## Onshore – Cable



## Offshore – Pipeline

### Costs

> At large scales/distances, transporting electrons through a cable is more expensive than molecules through a pipeline

> At large scales, transporting molecules through a pipeline is cheaper than electrons through a cable - therefore, offshore electrolysis is cheaper than on land

### Environment & permits

> Lower capacity per power cable (5-10 times) results in more trenching and transport through the fragile environment of coastal areas

> Much higher capacity pipeline (5-10 times), reducing trenching and transport through the fragile environment of coastal areas  
> No time-consuming permitting process in case of transport with existing pipeline

### Space

> Relatively high cost for cable, so preference to have wind farms close to coast where space is limited

> Much lower cost for pipeline, so wind farms much further from coast possible, even more so in case of existing pipeline

### Supply chain scale-up

> Slower upscaling of supply chain due to complex manufacturing process of offshore power cables with many components, higher demand for scarce resources

> Simpler production process of the sections of an offshore pipeline compared to cables allows for faster supply chain scale-up

### Storage

> Use of empty natural gas fields or salt caverns on land for hydrogen storage

> Possibility of storing green hydrogen offshore in depleted gas fields or salt caverns – Offshore storage enjoys stronger public support, and in case of an existing pipeline, already connected

Efficient economic solution to land green energy onshore

Source: Press releases, H<sub>2</sub>opZee consortium



# Screening Offshore H<sub>2</sub> Development Locations

Wind Area Assessment

# Maximizing North Sea Green Energy to shore → Locations for large-scale H<sub>2</sub> Developments

Dutch North Sea spatial designations incl. designated Wind Areas up to 2030

1

All Wind Development / Wind Search Areas

2

Initial Screening using high-level multi-criteria analysis

Potential match for H<sub>2</sub>opZee

NOGAT 24-36"

NGT 36"

TNW

Results of High-level Screening:  
Wind Search Areas 6 & 7 preferred

3

Detailed evaluation through sub-area analysis / screening

Wind Search Areas 6 & 7  
100km<sup>2</sup> grid generated; basis for sub-area analysis

4

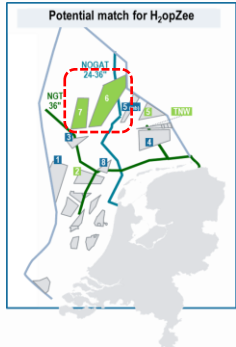
Optimum area for demonstration project

Preferred development location(s)  
for Demonstrator → room for  
future large-scale roll-out

It should be  
"And-And"  
**not**  
"And-Or"

