



**TNO** innovation  
for life

**SHIP>NL**  
**SUSTAINABLE HYDROGEN IMPORT PROGRAM**

## » AGENDA

### SHIP>NL SESSIE V 17 MEI 2023

**15:00-15:30** WELKOM EN TOUR DE TABLE

**15:30-16:15** DEEP DIVE: PRE-FEASIBILITY STUDIE NH<sub>3</sub> KRAKEN IN DE ROTTERDAMSE HAVEN | M STOELINGA POR

**16:15-17:00** DEEP DIVE: DE ROL VAN IMPORTTERMINALS EN DE BENODIGDE INFRASTRUCTUUR NAAR HET  
ACHTERLAND | KOOLE TERMINALS, EVOS, GASUNIE

**17:00-18:00** AFSLUITING EN BORREL

# MEERJARIG KENNISPROGRAMMA MET 5 LIJNEN

## In deze sessie:

1 Technisch economisch	2 Beleid	3 Markt	4 Internationaal	5 Omgeving
<ul style="list-style-type: none"> <li>Inzicht in importketens productie-conversie-transport-opslag-reconversie-gebruik</li> <li>Vraagontwikkeling, scenario's</li> <li>Infrastructuur &amp; systeemintegratie: corridors, benutten bestaande infra.</li> <li>Technology assessments, R&amp;D</li> </ul>	<ul style="list-style-type: none"> <li>Impact van 'Fit for 55', REDII, Delegated acts, ETS/CBAM, etc.</li> <li>Impact van certificering en CO2 allocatie: emissiefactoren, LCA ketenanalyse, etc.</li> <li>Financiering en stimulering (EU &amp; NL): IPCEI, PCI, TEN-E, JTF, EIB, Horizon Europe, MOOI, DEI, MIEK, SDE++, etc</li> </ul>	<ul style="list-style-type: none"> <li>Marktmodellen: bilaterale contracten, vrije handel, waterstofbeurs</li> <li>Internationale handelsstromen: verwachte vraag- en aanbodvolumes en transportstromen</li> <li>Importtarieven, trade agreements en handelsbeperkingen, WTO, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Samenwerking met omringende EU/niet-EU importlanden om corridors te ontwikkelen</li> <li>Concurrentie met omringende EU/niet-EU importlanden</li> <li>Geopolitieke aspecten: strategische voorraden, afhankelijkheid, politieke stabiliteit van exportlanden</li> </ul>	<ul style="list-style-type: none"> <li>Ruimtegebruik van ketenelementen</li> <li>Veiligheid: brandbaarheid, zorgwekkende stoffen, risicocontouren, etc</li> <li>Milieu: stikstof, lekkage</li> <li>Maatschappelijke acceptatie</li> <li>MVO / samenhang met SDG's in exportlanden</li> </ul>

## Synthese

## 'HUISREGELS'

- Telefoon op 'stil'; laptop gesloten
- Vragen? Steek je hand op!
  - › De moderator zorgt ervoor dat je vraag beantwoord wordt (eventueel achteraf).
- Slides worden na de sessie gedeeld en zijn beschikbaar op onze website:

[SHIPNL: Sustainable Hydrogen Import Program Netherlands | Nationaal Waterstof Programma](#)

- We bespreken uiteraard geen marktgevoelige zaken.
- Chatham house rules: De besproken informatie mag gedeeld worden, maar zonder de spreker te onthullen.

## ACTUALITEITEN | TOUR DE TABLE



# DEEP DIVE: PRE-FEASIBILITY STUDIE NH<sub>3</sub> KRAKEN IN DE ROTTERDAMSE HAVEN

Mark Stoelinga | Port of Rotterdam

# ROTTERDAM: EUROPE'S HYDROGEN HUB



Mark Stoelinga, Ship>NL, May 2023

# PORT OF ROTTERDAM FACTS 2023



AWARDED BEST  
PORT INFRASTRUCTURE



€63 BILLION  
ADDED VALUE,  
8.2% OF DUTCH BBP

100.000  
INLAND  
VESSELS  
PER YEAR

30.000  
SEA-GOING  
VESSELS  
PER YEAR

42 KM  
PORT AREA



4 CRUDE OIL  
REFINERIES



45 PETROCHEMICAL  
COMPANIES



4 VEGETABLE OIL  
REFINERIES



3 BIOFUEL PLANTS



CURRENT HYDROGEN  
PRODUCTION 0,4-0,5 MTON



13% OF TOTAL  
EU ENERGY CONSUMPTION  
PASSES ROTTERDAM



GATEWAY TO A MARKET OF  
440 MILLION CONSUMERS



LARGEST EUROPEAN PORT



565.000  
DIRECT & INDIRECT JOBS



# ENERGY TRANSITION BASED ON 4 PILLARS

PILLAR

**1**

**EFFICIENCY AND  
INFRASTRUCTURE**

PILLAR

**2**

**A NEW ENERGY  
SYSTEM**

PILLAR

**3**

**A NEW FEEDSTOCK  
AND FUEL SYSTEM**

PILLAR

**4**

**SUSTAINABLE  
TRANSPORT**

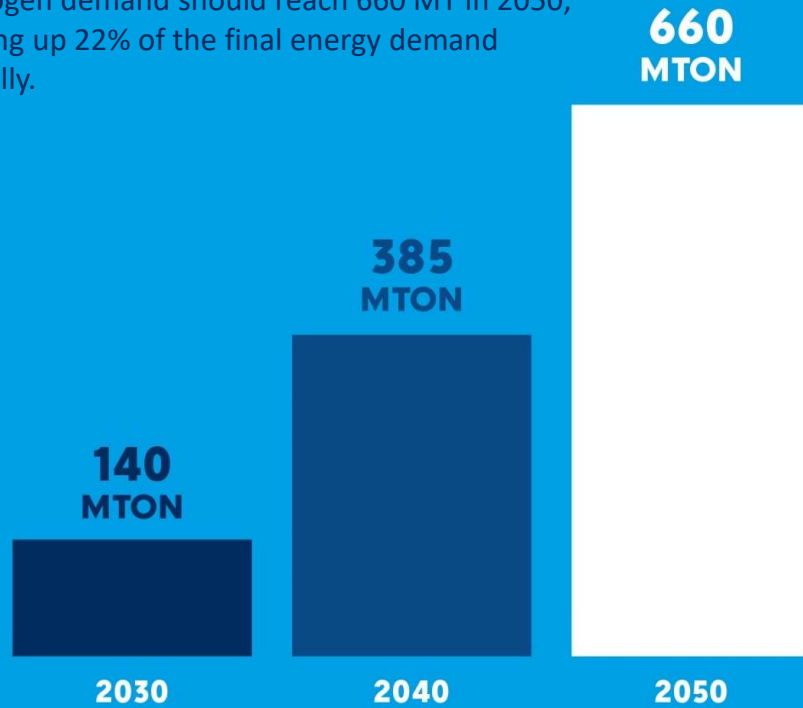
**-55% CO<sub>2</sub> IN 2030**  
(COMPARED TO 1990)

**CO<sub>2</sub> NEUTRAL IN 2050**

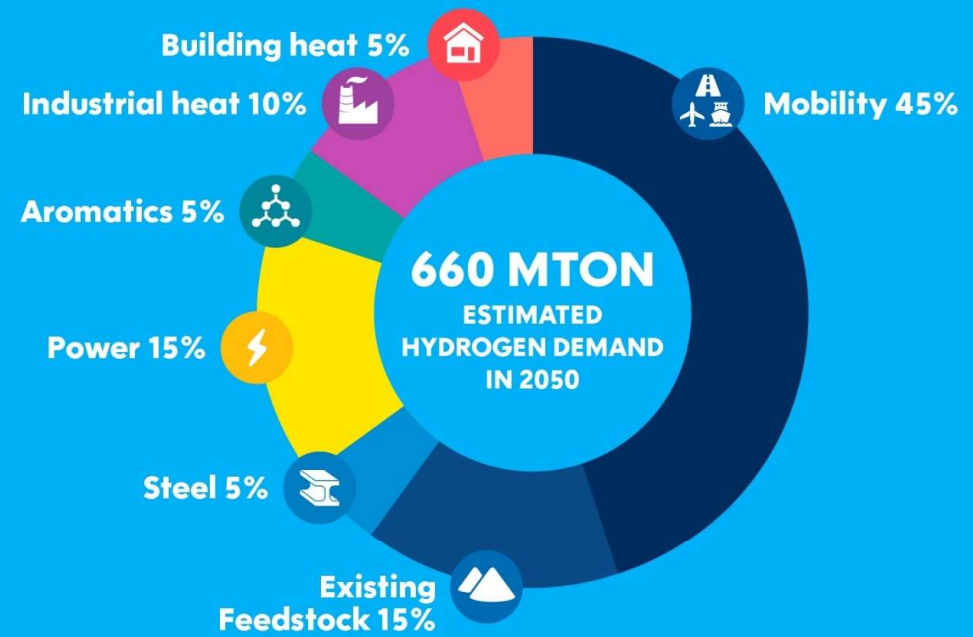
# FORECAST DEMAND & USE OF HYDROGEN WORLDWIDE

