CONNECTING THE WORLD
BUILDING TOMORROW'S SUSTAINABLE PORT

AMLAN BORA
01 AUGUST 2025
TUTICORIN, INDIA

Port of Rotterdam

Port of Rotterdam

At a glance

42 KM
PORT AREA

4 CRUDE OIL REFINERIES

45 PETROCHEMICAL COMPANIES

4 VEGETABLE OIL REFINERIES

3 BIOFUEL PLANTS

€29.6 BILLION
ADDED VALUE
2.9% OF DUTCH GDP

91,000
INLAND VESSELS PER YEAR

28,000
SEA-GOING VESSELS PER YEAR

LARGEST EUROPEAN PORT

CURRENT HYDROGEN PRODUCTION 0.5 MTON

13% OF TOTAL EU ENERGY CONSUMPTION PASSES ROTTERDAM

EXCELLENT CONNECTIONS WITH OTHER EU CLUSTERS

CA. 192,000
DIRECT & INDIRECT JOBS

GATEWAY TO EUROPE & GLOBAL CARGO HUB

30 MILLION
Consumers within two hours

160 MILLION
Consumers within eight hours

500 MILLION
Consumers within 24 hours

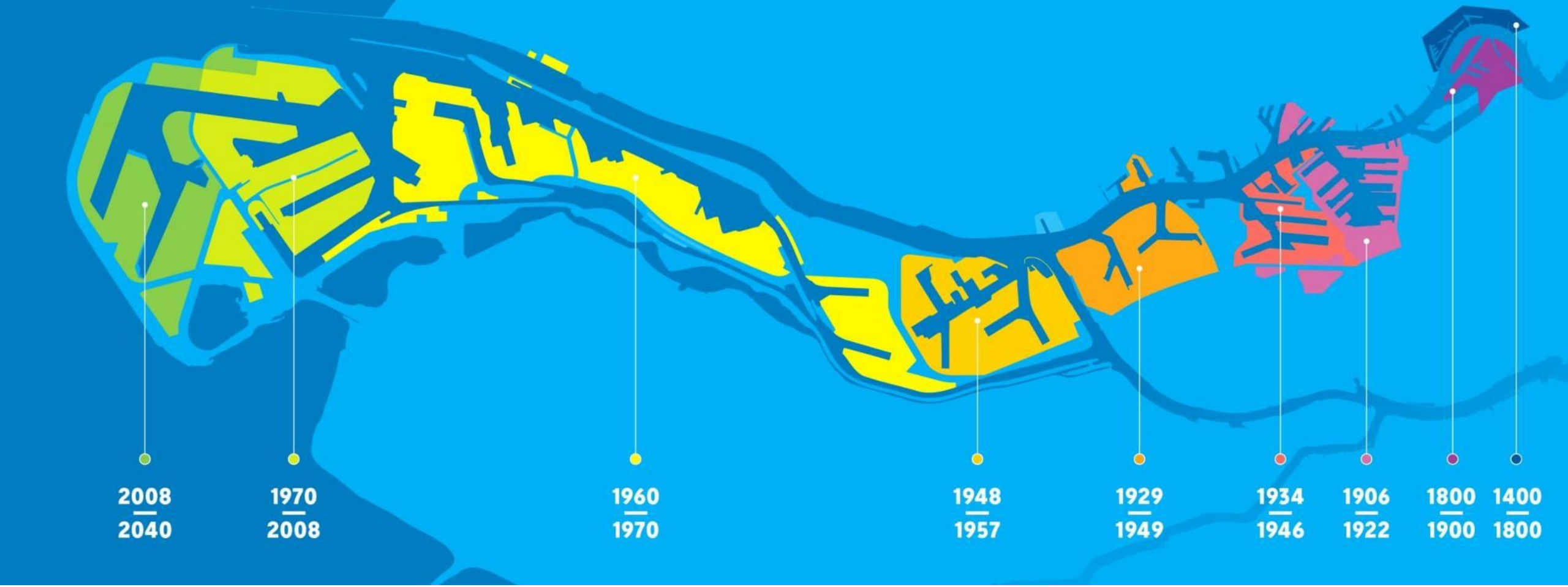
Mainly in direct hinterland < 200 km

Over 360 weekly barge services

Over 230 weekly rail cargo

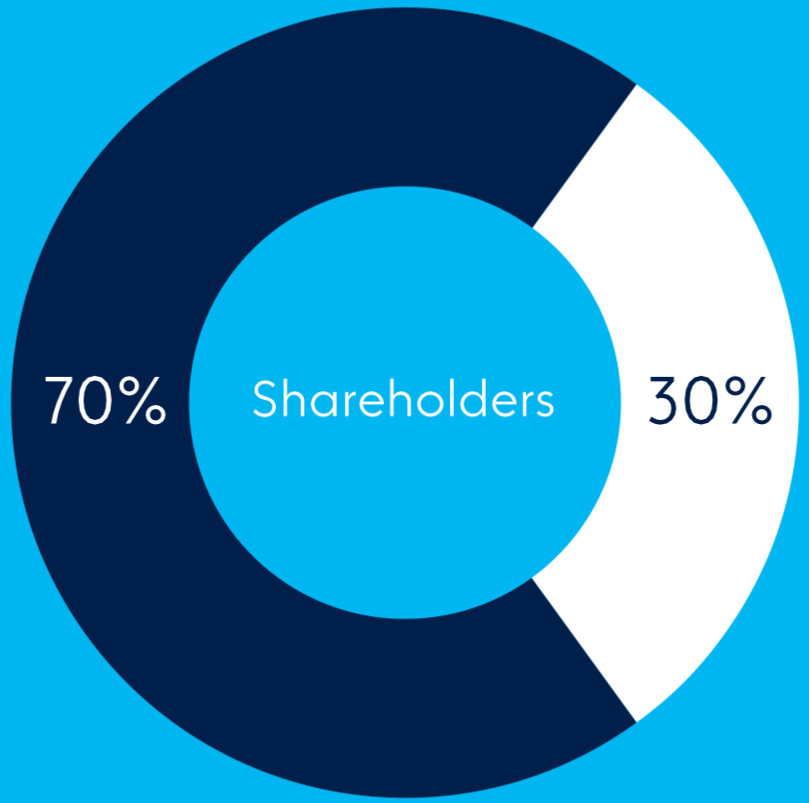
PORT OF ROTTERDAM THRU TIME

Rotterdam is an energy port, re-inventing itself when times are changing



PORT OF ROTTERDAM MAIN SHAREHOLDERS

A joint venture between the Ministry of Finance of The Netherlands and the municipality of Rotterdam



Our governance model splits investment roles between the port authority and private sectors…

Core tasks:

- Sustainable development, management and operation of the port
- Maintaining the safe and smooth handling of all shipping

Investment roles

- **PoR:** public infra and waterways
- **Private companies (clients):** superstructure and services