Avoiding  
competition  
with  
'planned'  
electrons to  
shore

# 'Deep-dive' into Wind Search Areas 6 & 7 using Multi-criteria Analysis

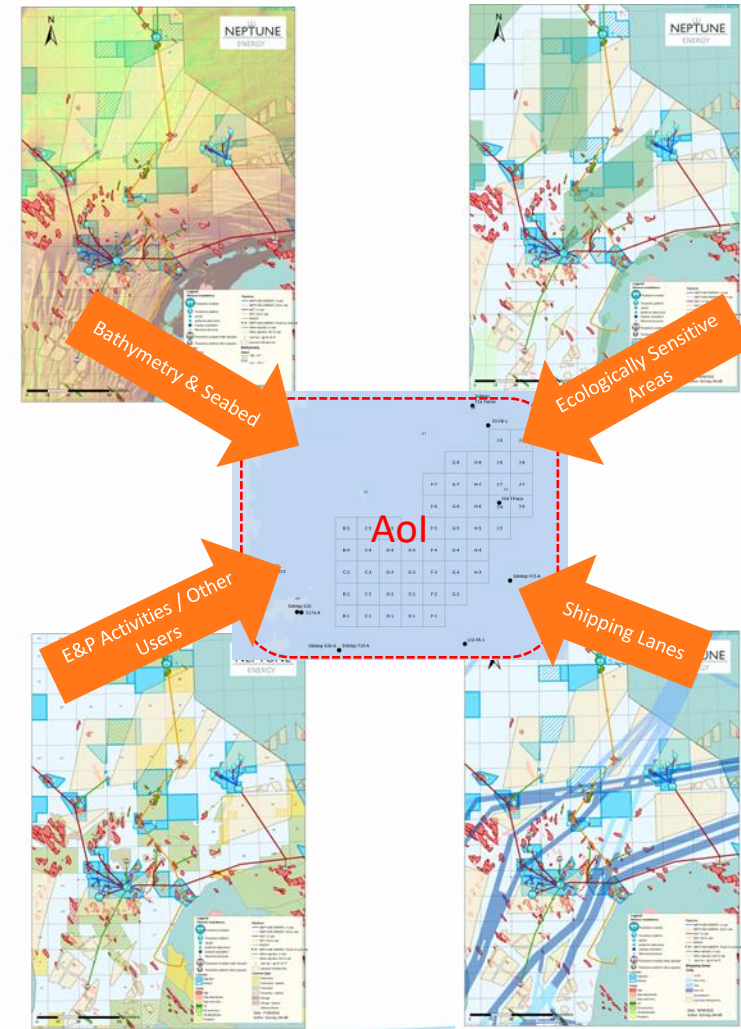


- Wind search areas divided into approx. 1 GW / 100 km<sup>2</sup> sub-areas
  - H<sub>2</sub>opZee demonstration project requires approx. 1/2 square (500 MW)
- 13 out of 14 identified criteria used to score each block
  - Each criteria weighted due to perceived importance
  - Potential conflict with Fishing Grounds not yet assessed due to lack of information

	Criteria	Details
Technical	Wind conditions	Yearly average speed Direction
	Water depth	Maximum, average and 80% percentile water depth
	Seabed conditions	Initial available soil information
	Infrastructure	Shortest distance to pipeline
		Distance to existing pipeline Tie-In
		Distance to nearest platform -possibility for electrical connection
	O&M	Conflict with helicopter routes Transit time/distance to O&M port (Den Helder)
Environmental	Nature protected Areas	Potential conflicts with protected areas e.g. Natura 2000
	Animals	Potential conflicts with other environmentally sensitive areas
	Fishing Grounds	Potential conflicts with existing fishing grounds
Socio-economic	Shipping Lanes	Distance to nearest shipping lane
	E&P licenses	Competition with E&P licenses

8-2-2023

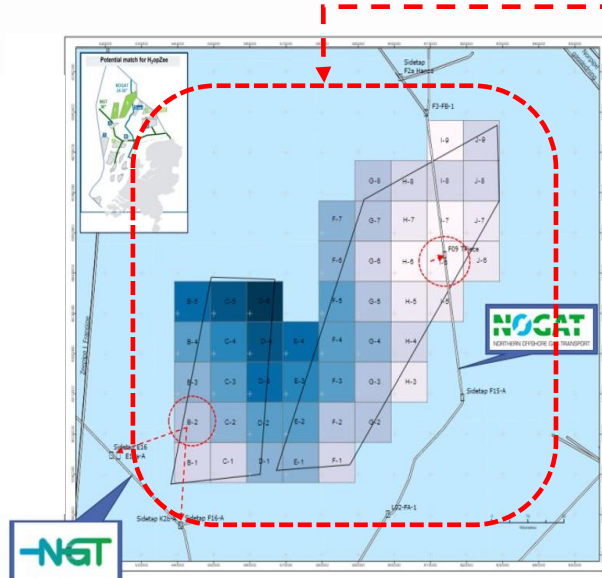
Public





# Wind areas 6 or 7 potential match for H<sub>2</sub>opZee and beyond

- **Not conflicting** with electrons production in designated areas
- Ability to **scale-up** in these areas right after H<sub>2</sub>opZee (>20GW)
- Significant distance to landfall - **pipeline** vs cable costs
- **Favourable** wind conditions – stronger/more consistent far from shore
- **Timely realisation** – minimising clashes with other North Sea users (Noordzeeoverleg)