## THE GLOBAL HYDROGEN MARKET IN 2050

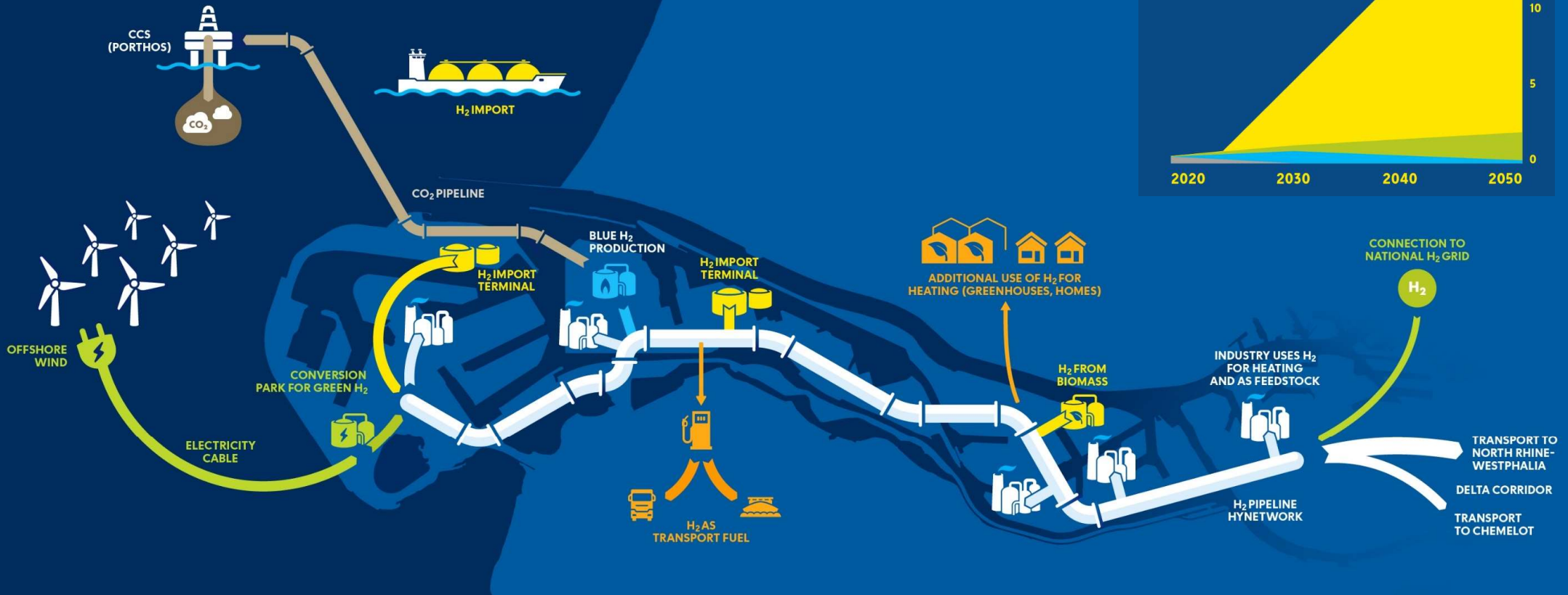
To meet net-zero targets, long-term hydrogen demand should reach 660 MT in 2050, making up 22% of the final energy demand globally.



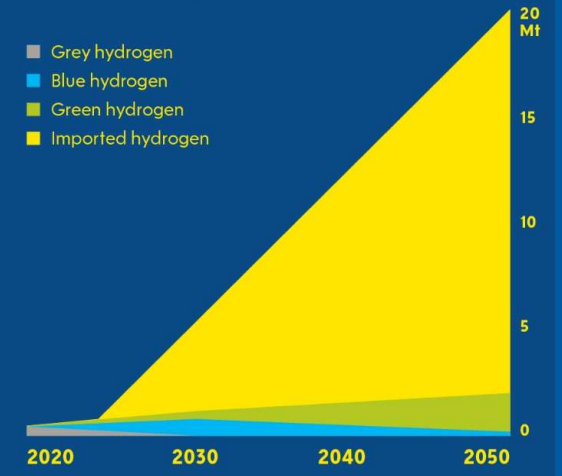
Source: Hydrogen Council, McKinsey & Company, Hydrogen for Net-Zero (2021)



# HYDROGEN ECOSYSTEM IN ROTTERDAM








EXPECTED H<sub>2</sub> VOLUMES

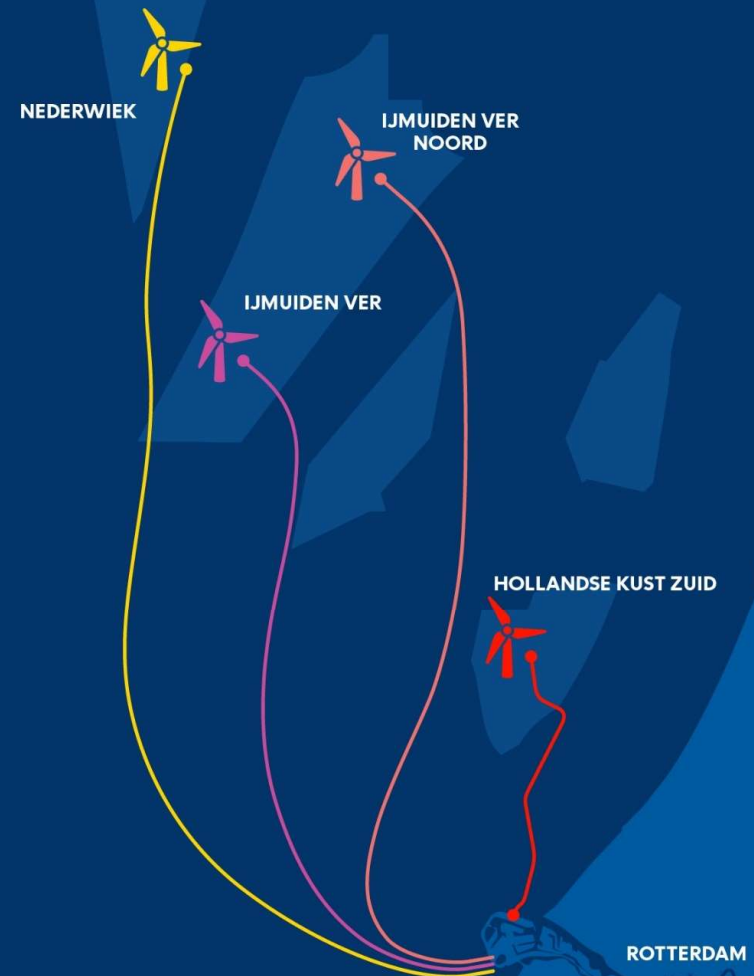


# 7.4 GW WINDFARMS NORTH SEA CONNECTED TO ROTTERDAM BY 2030

7.4 GW = 35% of all windpower projects in the Dutch part of the North Sea. These projects are to be realized by 2030.

Dutch ambition is to have 70 GW installed in 2050. Rotterdam aims to connect 25 GW = 35% to the port.

WINDFARMS		CAPACITY	OPERATIONAL
Hollandse Kust Zuid, kavel 1-4		1.4 GW	2023 
IJmuiden Ver, kavel 3-4		2 GW	2029
IJmuiden Ver Noord, kavel 5-6		2 GW	2029
Nederwiek, kavel 2		2 GW	2030
Total		7.4 GW H <sub>2</sub> production: 2-2,5GW	



# GREEN HYDROGEN PRODUCTION STARTS AT A DEDICATED SITE FOR ELECTROLYSIS

## Ambition Rotterdam

2030: 2.5GW (onshore)

2050: 20GW (onshore & offshore)