Port of Rotterdam

...making possible the development of large-scale infrastructure

2009

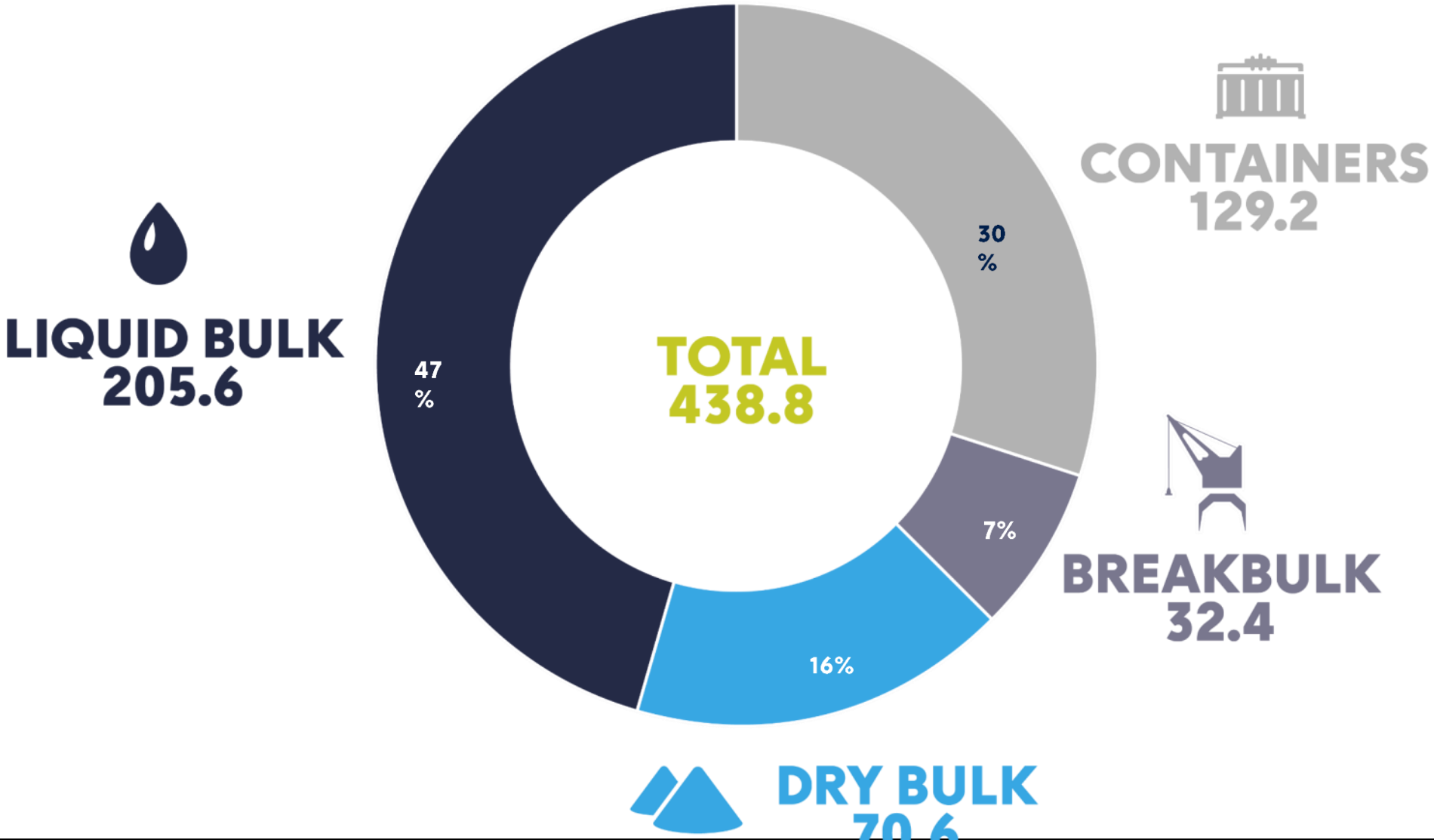
2010

2015

2012

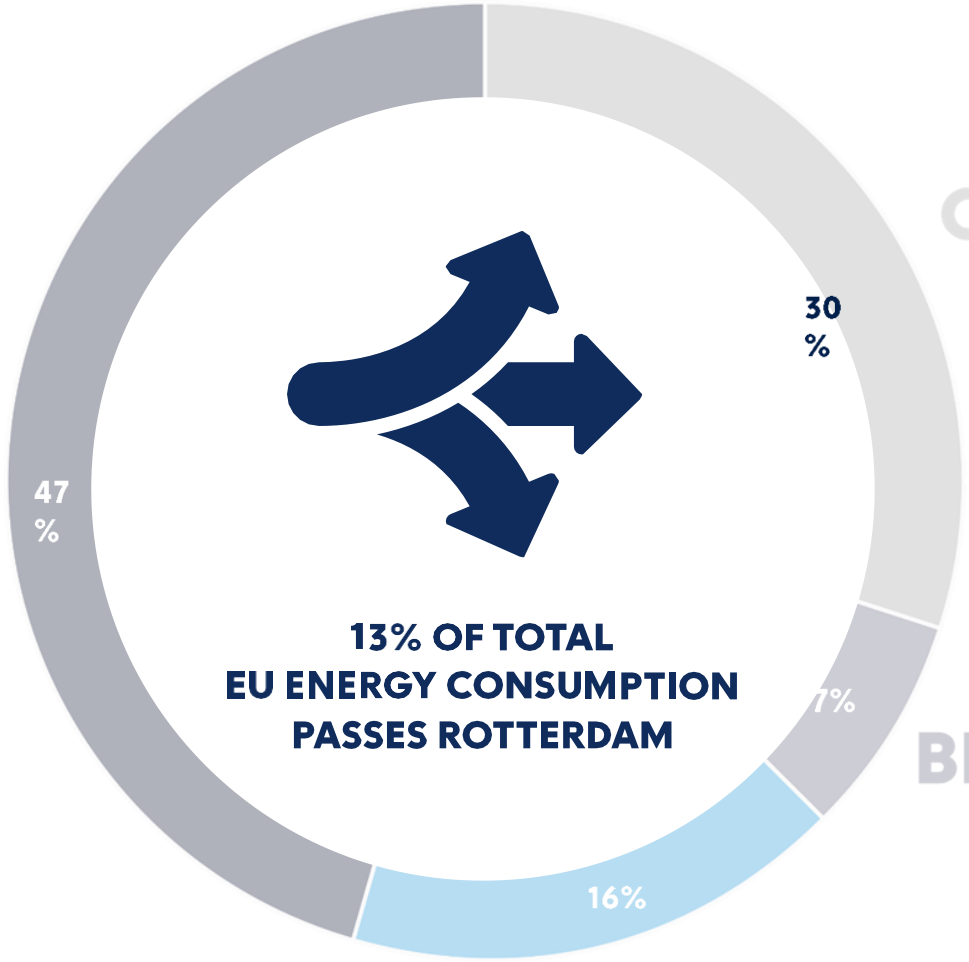
Port of Rotterdam

THROUGHPUT 2023 *(MM TONNES)*



THROUGHPUT 2023 *(MM TONNES)*

