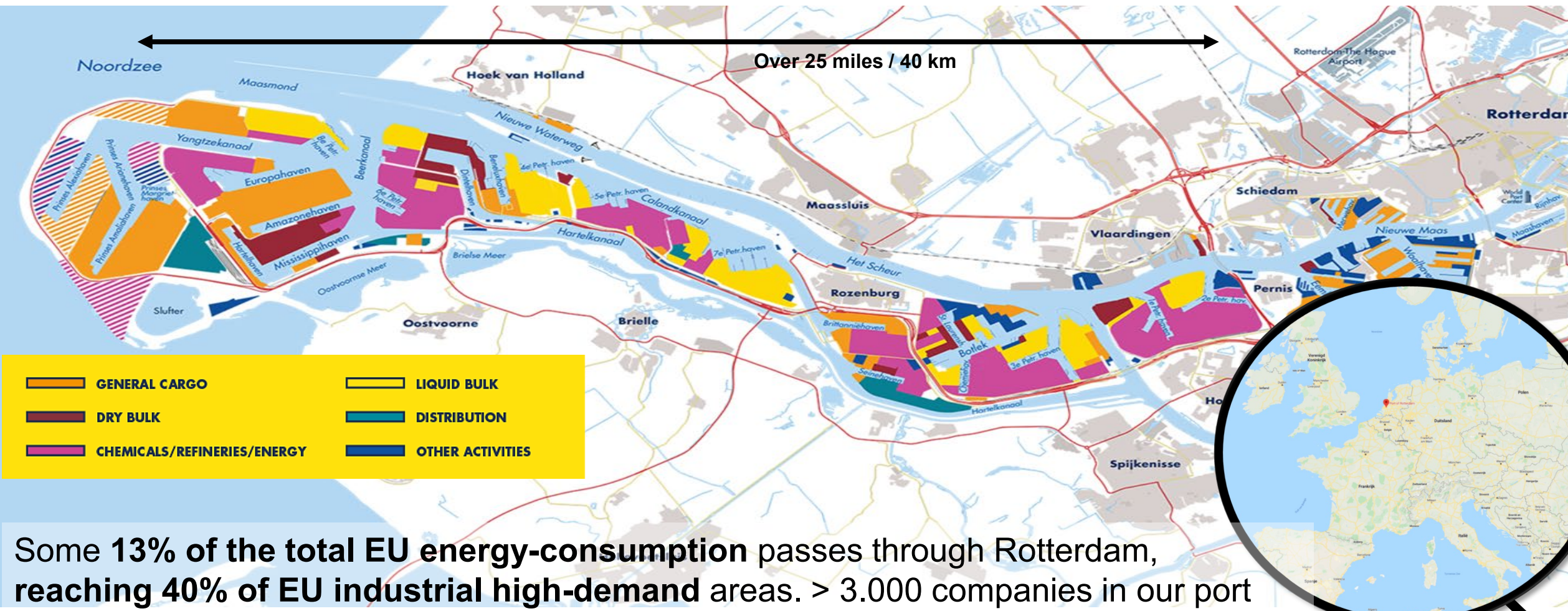


ROTTERDAM H2 HYDROGEN HUB 2020-2050

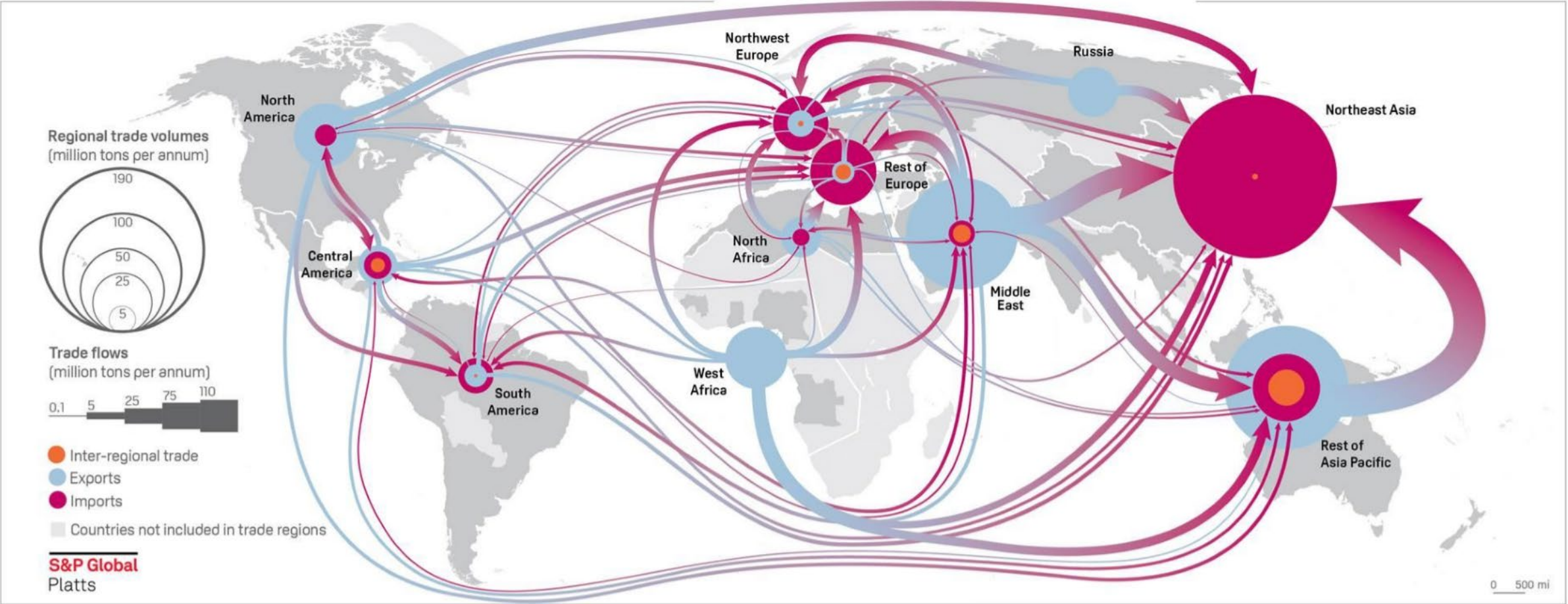
Monica Swanson

Hydrogen Vision Port of Rotterdam - The Supply Chain Puzzle

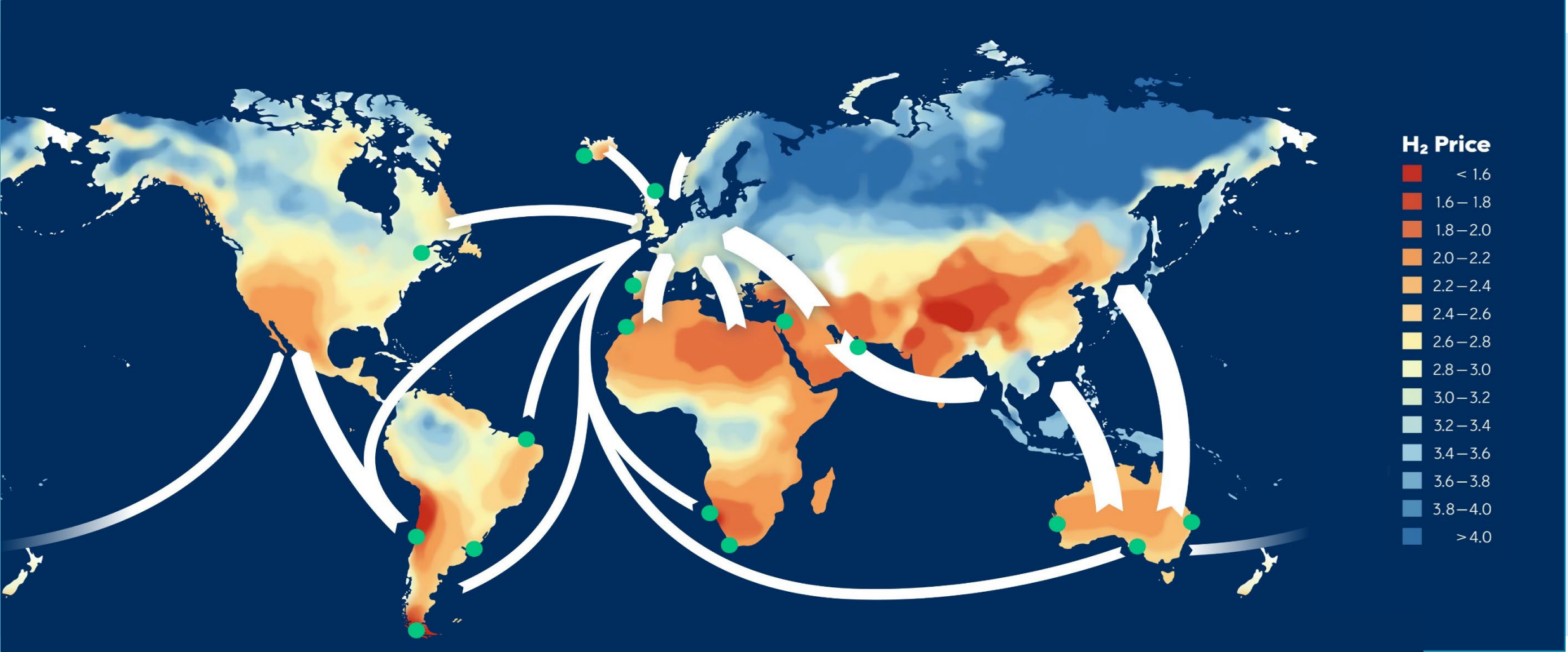
Port of ROTTERDAM - Energy hub of nw Europe