Wind areas 6 and 7 are a perfect match for H<sub>2</sub>opZee and beyond

Illustrative

Source: VAWOZ Deelsessie Verkenning 2030-2040, North Sea Energy Atlas, H<sub>2</sub>opZee consortium



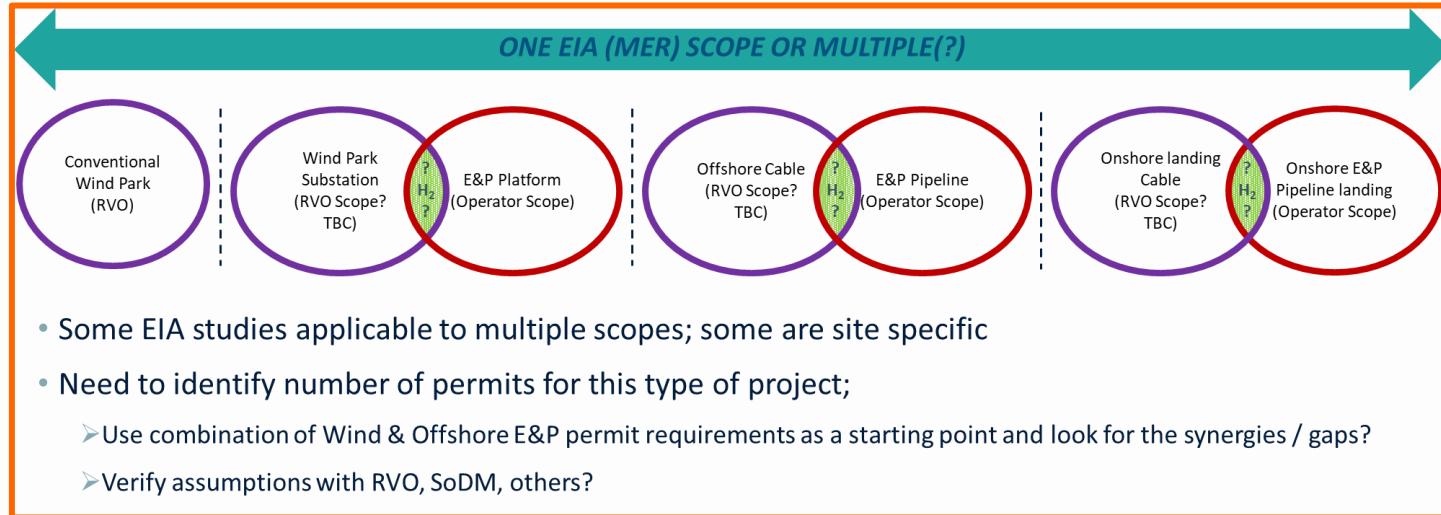


# Access to Sites & Permitting

Legislative Assessment

# Development of a Permitting & Consenting Roadmap for Offshore H<sub>2</sub> production

- Regulatory framework for offshore H<sub>2</sub> projects yet to be developed!
  - Offshore brine production
  - Oxygen production; venting or dispose at sea.
  - Hydrogen production; HSE elements
- Wind vs Mining approach → where are the scope boundaries?
- Starting assumptions / questions from a project perspective:



# H<sub>2</sub>opZee assumes scopes can be divided into 4 components **Offshore** from a permitting perspective; applicable to both centralized and de-centralized H<sub>2</sub> generation options

## 1. Realisation wind turbines + inter-array cables to the “connection point”

- (Hydrogen) platform to replace TenneT Substation; amendments to the Offshore Wind Energy Act makes it possible for the ‘connection point’ to be an ‘installation’ other than the electrical TSO offshore → envisaged future applications to offshore H<sub>2</sub>