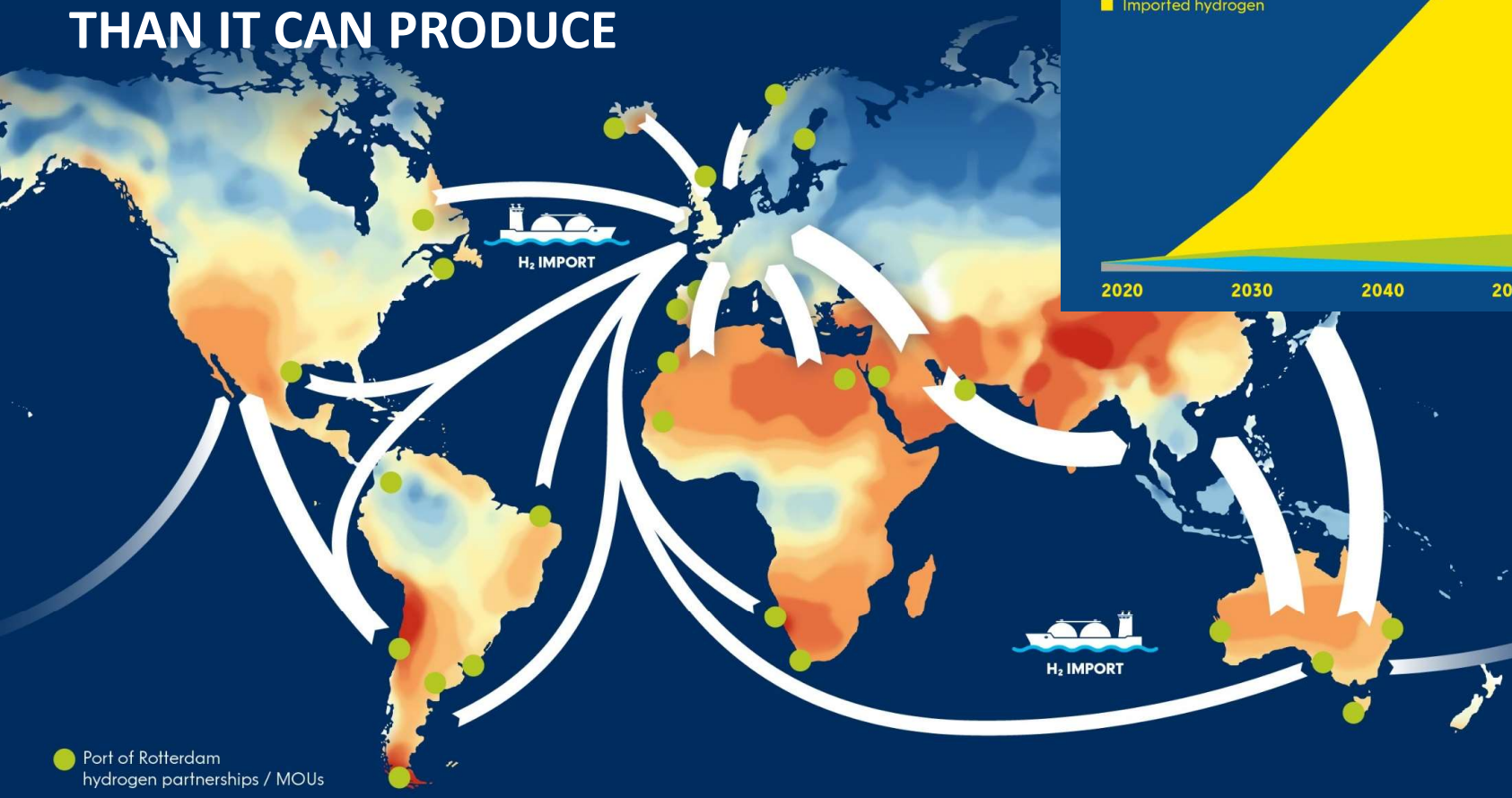


### Conversion park 1

COMPANY	CAPACITY	PLANNED FID	OPERATIONAL
bp & HYCC: H2-Fifty	250MW	2023	Q2 2025
Shell: Holland Hydrogen 1	200MW	2022	Q2 2024
Air Liquide: CurtHyl	200MW	2023	2024–2025
Not announced	200MW	2024	2025–2026

COMPANY	CAPACITY	PLANNED FID	OPERATIONAL
Uniper: H2Maasvlakte	100-500MW	2023–2028	2025–2030

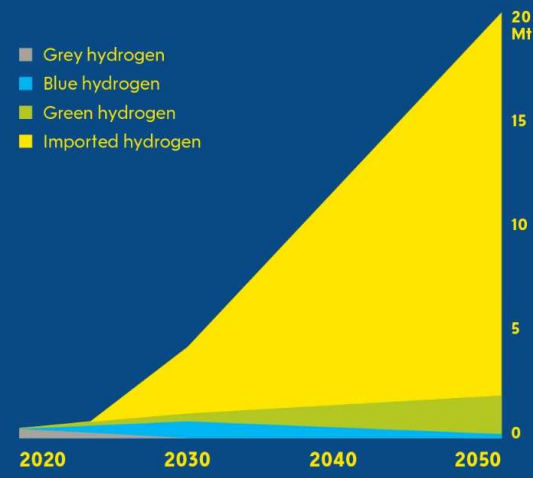
# IMPORTS ARE ESSENTIAL, AS EUROPE USES MORE ENERGY THAN IT CAN PRODUCE



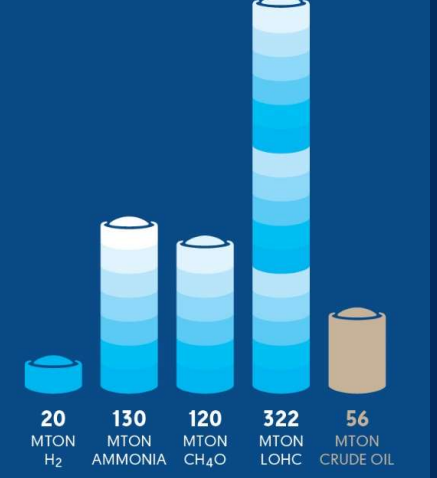
● Port of Rotterdam  
hydrogen partnerships / MOUs

## EXPECTED H<sub>2</sub> VOLUMES

- Grey hydrogen
- Blue hydrogen
- Green hydrogen
- Imported hydrogen



## WEIGHT



Imports are expected to start around 2025 in Rotterdam.

Hydrogen will come in a range of forms, with different weights and volumes.

# PORT OF ROTTERDAM IS READY TO RECEIVE ALL TYPES OF CARRIERS

## Green ammonia

One existing terminal.  
5 new ammonia terminals announced.

## LOHC

Conversion of 2 existing terminals,  
first pilot in 2023.

## LH2

2 Feasibility studies for  
new terminal completed.  
Possible before 2030.

## Green methanol

Multiple existing terminals.  
Already a European methanol hub.

## Powders

Other technologies are also  
being explored (e.g. NaBH<sub>2</sub>).



Cracking facilities in study.