Port of Rotterdam



13% OF TOTAL EU ENERGY CONSUMPTION PASSES ROTTERDAM

LIQUID BULK 205.6

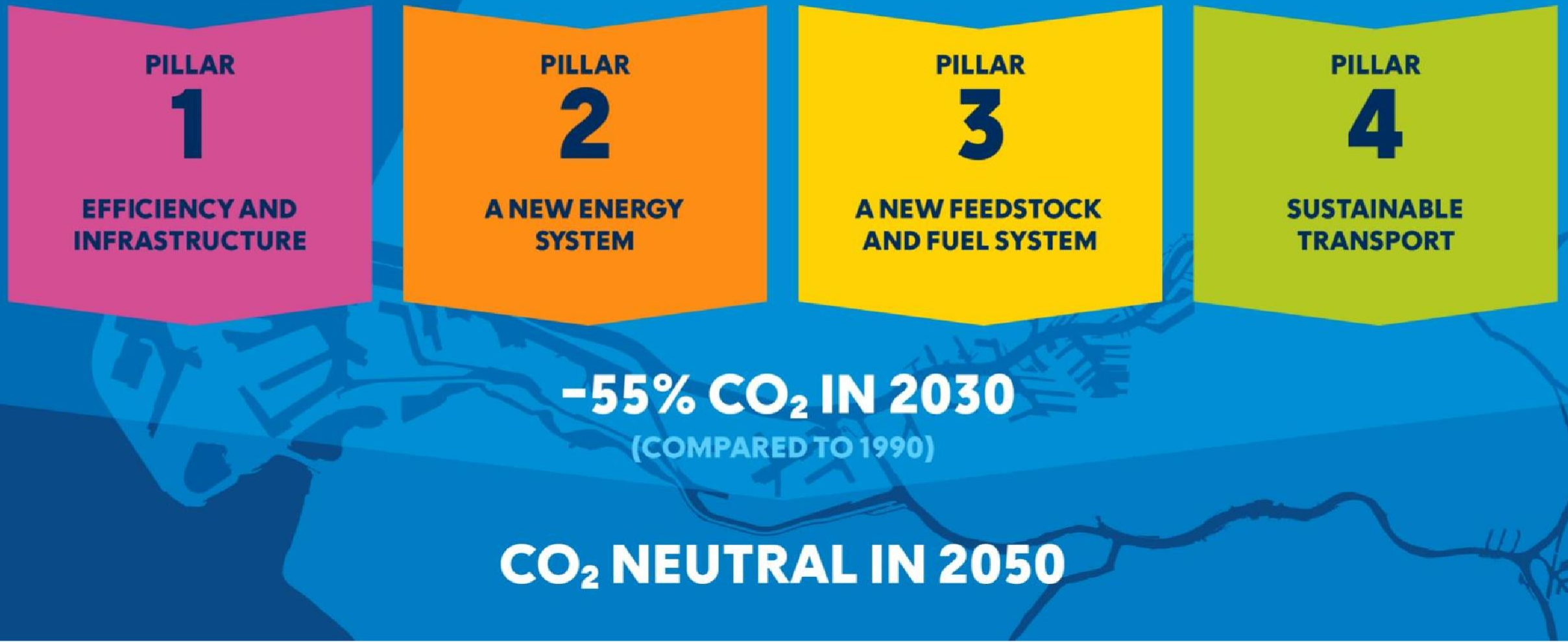
CONTAINERS 129.2

BREAKBULK 32.4

DRY BULK 70.6

Our governance model also enables us to play a leading role rising to the challenges of the Energy Transition