## 2. Transportation from the wind park to a platform:

- a) New array pipelines (+ cables?) if electrolysis takes place in the separate wind turbines (Decentral H<sub>2</sub> generation)
- b) Cable(s) if electrolysis takes place on a central platform (Central H<sub>2</sub> generation)

## 3. Realisation of a platform:

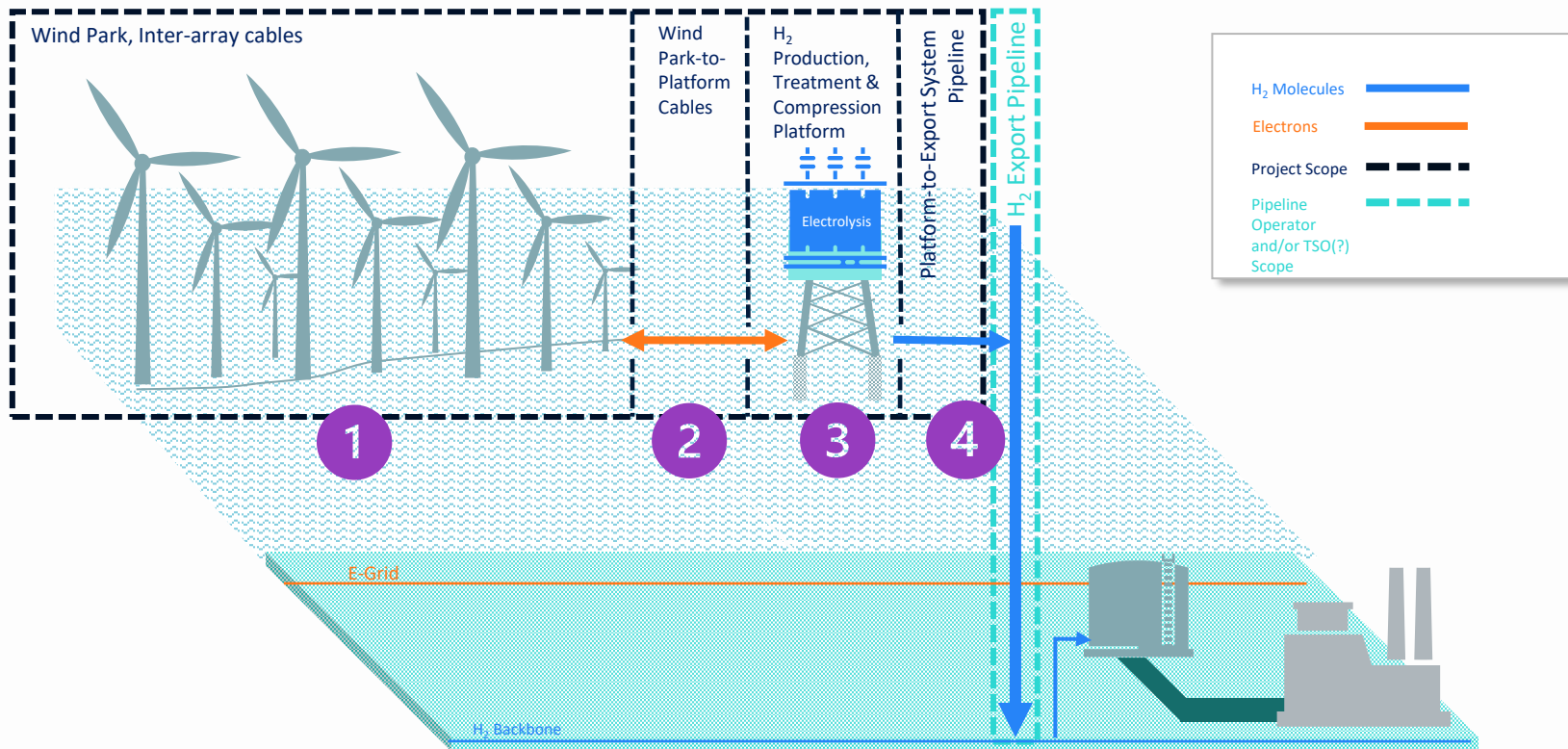
- a) New centralized H<sub>2</sub> production platform + H<sub>2</sub> treatment & compression (Centralized) or only H<sub>2</sub> treatment & compression (De-centralized)
- b) Re-use existing platform that will be fully accommodated for centralized H<sub>2</sub> production, treatment & compression (i.e. not a mining installation)
- c) Co-use existing platform for both centralized H<sub>2</sub> production and/or treatment & compression; and Mining (oil & gas) activities → [PosHYdon Example](#)