# 9 HYDROGEN TERMINAL PROJECTS ANNOUNCED

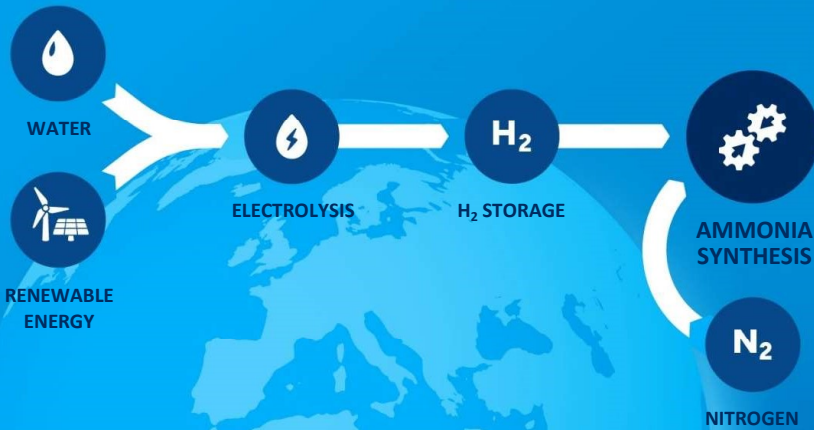
More initiatives expected





# AMMONIA VALUE CHAIN

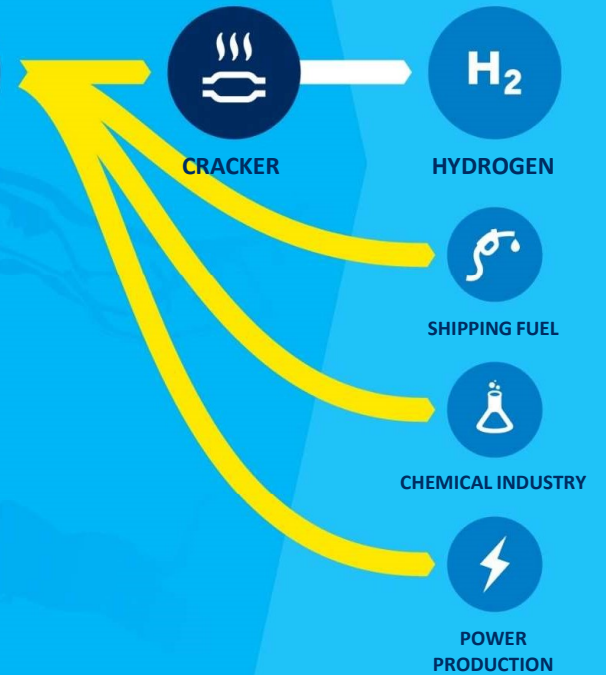
## NH<sub>3</sub> production



## Transportation

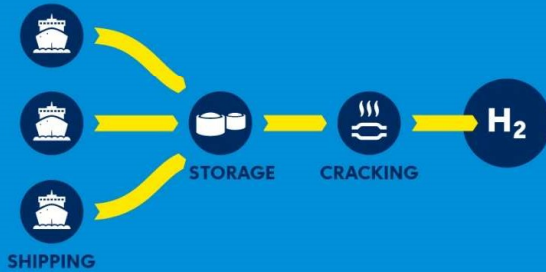




## Use



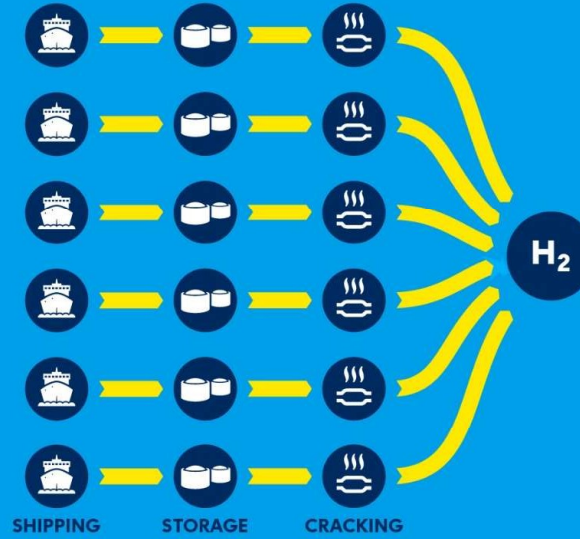
# THREE CONFIGURATIONS




## 1. Centralised



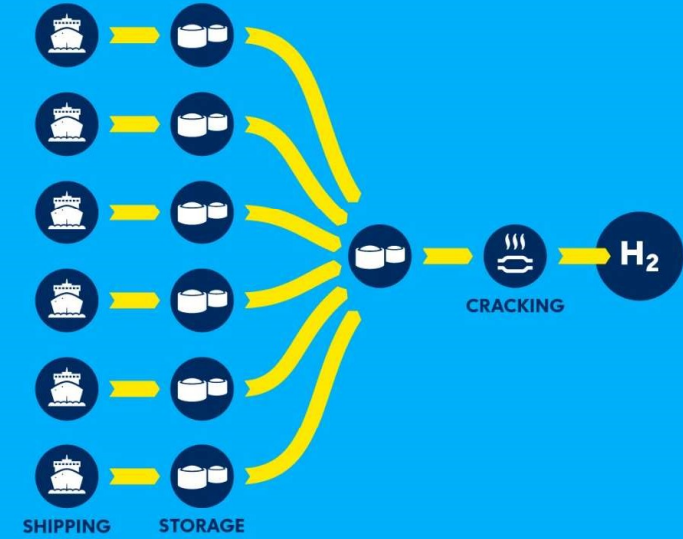
-  High investment
-  One large area
-  Meets safety standards




## 2. Decentralised



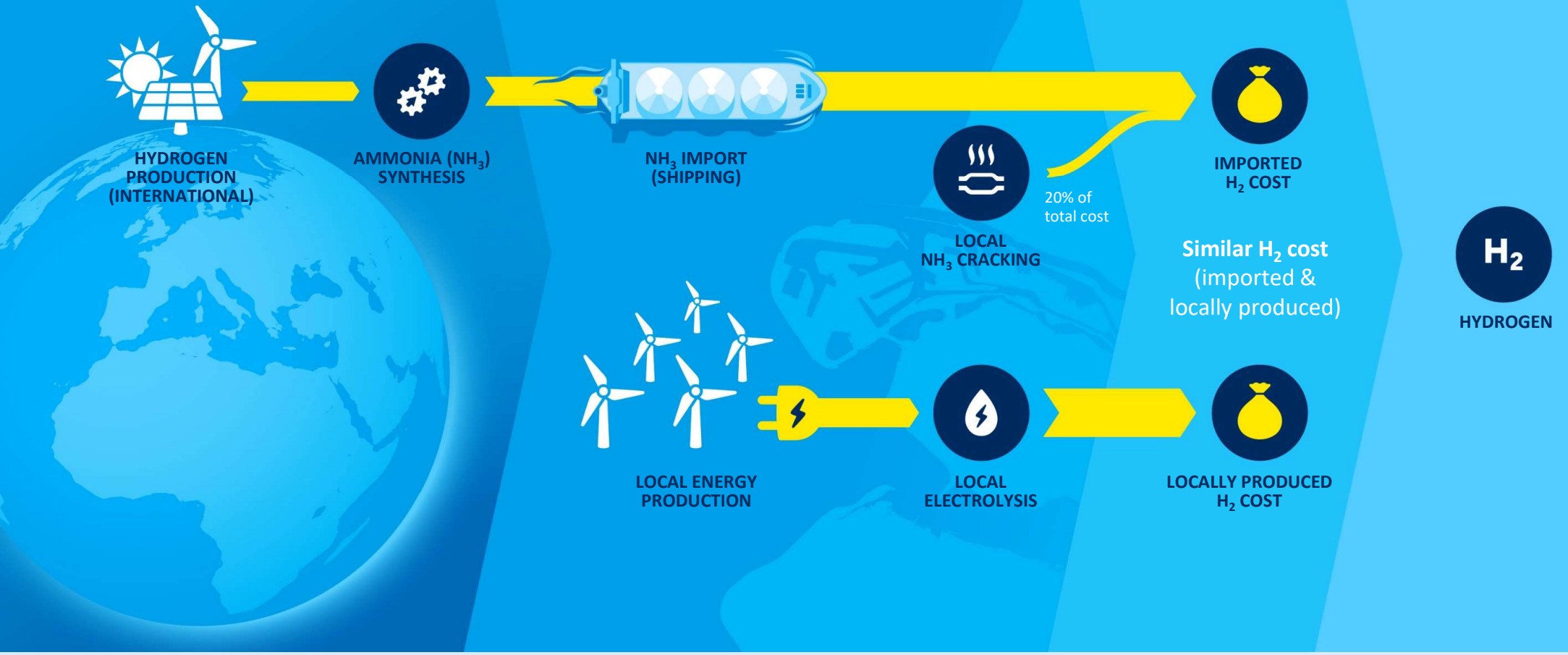
-  Very high investment
-  Several smaller area's (brownfield)
-  Meets safety standards

## 3. Mix



-  Very high investment
-  Combination of area's
-  Meets safety standards

# COST



# BOTH NEW & REFURBISHED NATURAL GAS PIPES ARE NEEDED

## HYNETWORK, PIPELINE ROTTERDAM



**LEGEND**

- Delta Rhine Corridor
- Possible extension Delta Rhine Corridor
- Hynetwork, new pipeline Rotterdam
- Hynetwork, existing natural gas pipelines (to be refurbished)
- Existing private hydrogen infrastructure (Rotterdam–Antwerp–Northern France)

# MULTIPLE HYDROGEN PROJECTS THROUGHOUT THE VALUE CHAIN



# WHAT IS NECESSARY ?



**Fast and reliable permitting**  
(incl. nitrogen regulations)



**A robust H<sub>2</sub> certification scheme for imports**



**Stimulation of demand and closing the financial gap with CO<sub>2</sub>-emitting alternatives**  
(like contracts for difference)



**Parallel development of public and private H<sub>2</sub> infrastructure**



**Financing run-up risks**  
(especially for infrastructure)



**Societal acceptance of new energy carriers**

# CONCLUSION



## Rotterdam is on track to be Europe's Hydrogen Hub

- 4.6 Mton hydrogen pledge for 2030
- Local production & imports
- Pipeline infrastructure connecting industrial clusters
- PoR asked by State to research import opportunities



## First projects are being built, many more upcoming

- FID's taken for 200 MW electrolysis, import terminal NH3
- Several FID's expected in 2023
- >20 MOU's regarding import



## Stimulating policies and regulations are needed

- Regulatory masterplan for permitting, stimulation of demand, certification, contracts for difference etc.

**20 Mton hydrogen =  
200 Mton CO<sub>2</sub>-reduction**

IT'S HAPPENING!