Energy Transition Strategy



Port of Rotterdam

THE PORT OF ROTTERDAM TODAY

Port of Rotterdam

THE PORT OF ROTTERDAM TODAY

Port of Rotterdam

THE PORT OF ROTTERDAM TODAY

Port of Rotterdam

THE PORT OF ROTTERDAM TODAY

RESERVED

LOGISTICS, SERVICES

STORAGE

Port of Rotterdam

THE PORT OF ROTTERDAM TODAY

Port of Rotterdam

THE PORT IN TRANSITION

RESERVED

- New industry (Biobased & circular)

LOGISTICS, SERVICES

STORAGE

INDUSTRY

Port of Rotterdam

THE PORT IN TRANSITION

RESERVED

- New industry (Biobased & circular)

LOGISTICS, SERVICES

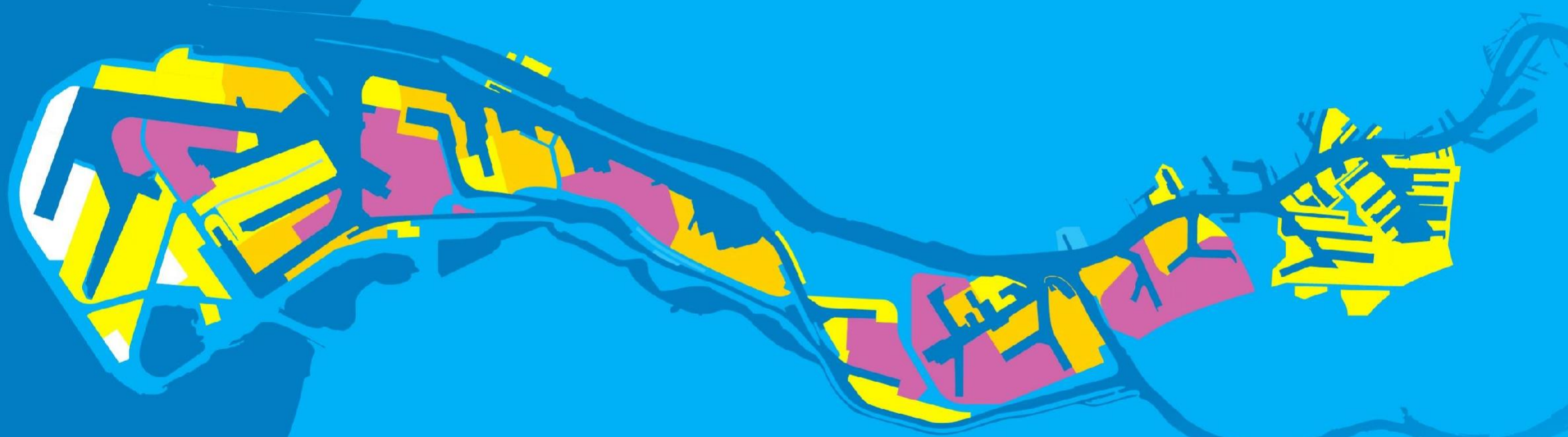
- Mostly ready
- Electrification

STORAGE

INDUSTRY

Port of Rotterdam

THE PORT IN TRANSITION



RESERVED

- New industry (Biobased & circular)

LOGISTICS, SERVICES

- Mostly ready
- Electrification

STORAGE

- Mostly ready
- Change of products

INDUSTRY

Port of Rotterdam

THE PORT IN TRANSITION

RESERVED
- New industry (Biobased & circular

LOGISTICS, SERVICES
- Mostly ready
- Electrification

STORAGE
- Mostly ready
- Change of products

INDUSTRY
- Change of feedstock & Process

Port of Rotterdam

2030: 55% CO2 reduction
2050: CO2 neutral

Presenter Notes
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Pijler 2: (Hydrogen 4Mton import, 0,6 Mt local production, Offshore wind connection 7,4 GW
Zon 130 MWp, Wind 300 MW)
Pijler 3: (3 Mt renewable production capacity 2-4 Mt waste as feedstock)
Pijler 4: (20% CO2 reduction compared to 2019 deepsea shipping) Shorepower: 90% ro-ro vessels, 90 % ULCS)

PILLAR 1
EFFICIENCY AND INFRASTRUCTURE

- Warmteling
- Porthos (CCS)
- Strenghtening power grid
- Offshore wind connection
- Hydrogen grid (HyTransPort.RTM)
- Delta Rhine Corridor
- Datasafehouse

PILLAR 2
A NEW ENERGY SYSTEM

- Electrification Industry
- Green hydrogen production
- H-vision
- Renewable & Low carbon hydrogen import
- Rotterdam Wind Power Hub
- HyExchange
- Ammonia cracking

PILLAR 3
A NEW FEEDSTOCK AND FUEL SYSTEM

- Biofuel production Biomethanol
- Plastic recycling
- Batteryrecycling
- Lithium refining
- Starlings

PILLAR 4
SUSTAINABLE TRANSPORT

- ZES (zero emission shipping)
- RH2INE - Condor
- Hytrucks, H_2 fueling station
- Shore power
- Green Corridors
- Digitisation logistic / HESP