## 4. Transportation from a platform to Onshore facilities (i.e. export infrastructure) – *expected future TSO Scope(?)*:

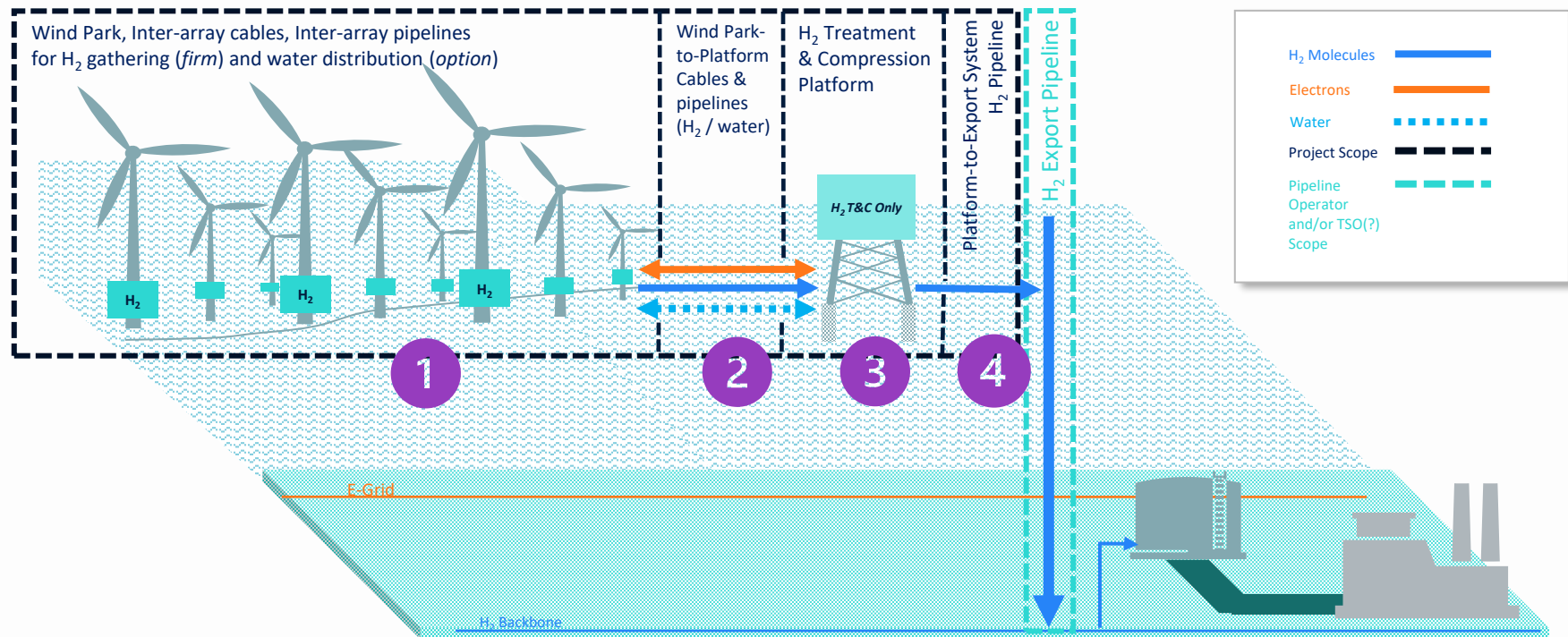
- a) A new pipeline
- b) Re-/co-use and existing pipeline – potentially requires a new pipeline to connect to the main H<sub>2</sub> trunkline