Offshore wind landfall



Pipes for Waterstofnetwerk Rotterdam



4.6 Mton H2 in 2030!



Building site Conversion Park



# DEEP DIVE: DE ROL VAN IMPORTTERMINALS EN DE BENODIGDE INFRASTRUCTUUR NAAR HET ACHTERLAND

Tamme Mekkes | Koole Terminals

# TOGETHER. DRIVING STORAGE FORWARD

SHIP>NL - THE HAGUE

17/5/2023



## **TAMME MEKKES**

### **BUSINESS DEVELOPMENT DIRECTOR**

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t.mekkes@koole.com

#### **RESPONSIBILITIES:**

- Commercial Growth Projects
- Terminal CO2 Reduction Projects
- Energy Transition and International Business
- Annual Capex of multi-100's of € mln

#### **BACKGROUND:**

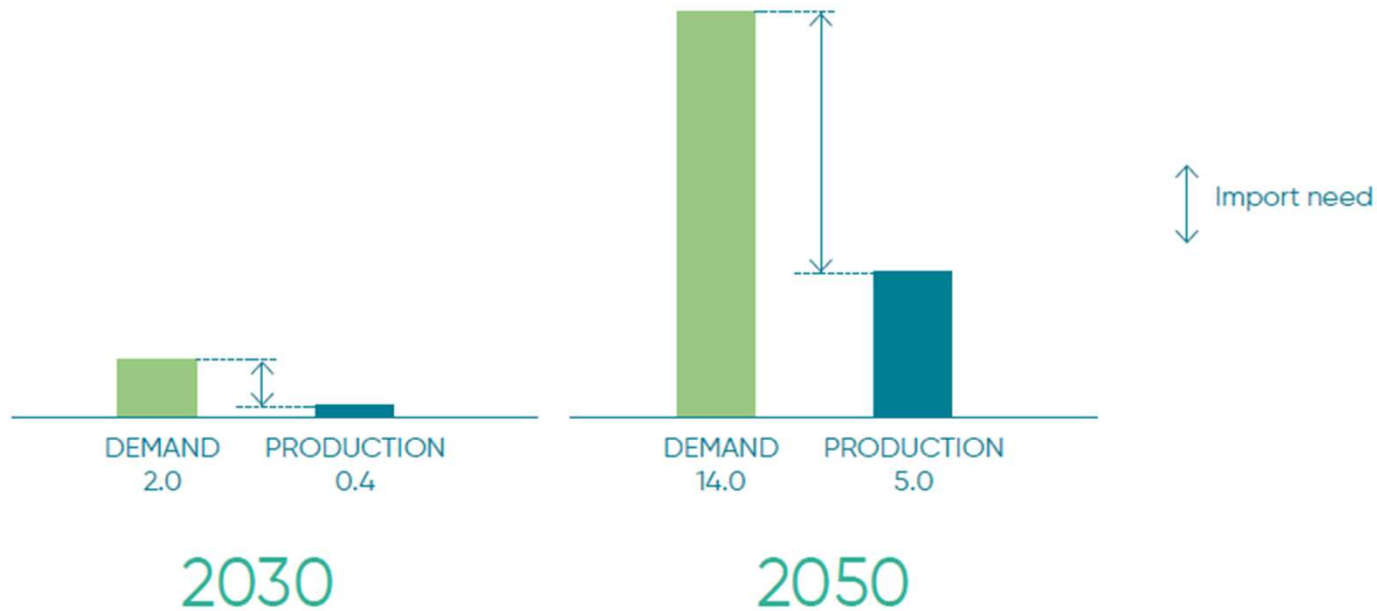
- Chief Commercial Officer – Attero Waste Management
- Associate Partner – OC&C Strategy Consultants
- MSc Business Administration – University of Twente
- MSc Applied Physics – University of Twente

# DEEP DIVE: DE ROL VAN IMPORTTERMINALS EN DE BENODIGDE INFRASTRUCTUUR NAAR HET ACHTERLAND

Bart van der Meer | Evos

# The need for green hydrogen imports

Green hydrogen deficit in the Netherlands in 2030 and 2050 (Mton/yr)



Source: Gasunie (2019), Gasunie & Tennet (2019), TKI Nieuw Gas (2018) & team analysis

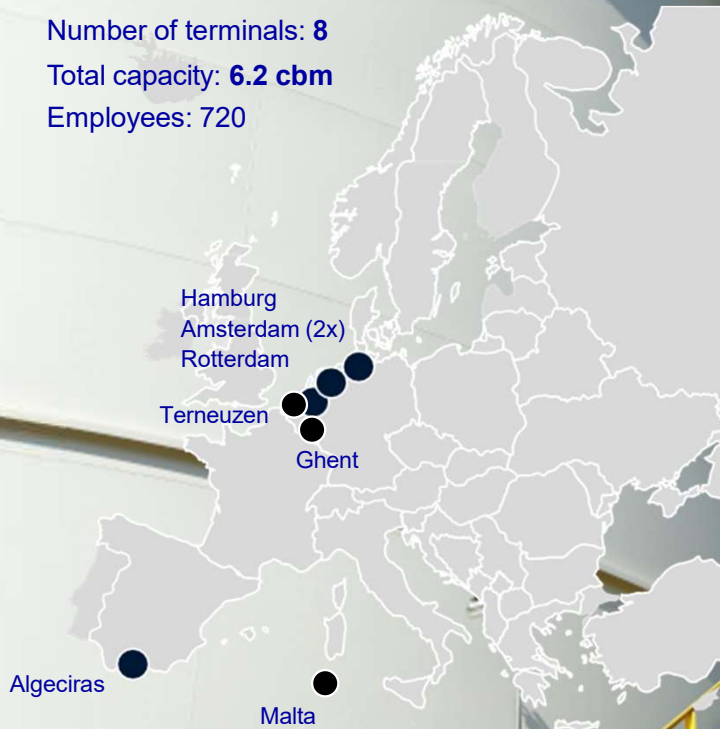
Importing one million  
tons of green hydrogen  
via the port of  
Amsterdam