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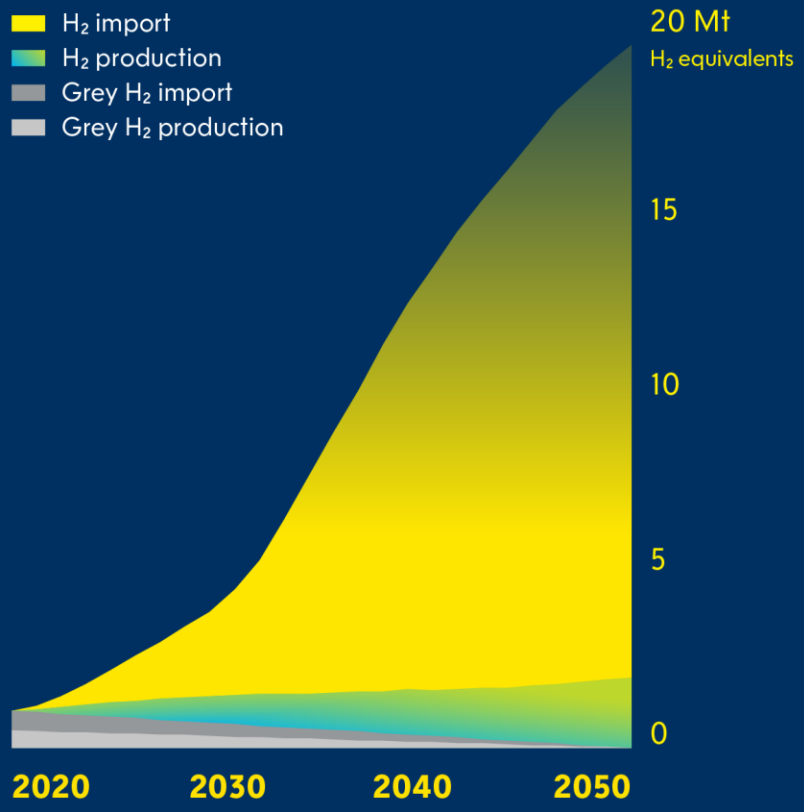
ROTTERDAM: EUROPE'S HYDROGEN HUB

CO_2-reduction with renewable & low carbon hydrogen and its derivatives, with a large role for imports

Net zero

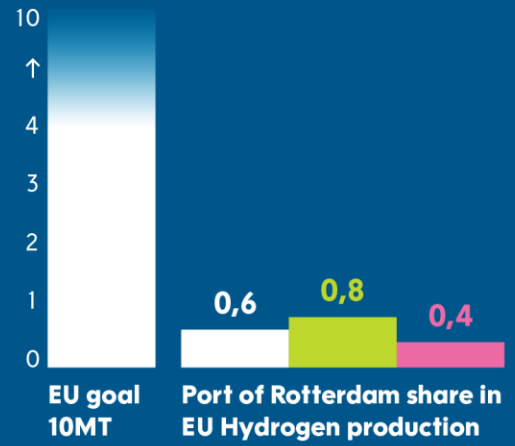
Paris Climate Agreement



European hydrogen goals for 2030

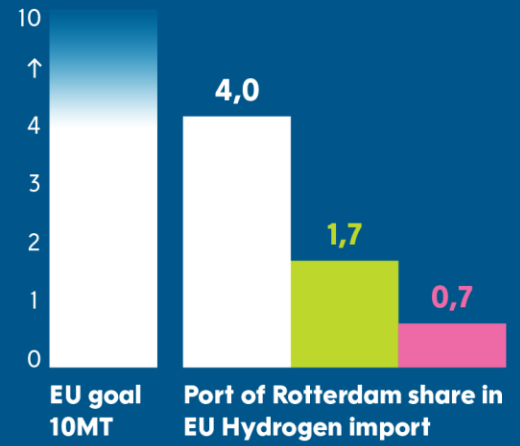
Rotterdam plays a huge role in fulfilling EU ambitions of 20Mton: our aim is to deliver 25%.

Hydrogen production



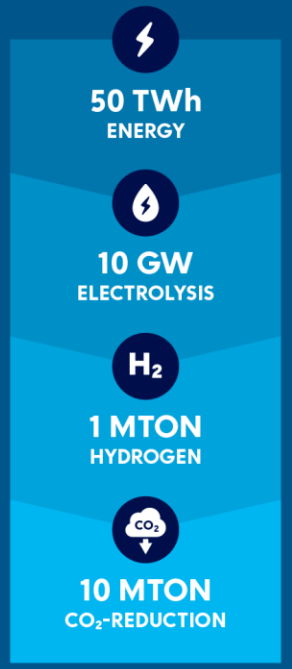
- REPowerEU ambitie: 0,6Mton
- Connected Deep Green: 0,8 Mton
- Protective markets: 0,4 Mton