The World's Current oil and gas trade



Global Hydrogen supply Chains



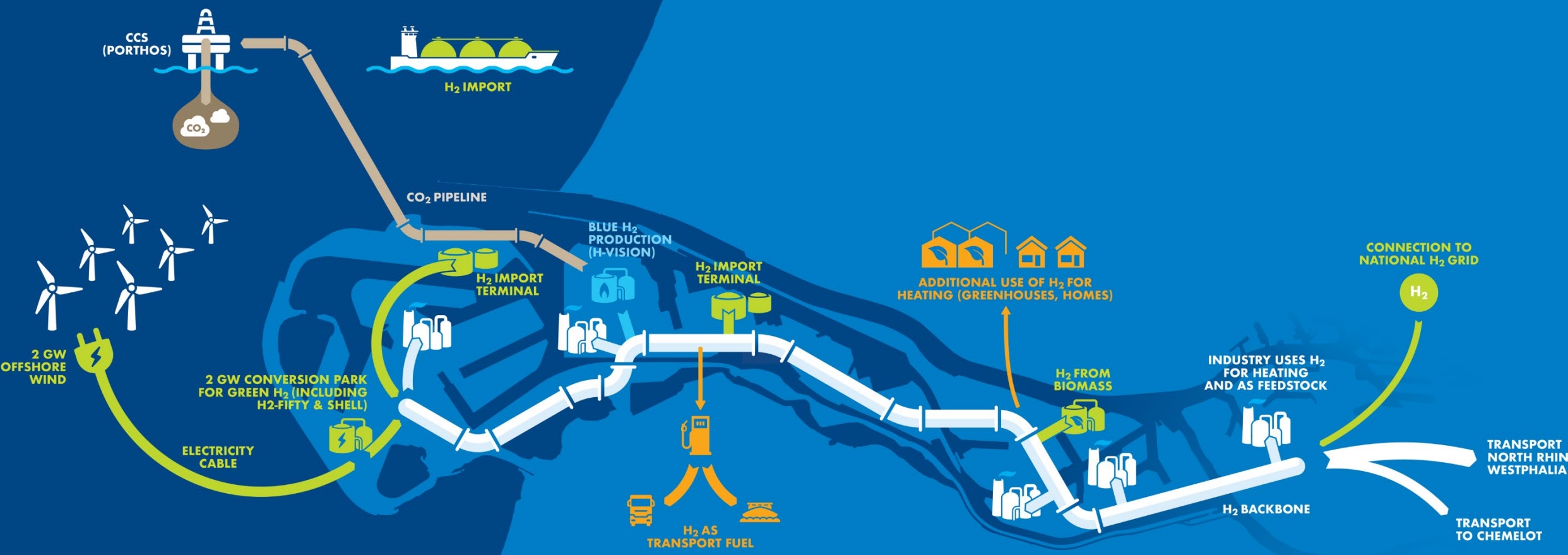
What does it mean to be a port in transition?



are we ready for change?



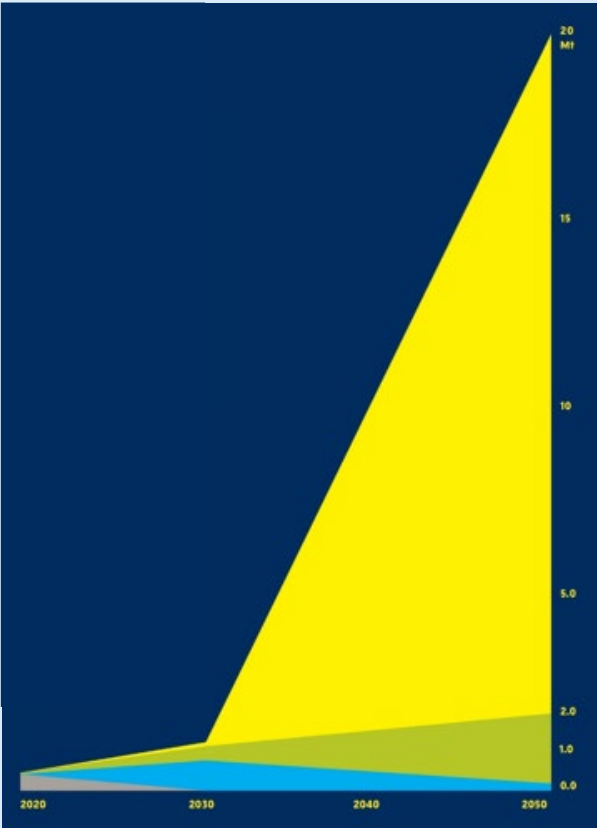
HYDROGEN ECONOMY IN ROTTERDAM STARTS WITH OPEN ACCESS BACKBONE