Delivering the benefits of green hydrogen

## Presence in key European ports

Number of terminals: 8  
Total capacity: 6.2 cbm  
Employees: 720



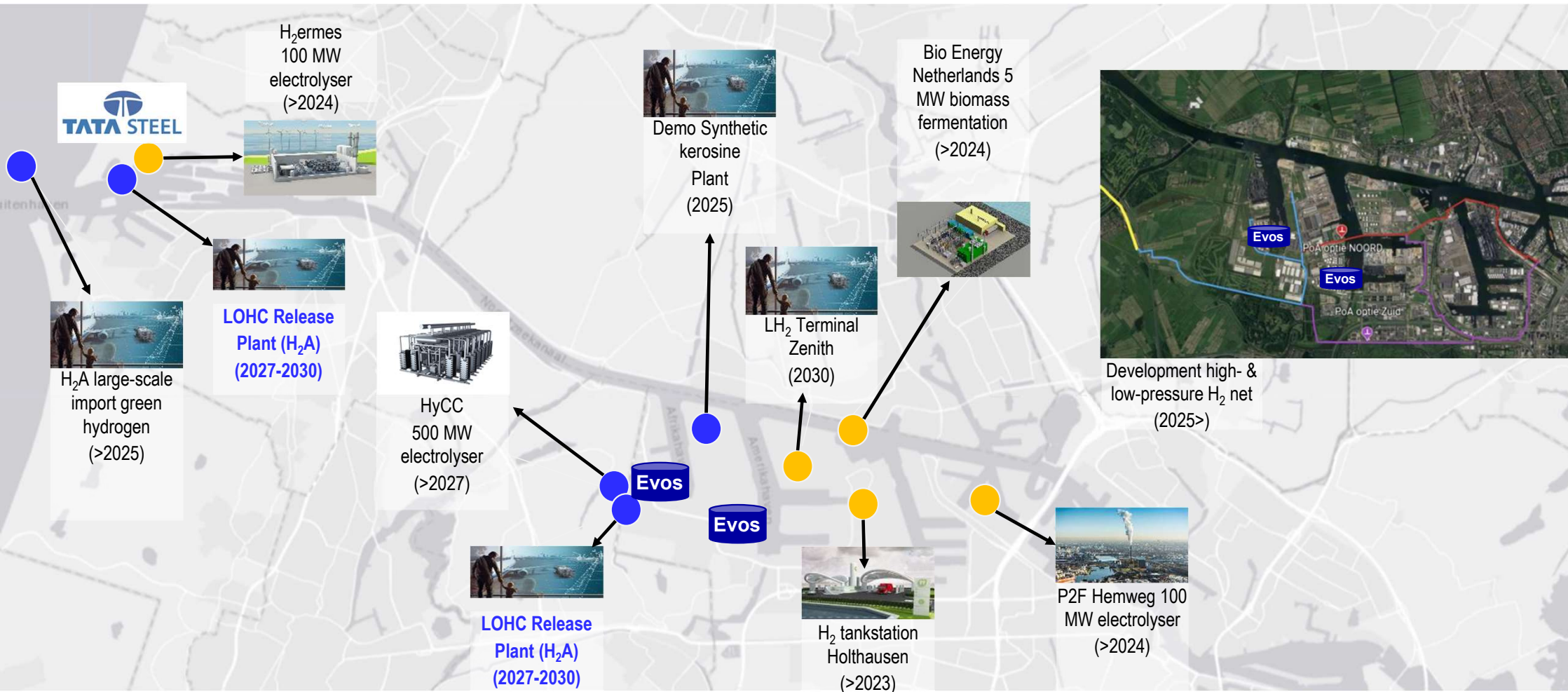
# EVOS

## Enabling essential flows – today and tomorrow

### Full product and service offering

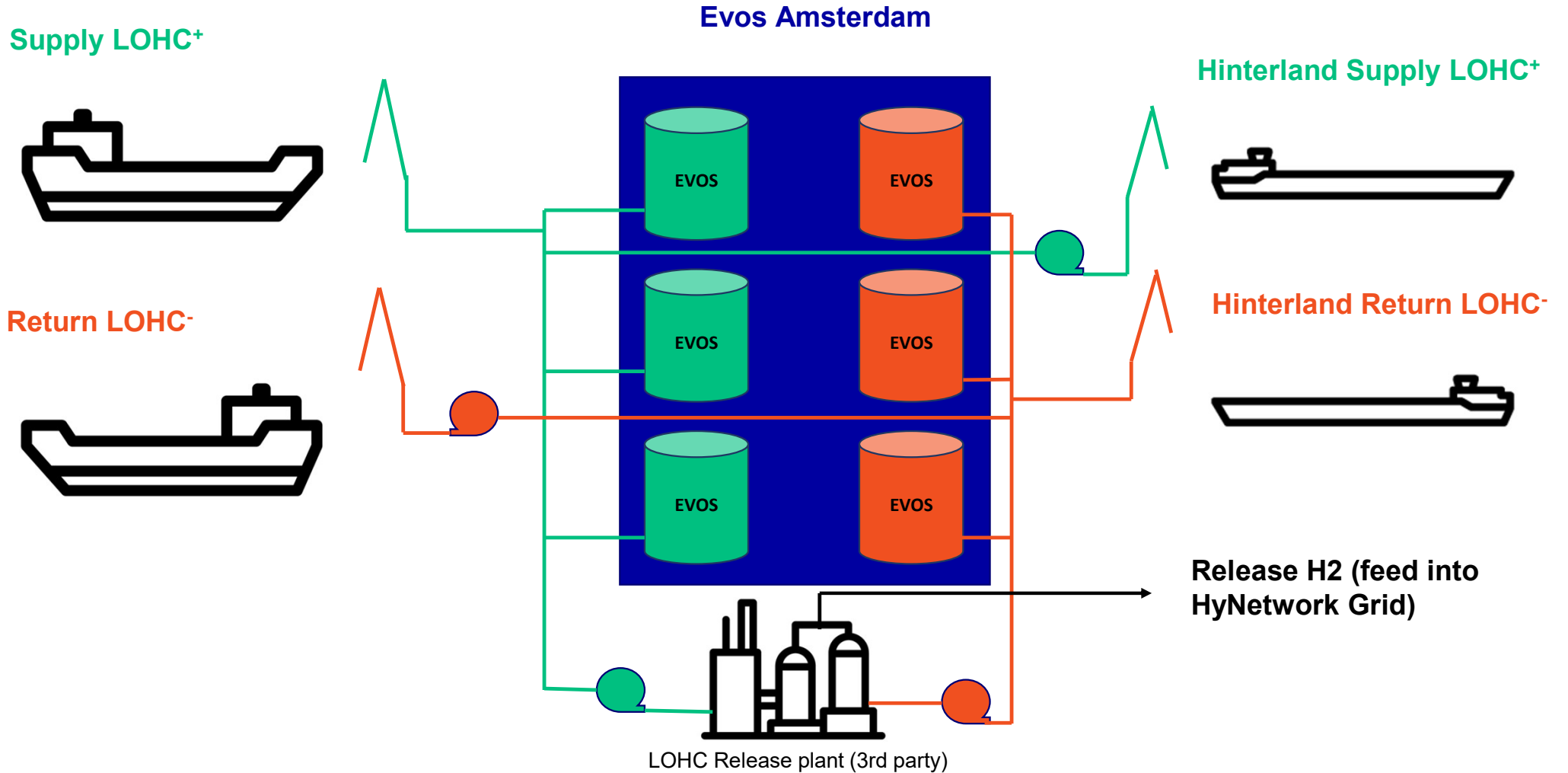
Gasoline	Methanol (incl. derivatives)	Blending
Diesel / Gasoil / Jet fuel	Bio chemicals and bio fuels	Additivation
Fuel oil	Base Oil	Homogenising
		Heating
Synthetic fuels	Hydrogen carriers	