Hydrogen import

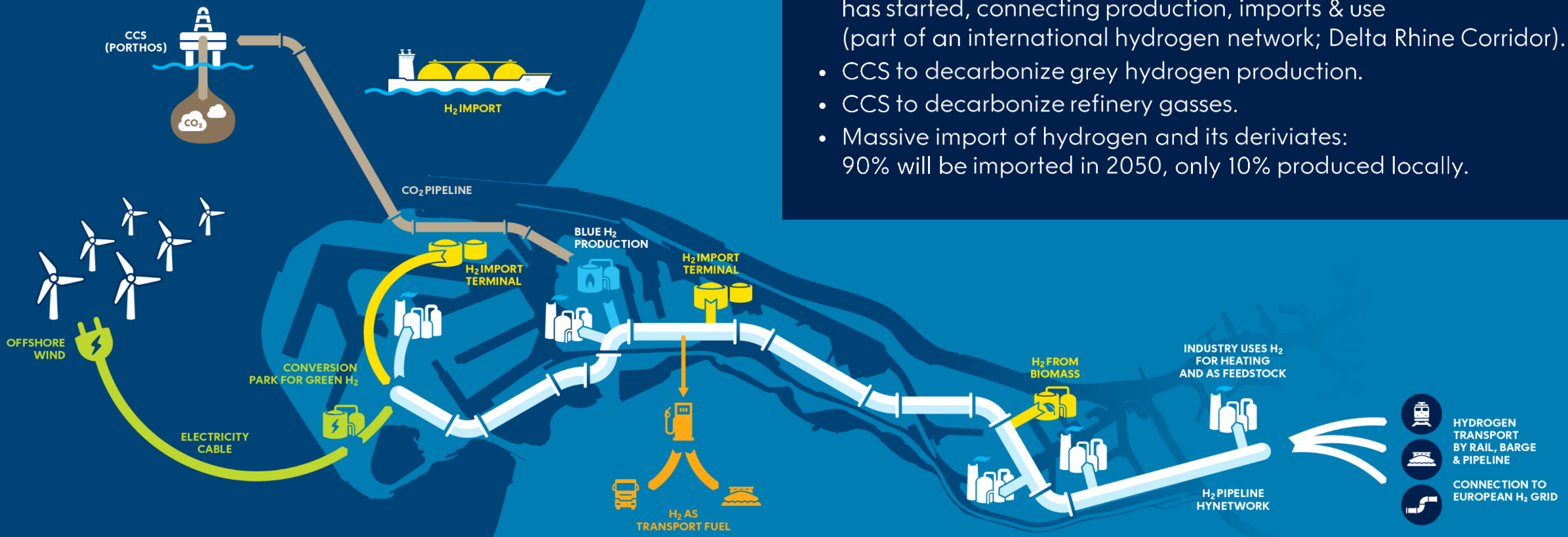


- REPowerEU ambitie: 4Mton
- Connected Deep Green: 1,7 Mton
- Protective markets: 0,7 Mton

RULE OF THUMB



ROTTERDAM'S HYDROGEN ECOSYSTEM IS BEING BUILT RIGHT NOW



We are making this happen

- 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.

HIGH POTENTIAL IMPORT AREAS

Green hydrogen import is essential for Europe, as it uses more energy than it can produce.

Progress and planning

- Expected import Hydrogen and its derivates in Rotterdam: 0.7-1.7 Mton in 2030, 18 Mton in 2050.
- Huge potential for production in many areas worldwide.
- Imports Rotterdam are expected to start around 2025.
- 14 terminals have announced plans for import facilities.
- Rotterdam is preparing itself for Ammonia, methanol, Liquid H_2, SAF and LOHC.

HYDROGEN IMPORT ARRIVAL LOCATIONS ROTTERDAM

14 hydrogen existing and announced terminals

	TERMINALS (COMPANY)	PLANNED FID	OPERATIONAL
AMMONIA	OCI	Operational	✓ 2026
AMMONIA	Air Products	2025	2028
AMMONIA	VTTI Amplifhy	2026	2029
AMMONIA	Chane	2026	2029
AMMONIA	ACE (Location undecided)	2027	>2030
AMMONIA	Global Energy Storage	2028	>2030
LH_2 LOHC METHANOL/SAF	Chane	Operational	✓
LH_2 LOHC METHANOL/SAF	EVOS	Operational	✓
LH_2 LOHC METHANOL/SAF	ETT	Operational	✓
LH_2 LOHC METHANOL/SAF	Liquin	Operational	✓
LH_2 LOHC METHANOL/SAF	Advario	2027	2030
LH_2 LOHC METHANOL/SAF	Vopak	t.b.d.	2029
LH_2 LOHC METHANOL/SAF	Chane	t.b.d.	2029
LH_2 LOHC METHANOL/SAF	Vopak (Location undecided)	t.b.d.	>2030