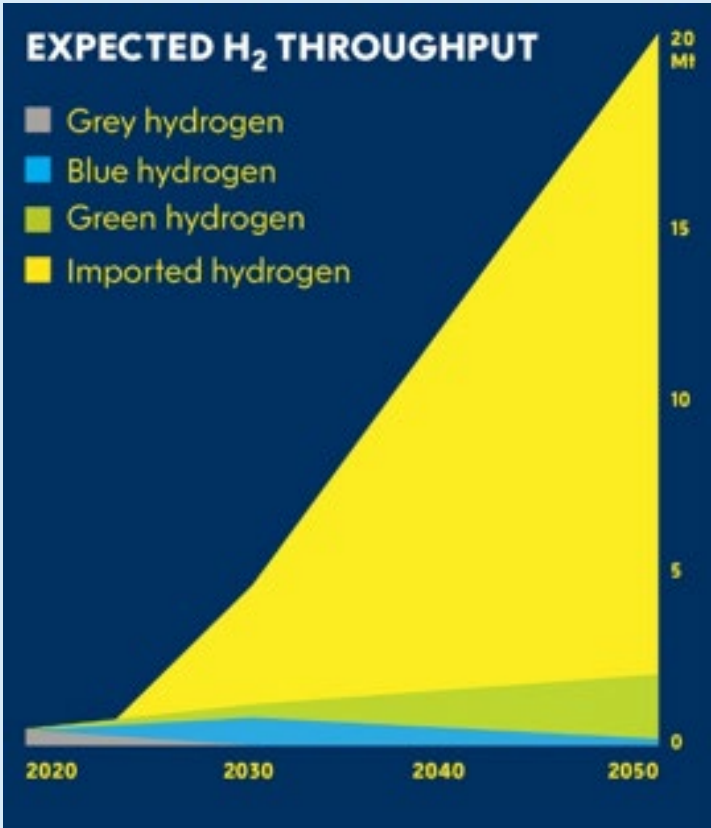
The locations depicted are approximate.

Demand development 2020 - 2022:

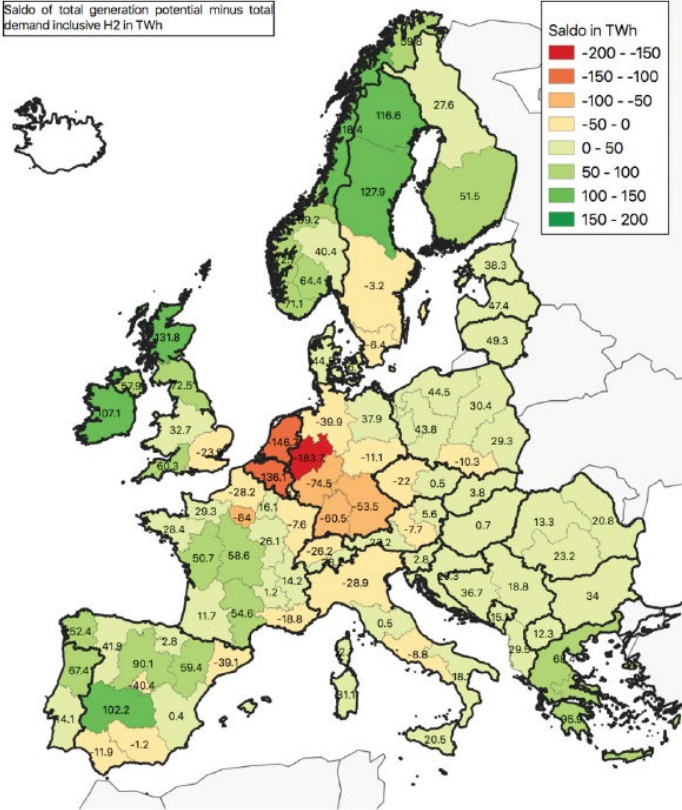
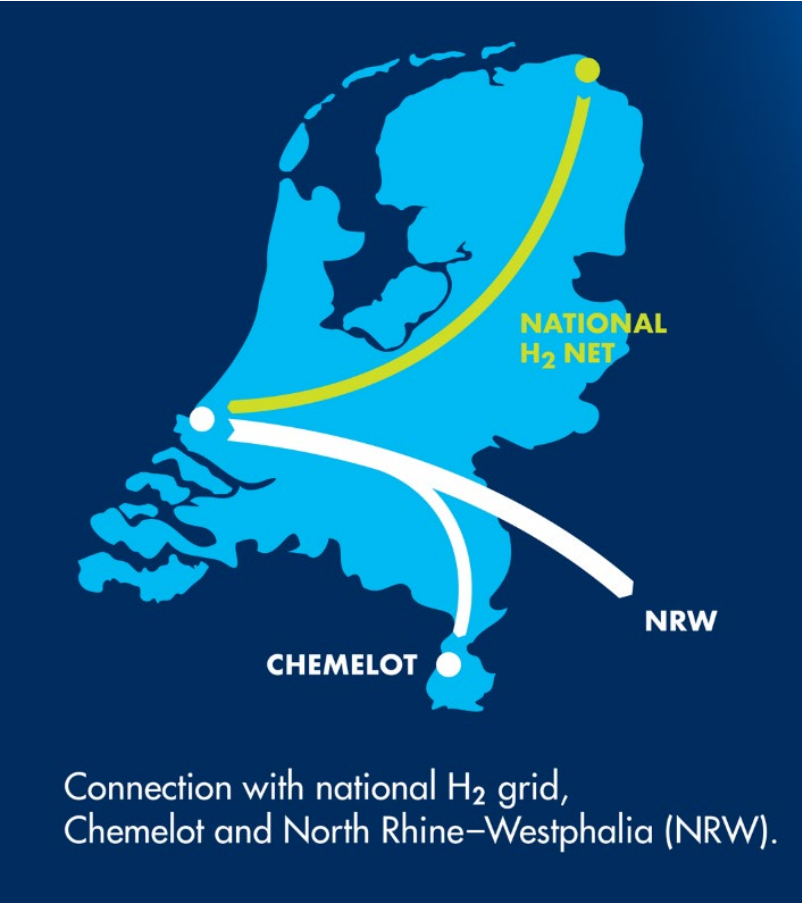
2020