- *Requirements for Onshore reception facilities not evaluated at this stage – [learnings from recent Porthos ruling to be considered!](#)*

## H<sub>2</sub> from Offshore Wind → Expected Permitting boundaries for a **Centralized** H<sub>2</sub> Production System



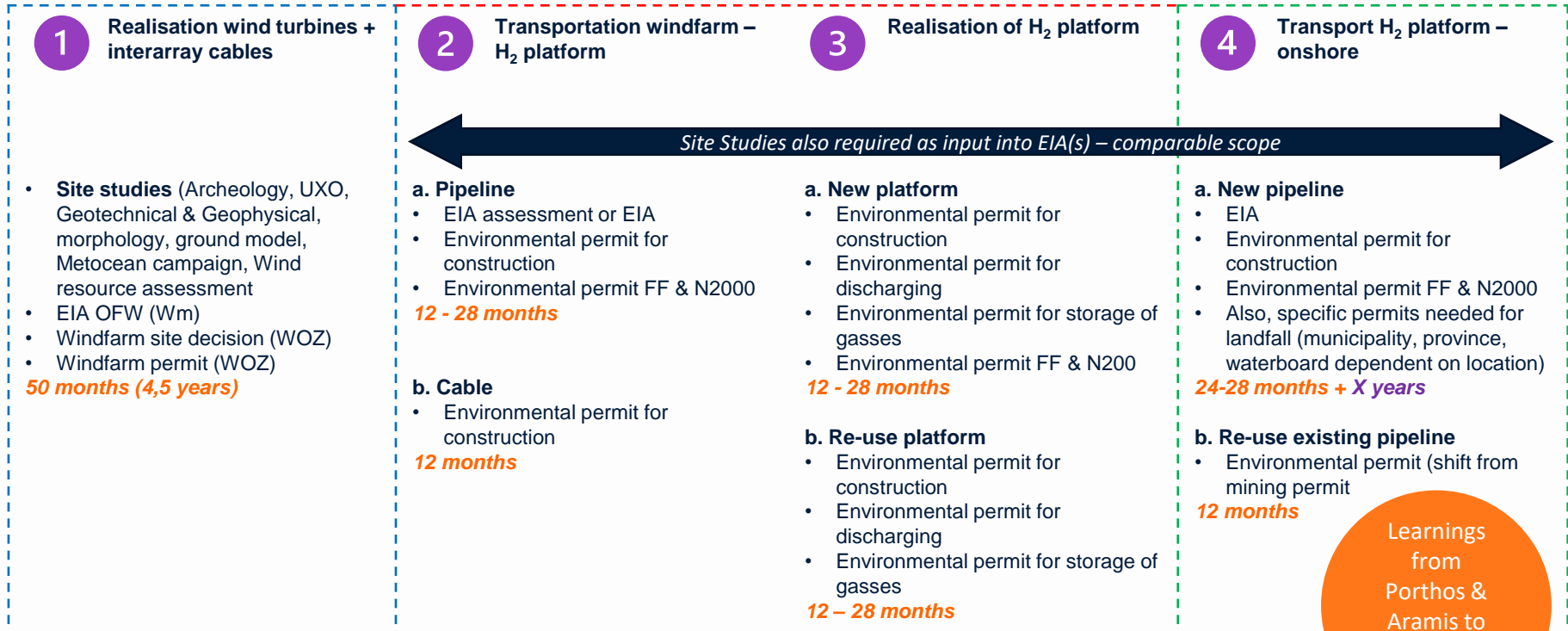
## H<sub>2</sub> from Offshore Wind – Expected Permitting boundaries for a **De-centralized** H<sub>2</sub> Production System



# Which studies & permits does a project like H<sub>2</sub>opZee need?

Project Understanding based on existing legislation; including high level lead times

Assumed RVO Scope  
Assumed H<sub>2</sub>opZee Scope  
Assumed future Offshore TSO Scope?