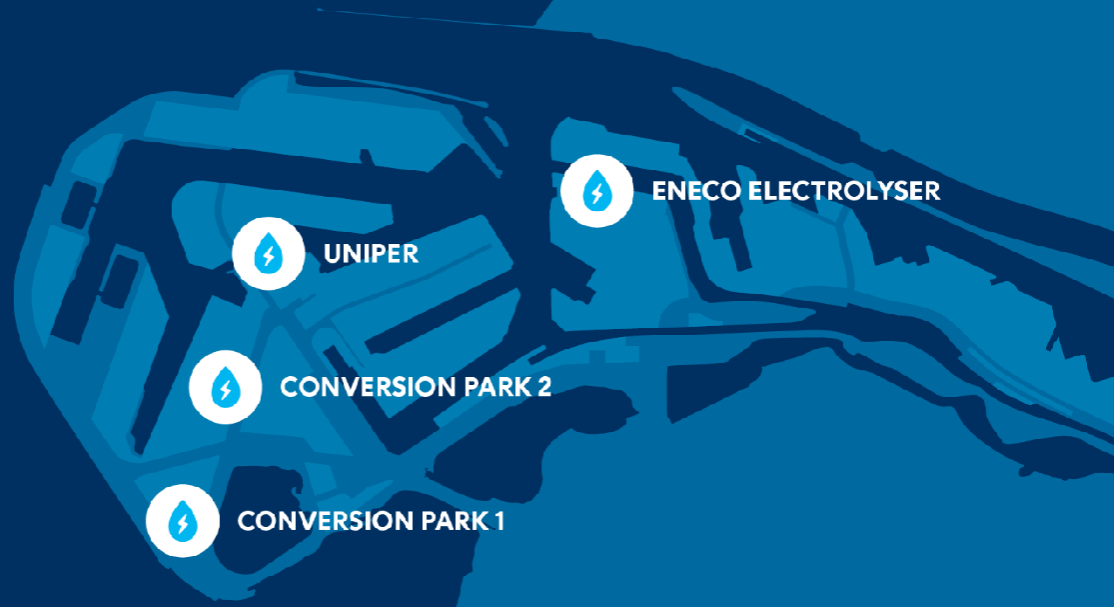
1 — expansion to 90,000 cbm

GREEN H_2 PRODUCTION STARTS AT DEDICATED SITES FOR ELECTROLYSIS

PROJECT (COMPANY)	CAPACITY	PLANNED FID	OPERATIONAL
Conversion park 1			
Holland Hydrogen I (Shell)	200MW	✓ **2022**	2025
ELYgator (Air Liquide)	200MW	**2025**	2027
HyCC Project (HyCC)	250MW	2026	2029
Confidential	200MW	2026	2029
Conversion park 2			
Zeevonk (CIP/Vattenfall)	~1000MW	2026	2029
MaasH2 (RWE)	~250MW	2026	2029
Brownfield			
Eneco Electrolyser (Eneco)	800MW	2026	2029
H2Maasvlakte (Uniper)	500MW	2026	2030

Ambition Rotterdam

2030: 2.5GW (onshore)
2050: 20GW (onshore & offshore)



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NEW BUILT AND EXISTING PIPELINE CONNECTIONS

PROJECT (COMPANY)	CAPACITY	PLANNED FID	OPERATIONAL
Open access			
Hydrogen network Rotterdam	1,200 ktpa	✓ **2022**	**2026**
Delta Rhine Corridor	2,000 ktpa	2026	2032
Hydrogen network Netherlands	2,000 ktpa	n/a	2033
Private (in Rotterdam)			
Air Liquide	confidential	n/a	✓
Air Products	confidential	n/a	✓

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INLAND DISTRIBUTION

Hydrogen carrier are already distributed inland via barge and rail

91,000
VESSELS PER YEAR

1,000-5,000
SHIP CAPACITY

Multiple
OPERATORS

PRODUCT	# VESSELS	CAPACITY (TONNES)	OPERATIONAL
Ammonia[1]	10	1,000-2,000	✓
Methanol	20	1,000-2,500	✓
LOHC	n/a	3,000	✓
LH_2 (isotainers)			✓
Compressed H_2 (containers)			✓