2022

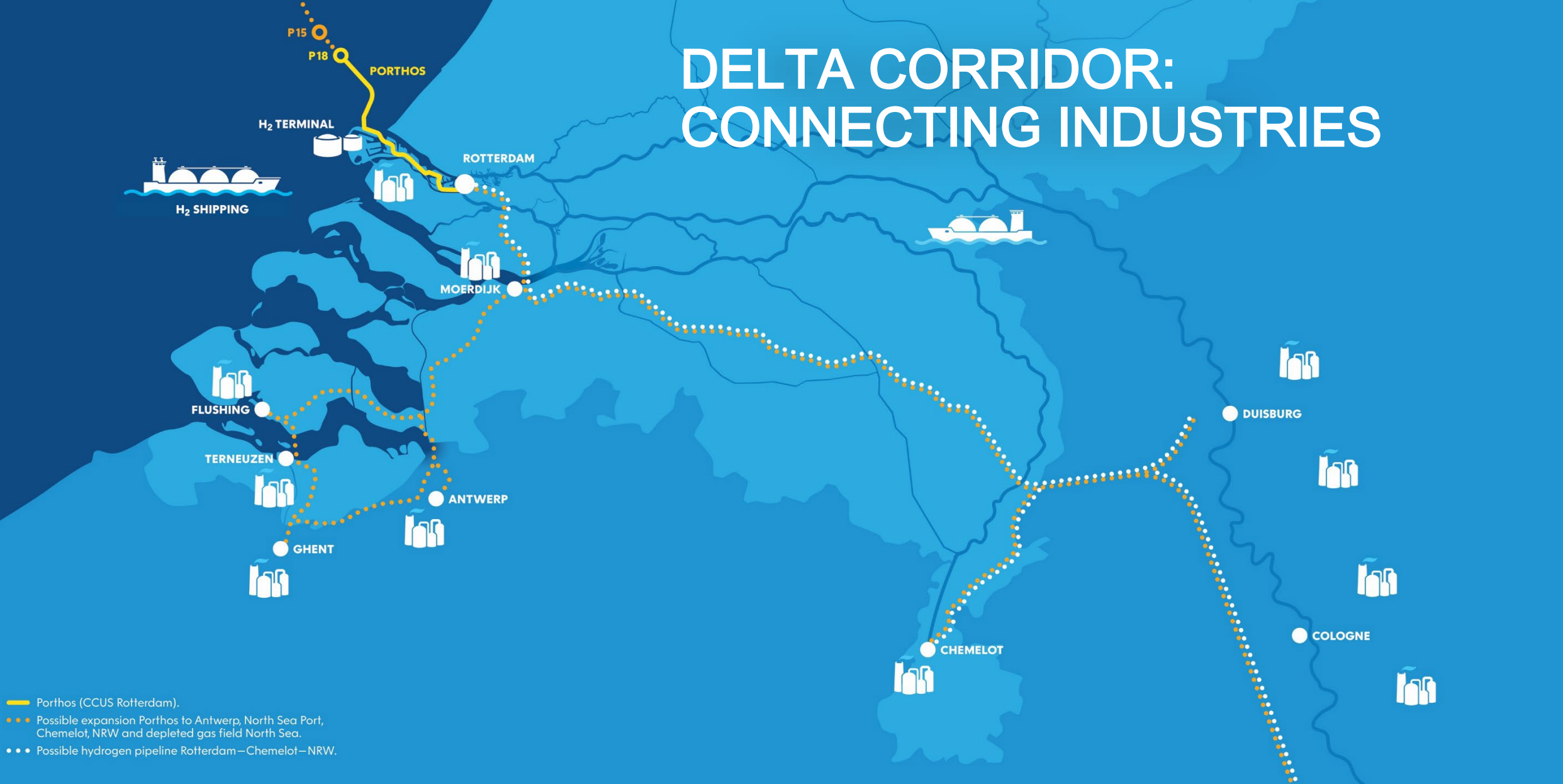


Hinterland connections Versus Demand

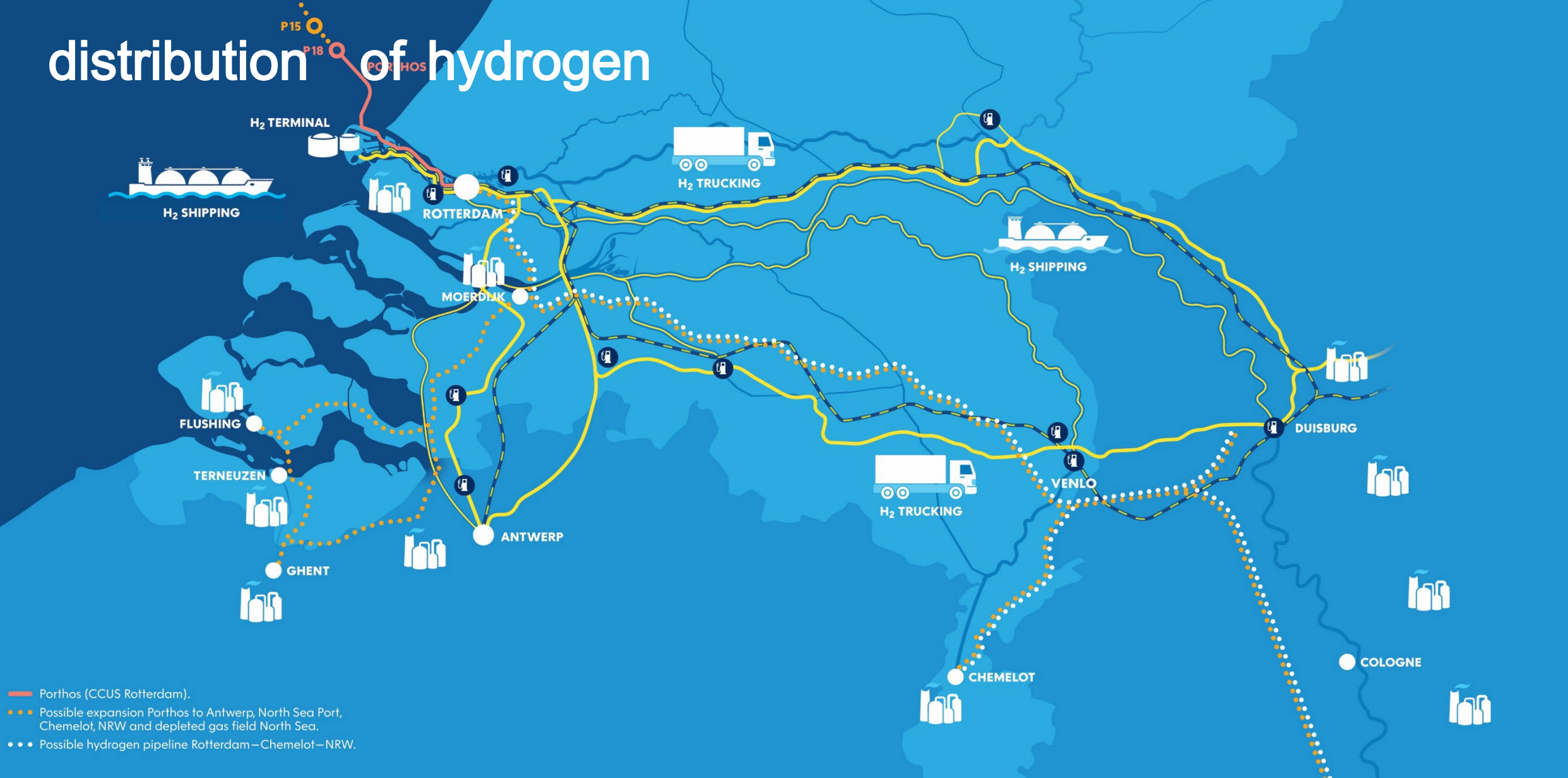


Source: Wuppertal Institute

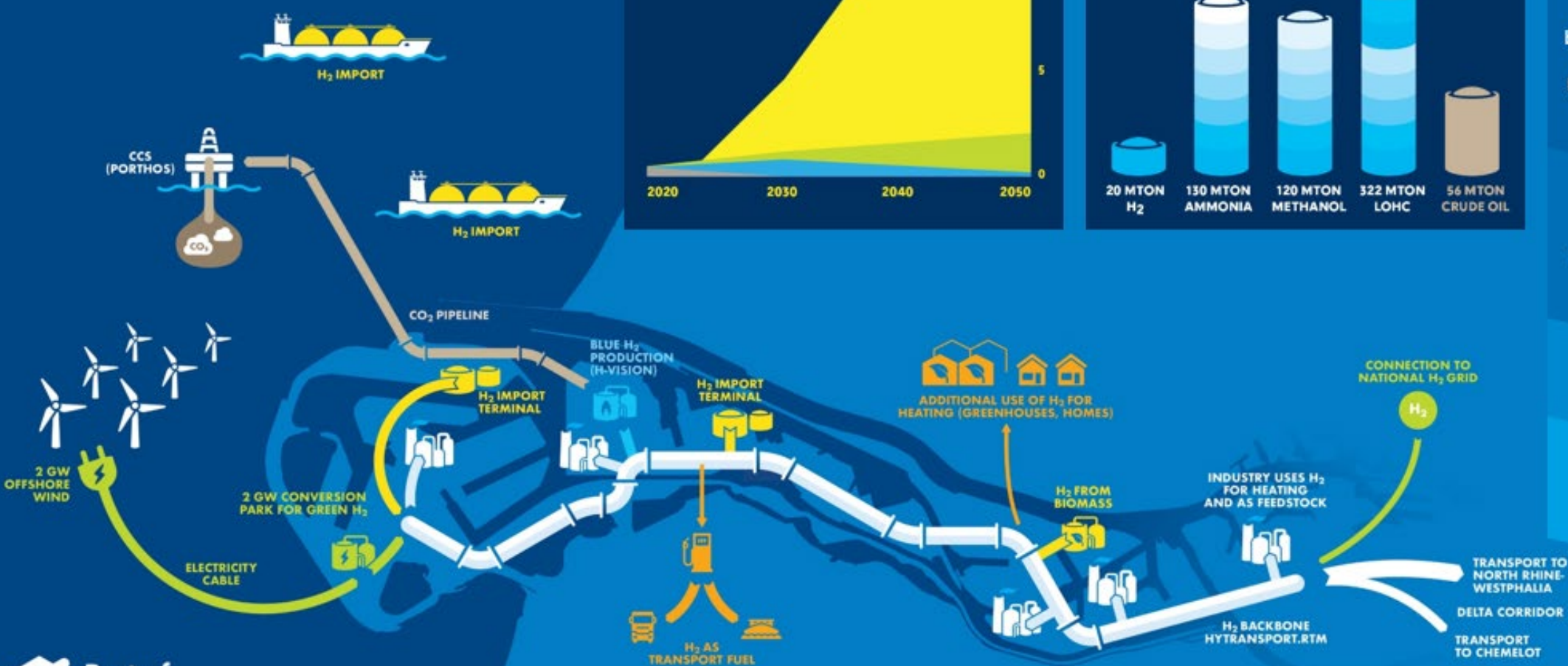
DELTA CORRIDOR: CONNECTING INDUSTRIES



distribution of hydrogen



HYDROGEN DEVELOPMENTS IN ROTTERDAM

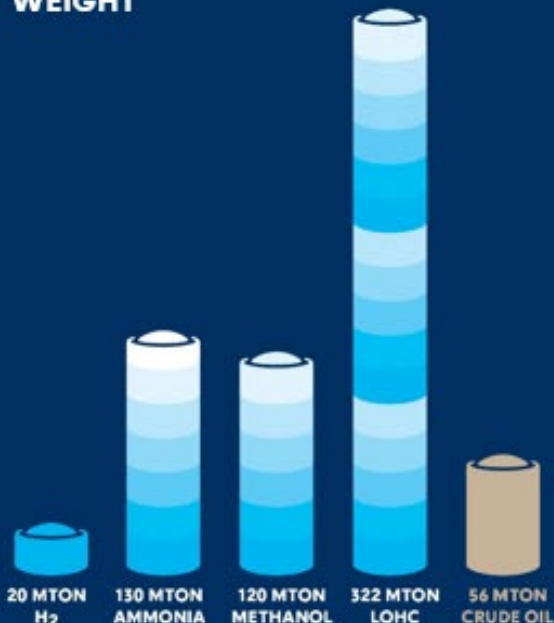


EXPECTED H₂ THROUGHPUT

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



WEIGHT



TIMETABLE

Shell 200 MW electrolyser
2024

H₂ backbone HyTransport.RTM;
Green ammonia imports start
2024

bp-HyCC 250 MW electrolyser;
Uniper 100 MW electrolyser;