# Hydrogen initiatives Port of Amsterdam



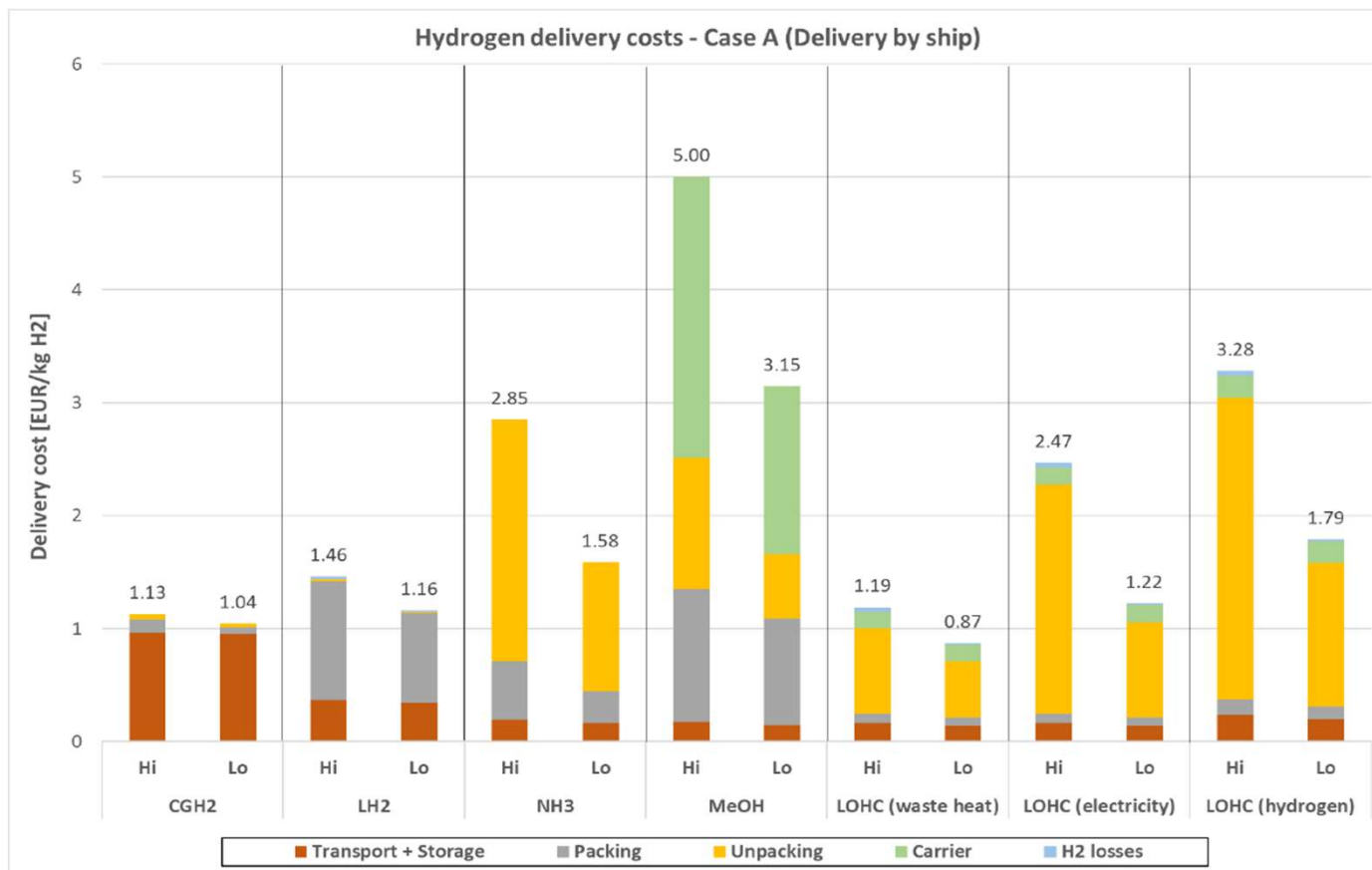


# LOHC Green Hydrogen carrier concept for Evos



# Cost Comparison

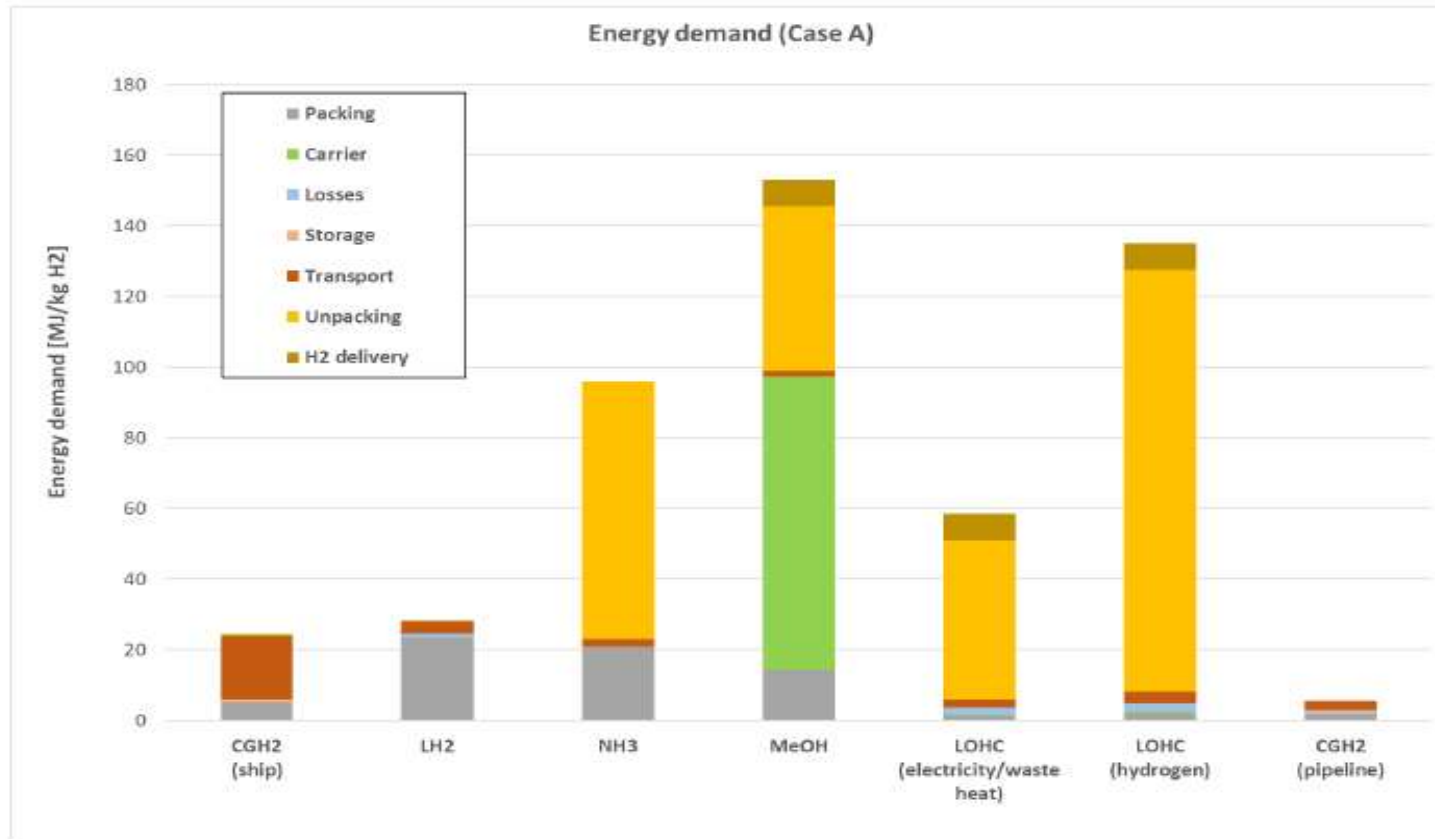
**Figure 7** Hydrogen delivery costs for Case A (delivery by ship). High and Low electricity prices for each carrier.



Source: [JRC Technical Report, Assessment of Hydrogen Delivery Options](#), Okt 2022



# Energy demand



Source: JRC analysis

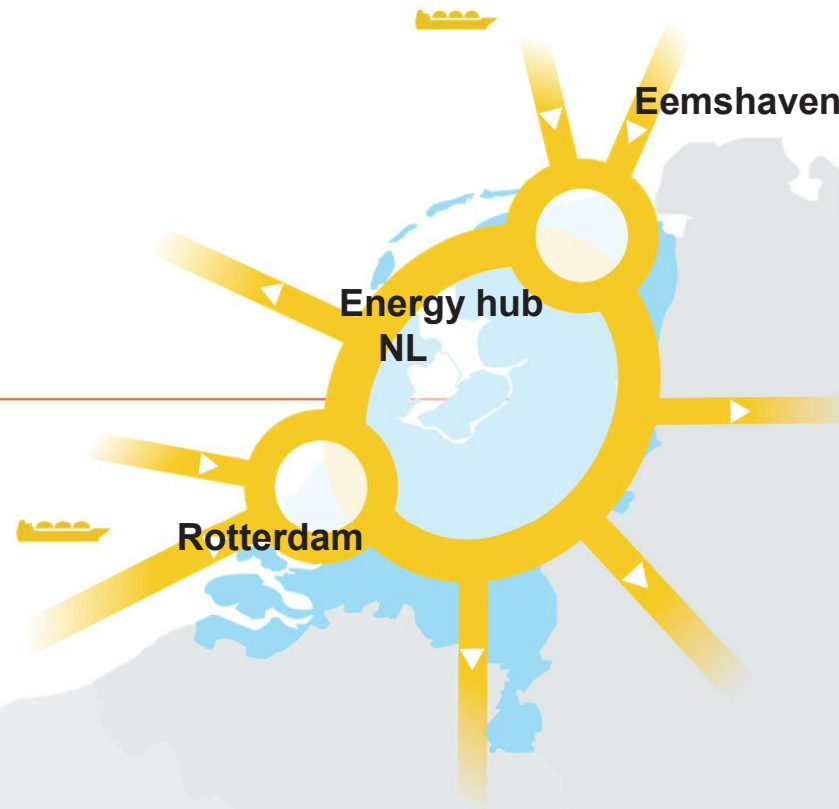
Source: [JRC Technical Report, Assessment of Hydrogen Delivery Options](#), Okt 2022