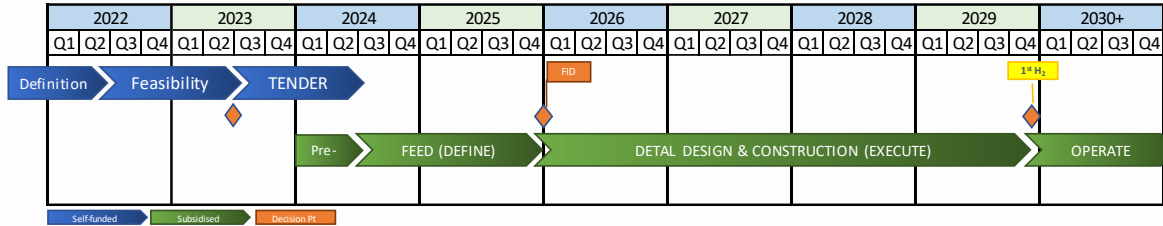


Learnings from Porthos & Aramis to be considered

This overview is based on the Environmental act to enter into force in the course of 2023; but even with current legislation no big changes in lead times expected  
For most permits **Rijkswaterstaat Zee en Delta** is the competent authority on behalf of the Minister of Infrastructure & Water Management. For flora and fauna activities and Natura 2000 activities, the **Minister of Agriculture, Nature and Food Quality (ANFQ)** is the competent authority.

# Impact of Permitting on delivery of first H<sub>2</sub>– based on understanding of existing (Wind) framework

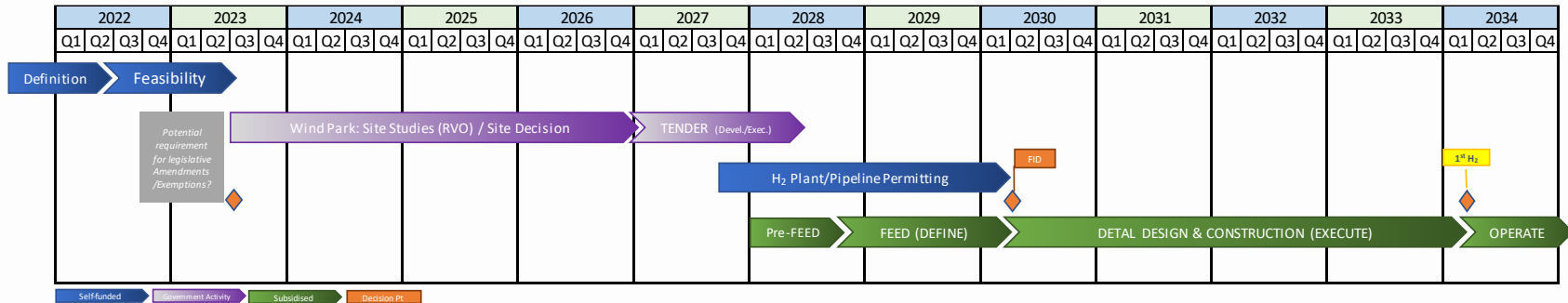
## Project Aspiration – 1<sup>st</sup> H<sub>2</sub> before 2030



No time to waste

Options for an integrated/stream lined approach possible(?)

## Current understanding based on existing legislation





**RWE**

  
**NEPTUNE**  
ENERGY

  
**TKI WIND OP ZEE**  
Topsector Energie