LOHC import at industry scale;
1000 H₂ powered trucks
2025

Pipelines Delta Corridor
Chemelot-NRW;
12 H₂ powered inland barges;
H-vision (blue H₂)
2026

LH₂ terminal
2027

2 – 2,5 GW electrolyzers
4 Mton imports
2030

So how do we connect with Pecém?



Our sister port in Brazil: Pecém Hydrogen Hub

All elements in place. Started H2 hub idea in 2020.

PoR/CIPP bring local benefits and plans for export; leading H2 industrial hub development

Now: 9 projects, 19 MOUs, 8-15 GW planned for 2032

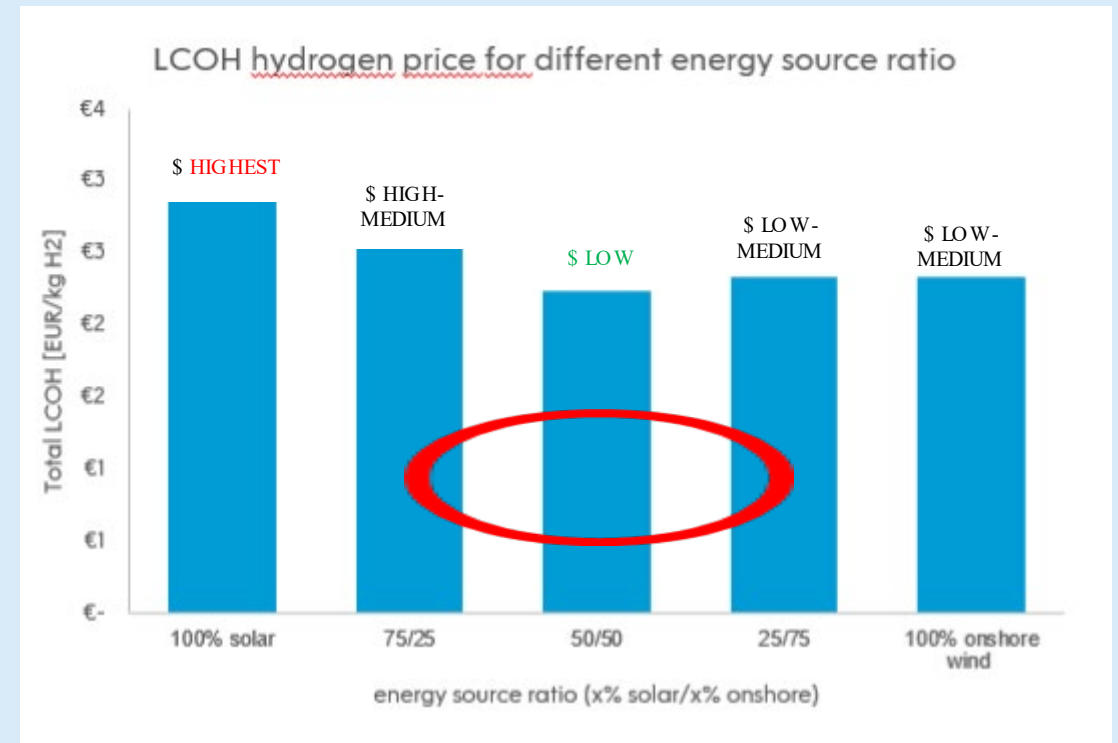
Aim to contribute 1 million tons to 2030 target