# DEEP DIVE: DE ROL VAN IMPORTTERMINALS EN DE BENODIGDE INFRASTRUCTUUR NAAR HET ACHTERLAND

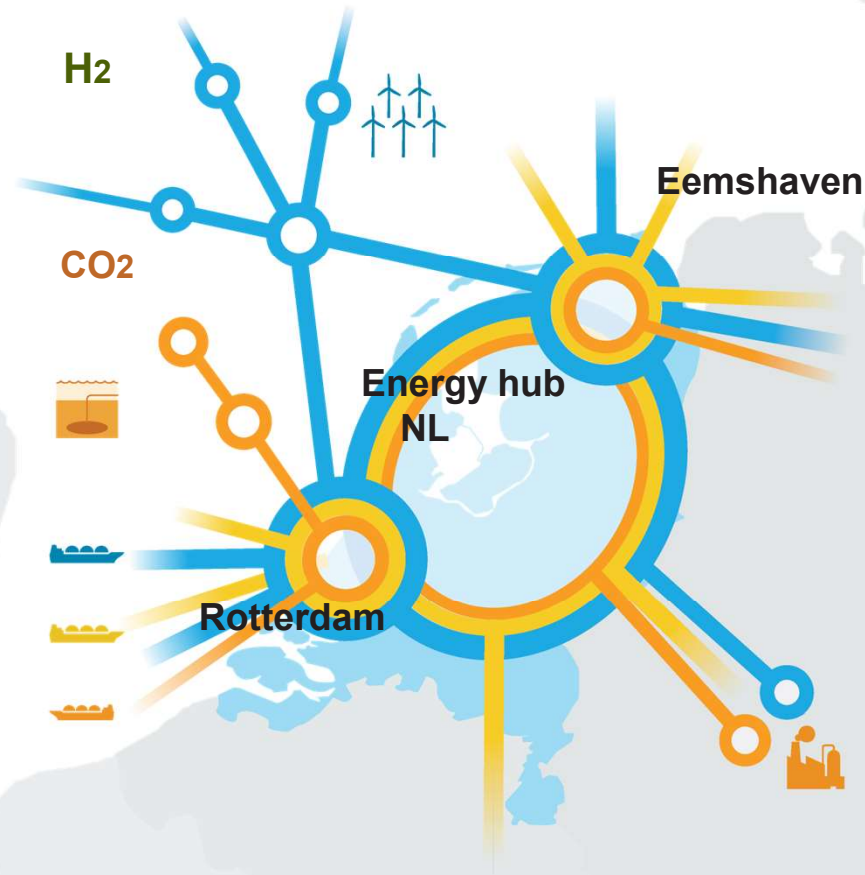
Johan Douma | Gasunie



# Now: Netherlands gas roundabout

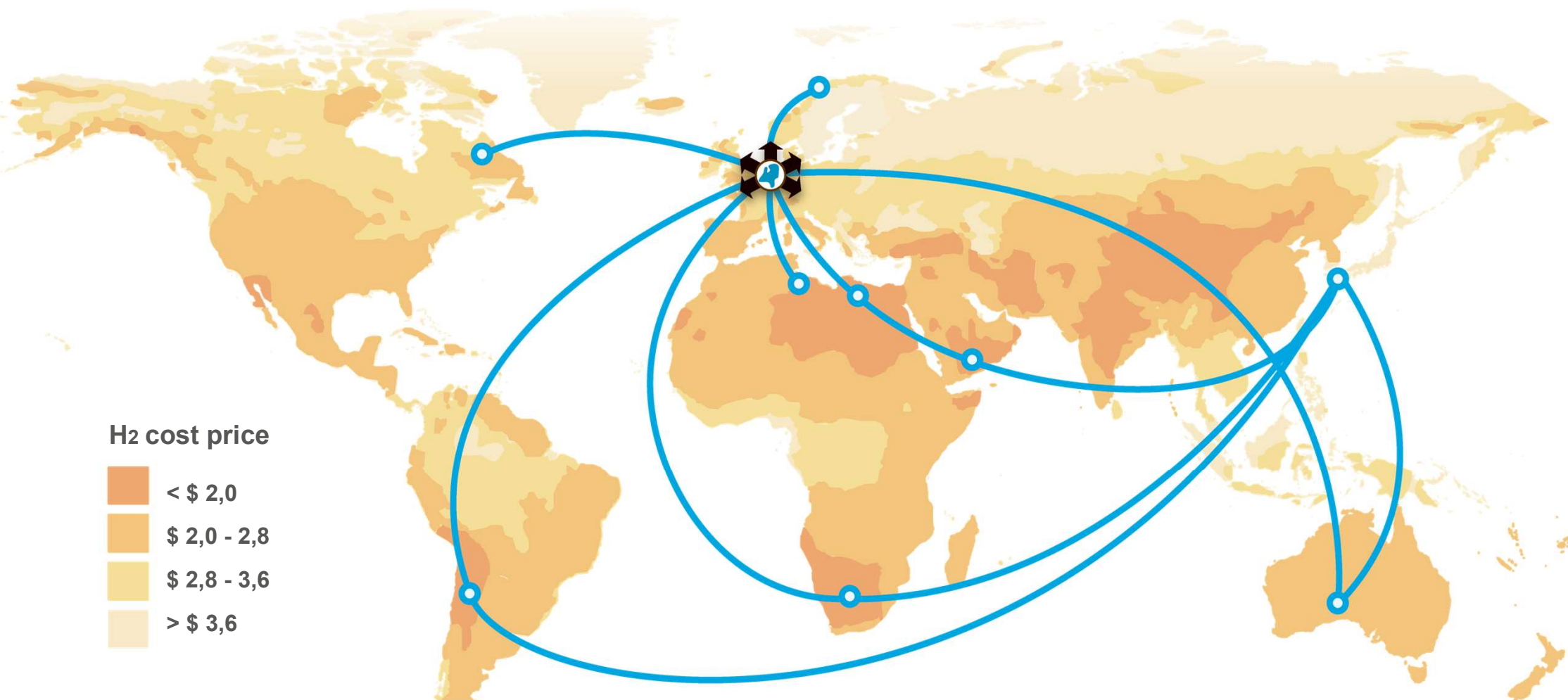
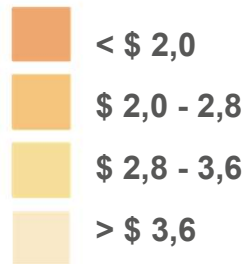


## Step 2: Transition renewable energy



## Step 3: Gate to Northwest Europe

### H<sub>2</sub> cost price





## *Gasunie has organized hydrogen development activities along four lines ('pillars')*

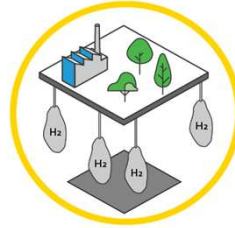
1

Transport



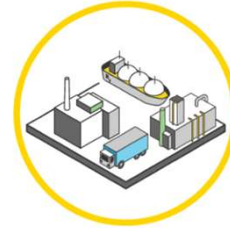
2

Storage



3

Import



4

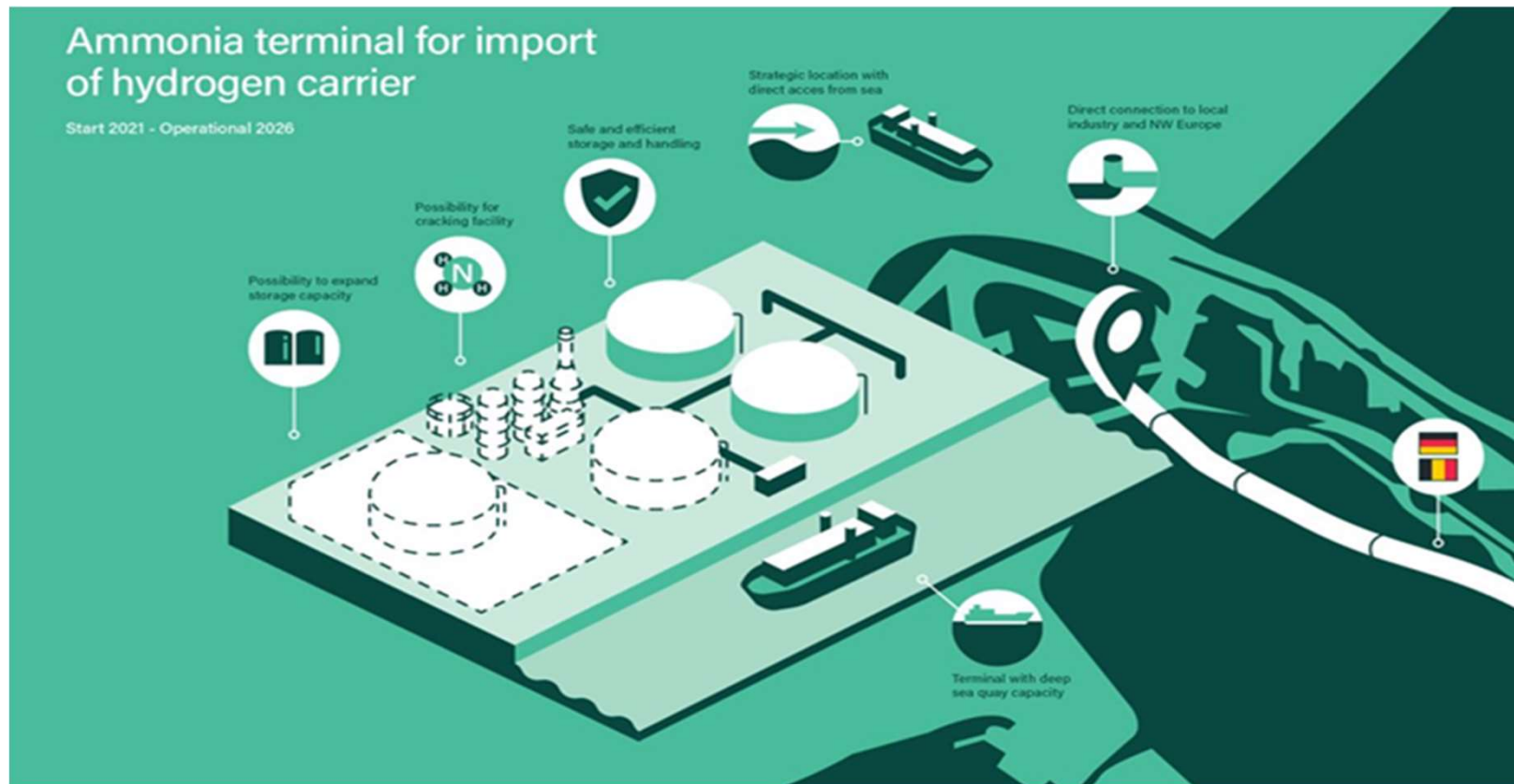
Offshore



# Hydrogen network 2030



## ACE Terminal – Rotterdam



# This is where hydrogen supply and demand come together

Match & Connect helps you securely and reliably connect with potential users (end users), producers or shippers (traders) of hydrogen from around the world.

[More information](#)

[Create an account now](#) ↗



# VOLGENDE KENNISSESSIE WOENSDAG 21 JUNI

**On-line, 16.00 – 17.00 uur**

- Voorlopige agenda 21 juni:
  - › Deep dive: Brief energiediplomatie en waterstof | Han Feenstra, Min.EZK
  - › Terugblik World Hydrogen Summit matchmaking sessie | David Koole, RVO
  
- Volgende F2E kennissessie op 5 juli
  - › Deep dive: CBAM
  - › Update: Routekaart Nationaal Waterstof Programma

## HARTELIJK DANK VOOR UW AANDACHT

Vragen? Of wil je iets delen met de groep tijdens een volgende sessie?

Neem gerust contact met mij op:

Monique Rijkers

[Monique.Rijkers@tno.nl](mailto:Monique.Rijkers@tno.nl)

+31 6 23 34 65 16