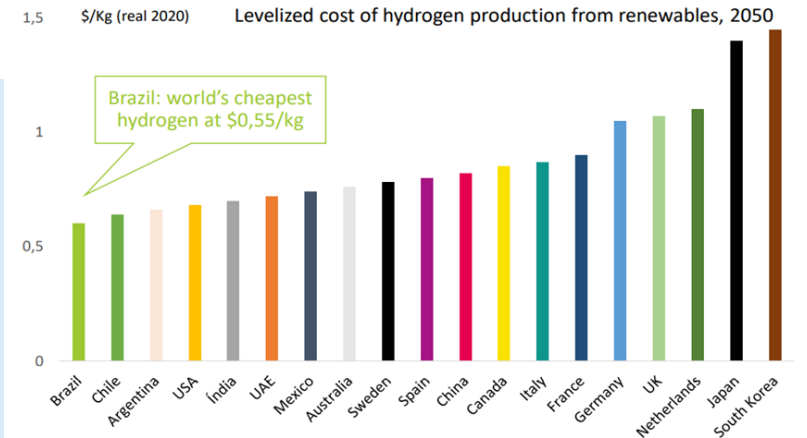
THE GOOD FORTUNE OF CEARÁ: WIND AND SUN

wind energy
+ solar energy
= **lowest cost**

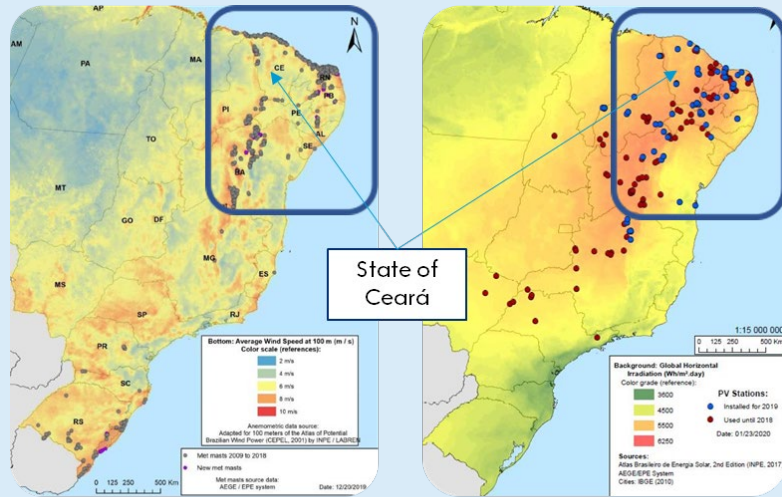
- Electrolyser utilization most effective if sources are combined
- Both sources available in Ceará



FAVOURABLE HYDROGEN POTENTIAL OF CEARÁ

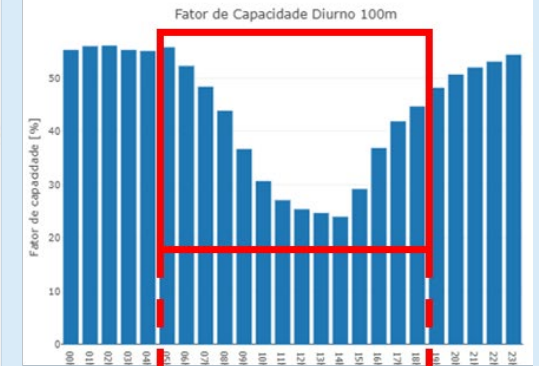
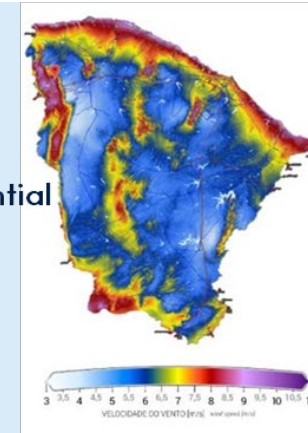


Source: BloombergNEF (2020)

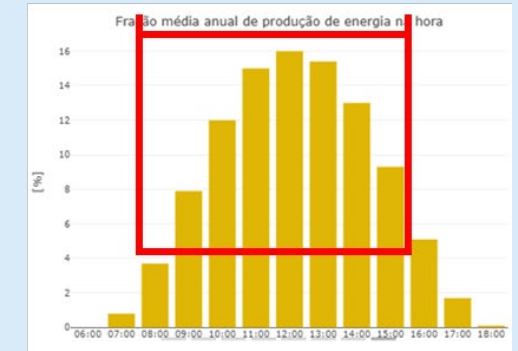
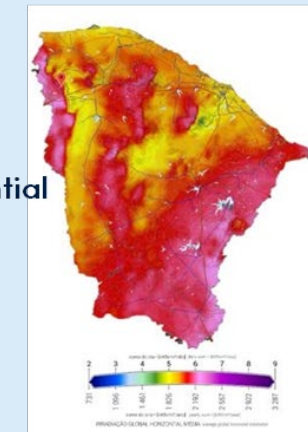


Source: EPE/MME

Wind power potential



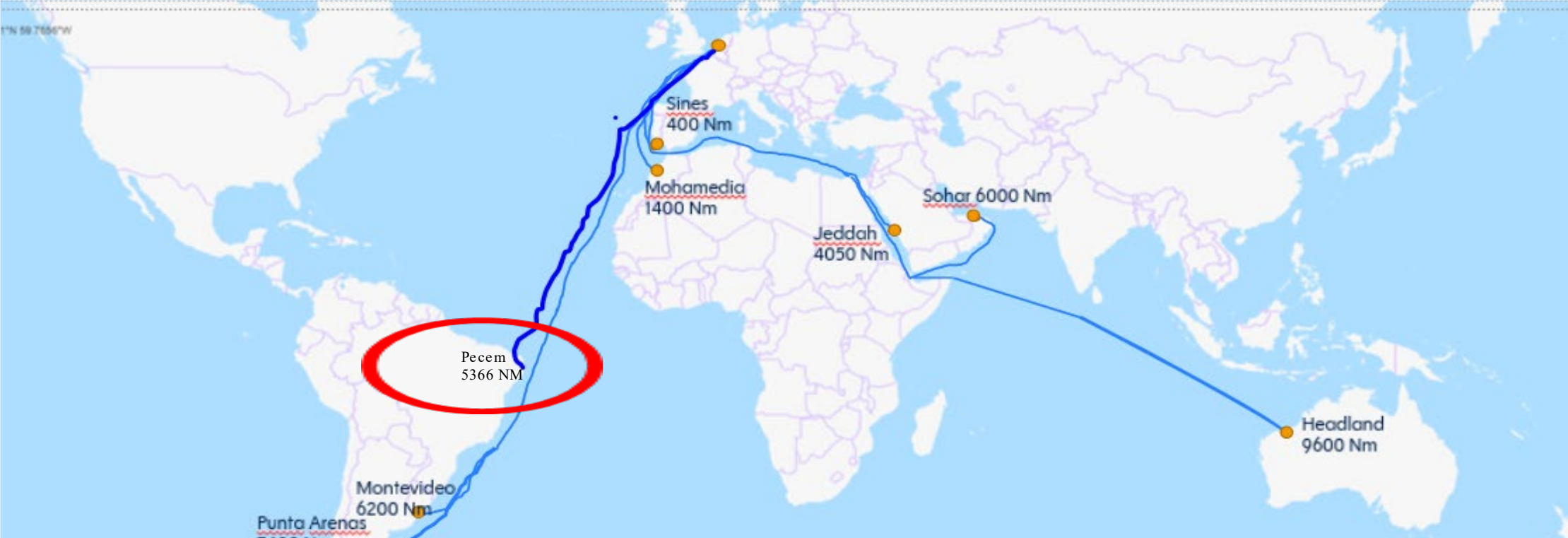
Solar power potential



complementary production profile s almost 40% reduce the costs of hydrogen

The state is already home to 88% of installed solar and wind capacity of Brazil's Northeastern region

SHIPPING DISTANCE: COST EFFECT?



RESEARCH : DISTANCE IS NOT SO IMPORTANT

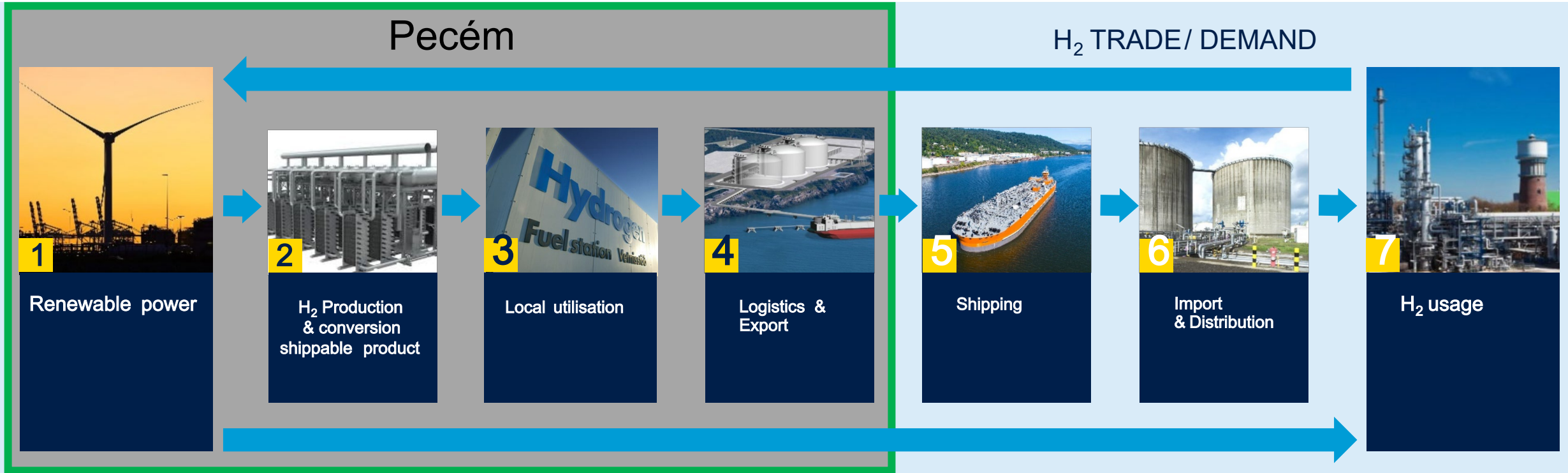
- Research shows that **shipping cost is only a small part of total cost**
- Global export is realistic, provided your cost of production is low and with right carrier
- Cost of H2 is determined for +/- 70% by cost of energy & electrolyser CAPEX
- Conclusion: Ceará has very good conditions to be a competitive producer and exporter of Hydrogen to any destination



Numbers are indicative, not calculated specifically
For Ceará/ Pecem. One specific carrier type (NH3).

HYDROGEN SUPPLY CHAIN

Seven steps to move from renewable generation to usage



LOGISTICS Develop the infrastructure so others can develop their activities .

IMPORT – EXPORT RELATED ACTIVITIES

Port of Rotterdam now working on terminals to receive Hydrogen from other countries

1. Short term:

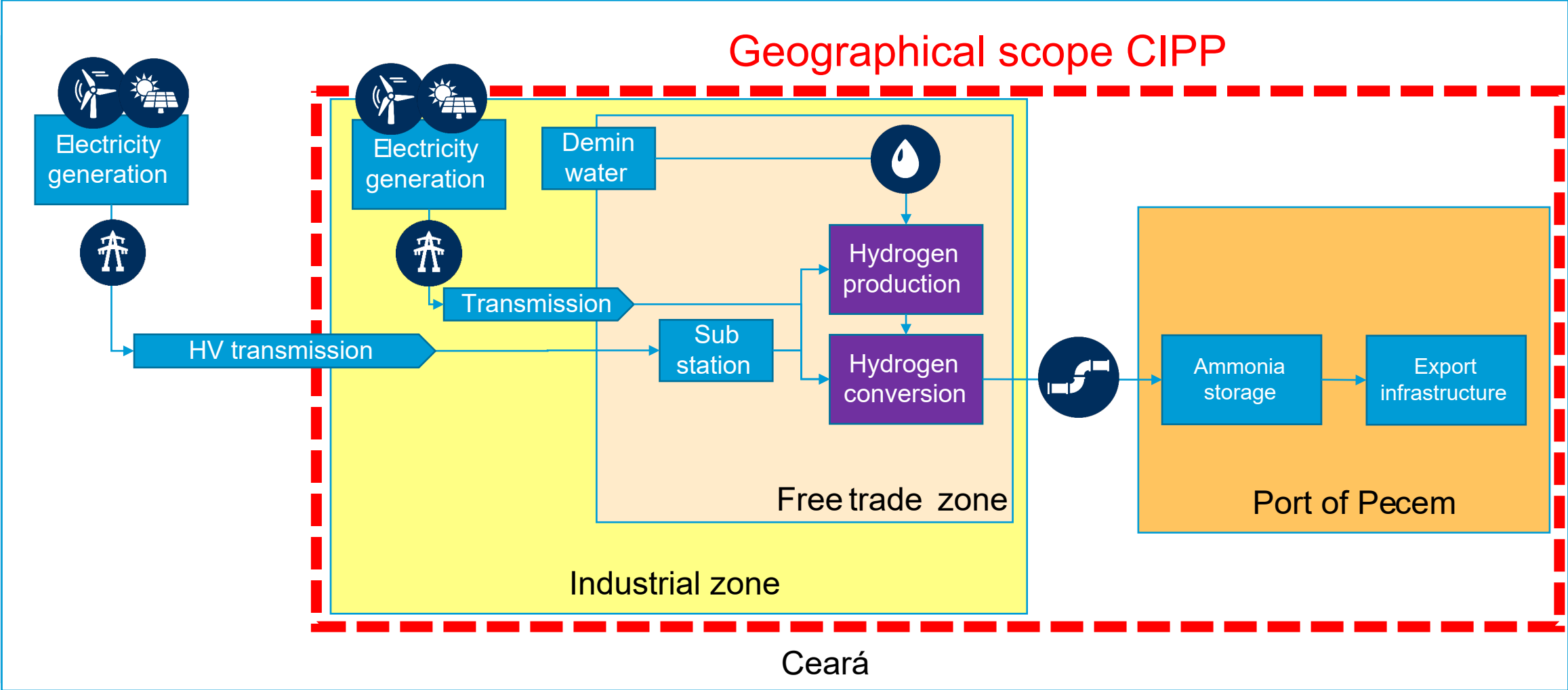
- Ammonia (NH₃)
- Methanol
- LOHC (DBT or MCH)

2. Mid-Long term:

- LH₂ (Liquid H₂) -253°C
- KBH₄? (potassium borohydride), or...?

PRODUCTION & CONVERSION

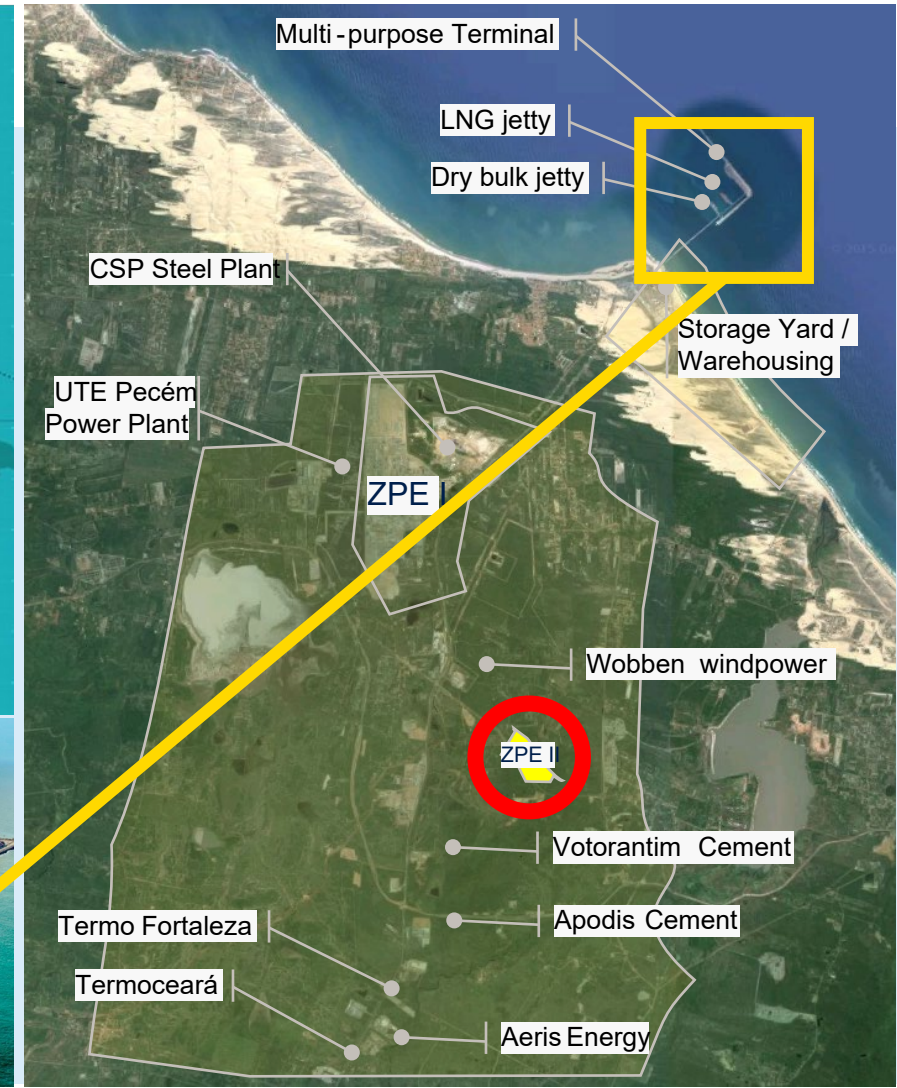
CIPP scope of the supply chain



THE PORT OF PECÉM (CIPP)



- Port of Pecém
- 10 berths, 19000 ha industrial area
- 2 free trade zones (ZPE's)
- Companhia de Integração do Complexo Portuário do Pecém – CIPP



> 3.000 RDAM COMPANIES– WANTING TO CONNECT



ENERGY RELATED INDUSTRY IN ROTTERDAM



IN MORE DETAIL...

OIL & OIL PRODUCTS

Refineries

- 1 BP Raffinaderij Rotterdam
- 2 Gunvor Petroleum Rotterdam
- 3 Koch HC Partnerships
- 4 ExxonMobil Lubricants
- 5 Shell Nederland Raffinaderij
- 6 Esso Nederland (ExxonMobil)

Refinery terminals

- 7 Gunvor Petroleum Rotterdam
- 8 Maasvlakte Olie Terminal (MOT)
- 9 Maatschappij Europoort Terminal (MET)
- 10 BP Raffinaderij Nederland
- 11 Shell Europoort Terminal
- 12 TEAM Terminal

Tank terminals for oil products

- 13 Vopak Terminal Laurens Haven
- 14 Service Terminal Rotterdam
- 15 Sargeant Terminal

- 16 Koole Tankstorage Minerals BV

- 17 Rubis Terminal
- 18 Odfjell Terminals Rotterdam
- 19 Euro Tank Terminal (ETT)
- 20 Vopak Terminal Europoort
- 21 Haan Oil Storage

CHEMICALS, BIOFUELS AND EDIBLE OILS

Chemical Manufacturers

- 1 Lyondell Covestro
- 2 Indorama
- 3 BP
- 4 Synres
- 5 Caldic Chemical
- 6 ExxonMobil Chemical Aromatics Plant
- Akzo Nobel Industrial Chemicals
- 7 Kemira Rotterdam BV
- 8 Euroliquide
- 9 Huntsman Holland
- Invista
- Lucite International
- Ducor Petrochemicals
- 10 Emerald Kalama Chemical
- 11 Cabot
- 12 Tronox Pigments
- 13 Kemira Rotterdam BV
- 14 Yara International
- Aliphos
- 15 Cerexagri
- Arkema Rotterdam
- 16 Almatris
- 17 Climax Molybdenum
- 18 Lyondell Chemical
- 19 Hexion UK Ltd
- 20 Akzo Nobel Industrial Chemicals Shin-Etsu
- Akzo Nobel Functional Chemicals
- 21 Organik Kimya
- 22 ExxonMobil Chemical
- 23 Aluchemie
- 24 Shell Nederland Chemie Shin-Etsu
- Hexion UK Ltd
- 25 Shell Moerdijk LyondellBasell
- Hexion UK Ltd
- Eliba
- 26 Dr. W. Kolb
- 27 Costex B.V.

- 28 Solvay Solutions Nederland

Biofuels manufacturers

- 29 Biopetrol Pernis
- 30 Biopetrol Rotterdam
- 31 Abengoa
- 32 Neste

Edible oils refineries

- 33 MaasRefinery
- 34 IOI-Loders Crockaan
- 35 Cargill Refined Oils Europe
- 36 Wilmar Edible Oils
- 37 Sime Darby Unimills

Tank terminals for chemicals, biofuels and edible oils

- 38 Maastank
- 39 Vopak Terminal Vlaardingen
- 40 Botlek Tank Terminal (BTT)
- 41 Koole Tank Storage Pernis

- 42 LBC Rotterdam

- 43 Odfjell Terminals Rotterdam
- 44 Rubis Terminal
- 45 Brenntag
- 46 Vopak Terminal Chemiehaven
- 47 Vopak Terminal TTR
- 48 Vopak Terminal Botlek
- 49 Aglobis
- 50 Lyondell Europoort Terminal
- 51 OCI Terminal Europoort
- 52 Standic
- 53 Stolthaven Moerdijk

GAS AND POWER, COAL AND BIOMASS

Gas fired

- 1 Uniper Utility Center Maasvlakte Leftbank (UCML)
- 2 Enecogen (Eneco, Dong)
- 3 Indorama Ventures Europe Utility Island
- 4 Rijnmond Energie Maasroom Energie
- 5 Air Liquide
- 6 Air Products-Electrabel
- 7 PerGen

Coal and Biomass fired

- 8 Uniper MPP 1 & 2
- Uniper MPP 3
- 9 ENGIE RC

Renewables

- 10 AVR

Natural gas terminals

- 11 Gate terminal
- 12 Gate break bulk facilities
- 13 LNG-Peakshaver Gasunie

Coal and biomass terminals

- 14 EMO
- 15 European Bulk Services (Botlek)
- 16 European Bulk Services (Europoort)
- 17 RBT (Rotterdam Bulk Terminal)
- 18 BSR VanUden Stevedoring
- 19 ZHD Stevedoring

INDUSTRIAL GASES AND WATER

- 1 Air Products
- 2 Air Liquide
- Evibes Industriewater
- 4 Linde Gas Benelux
- 5 AVR

PUBLICLY ANNOUNCED IMPORT PROJECTS (2022)

AND MORE TO COME... [Latest developments: Please click: Hydrogen in Rotterdam | Port of Rotterdam](#)



TO CONCLUDE: WE ARE READY