Port of Rotterdam

1 — Today pressurised ammonia barges. Cold ammonia barges are being developed

WELL CONNECTED TO H_2 DEMAND CENTERS IN NORTHWEST EUROPE

Offtakers in this region

Airports
8

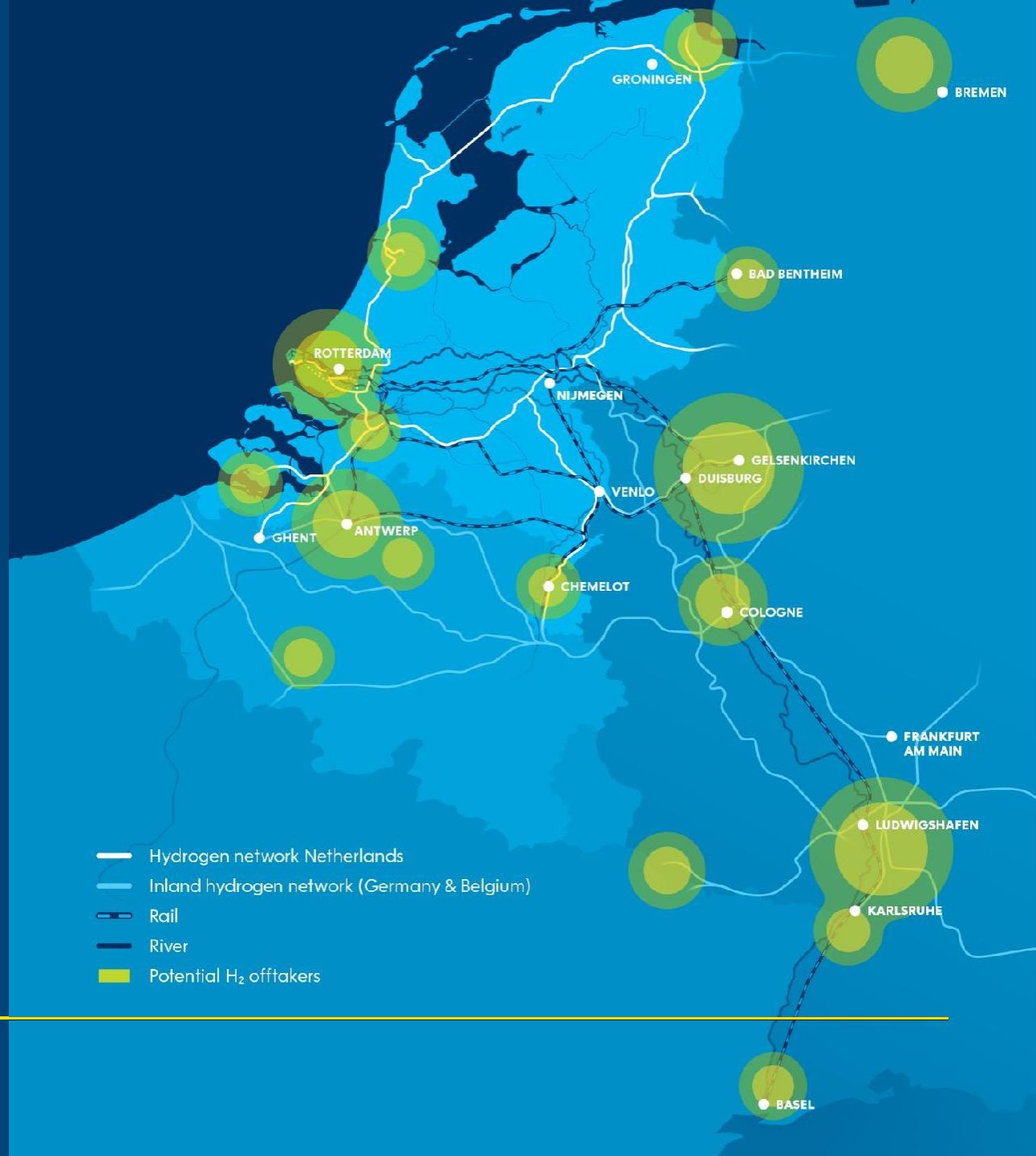
(Bio) Refineries
>20

Steel plants
>6

Chemical Parks
>25

Power Plants
>80

Bunkering
>28,000 vessels



Port of Rotterdam

HYDROGEN PROJECTS

PLANNING

2025

Import
First green ammonia imports.

Import
Expansion existing ammonia terminal operational.

Use
First H_2 fueling station for trucks in the Port operational.

Pilot ammonia ship2ship operation.

2026

Production
First 200 MW elektrolyzer operational (Shell Holland Hydrogen I).

Infrastructure
'Hydrogen network' pipeline in the port operational.

Use
First green hydrogen replaces grey in refineries

Use
CCS infrastructure operational (Porthos), grey hydrogen turns blue.

First 'Condor' hydrogen powered inland barges operational.

2028

Production
Conversion Park I elektrolyzer expansions ~400MW.

Import
2nd import terminal for ammonia operational, first ammonia cracker operational.

2030

Production
2,5 GW elektrolysers operational (~0.3 Mton H_2).

Import
0.7-1.7 Mton H_2 imports.

Road transport
1,000 H2 powered trucks.

Import
LOHC imports industrial scale.

2032

Production
First blue hydrogen plant operational using Refinery Fuel Gases.

Import
First LH_2 terminal operational.

Infrastructure
'Delta Rhine Corridor' pipelines to Chemelot, North Rhine-Westfalia operational.

Infrastructure
National 'Hydrogen pipeline network' operational.

2035

Production
3,5 GW elektrolysers operational (~0.4 Mton H_2).

Import
4.0 Mton H_2 imports.

IT'S HAPPENING!

Building site Conversion park

Porthos & Hynetwork

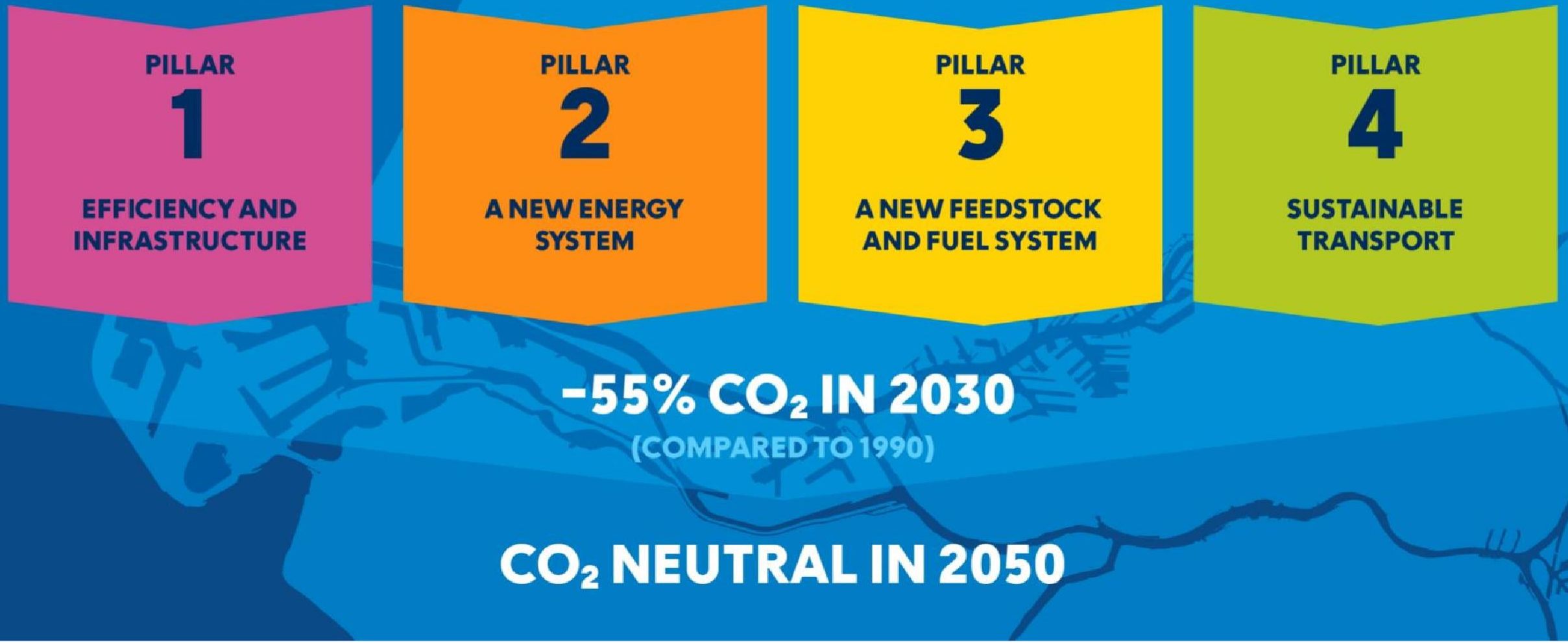
Shell Holland Hydrogen 1

Offshore wind landfall

Port of Rotterdam

Our governance model also enables us to play a leading role rising to the challenges of the Energy Transition

Energy Transition Strategy



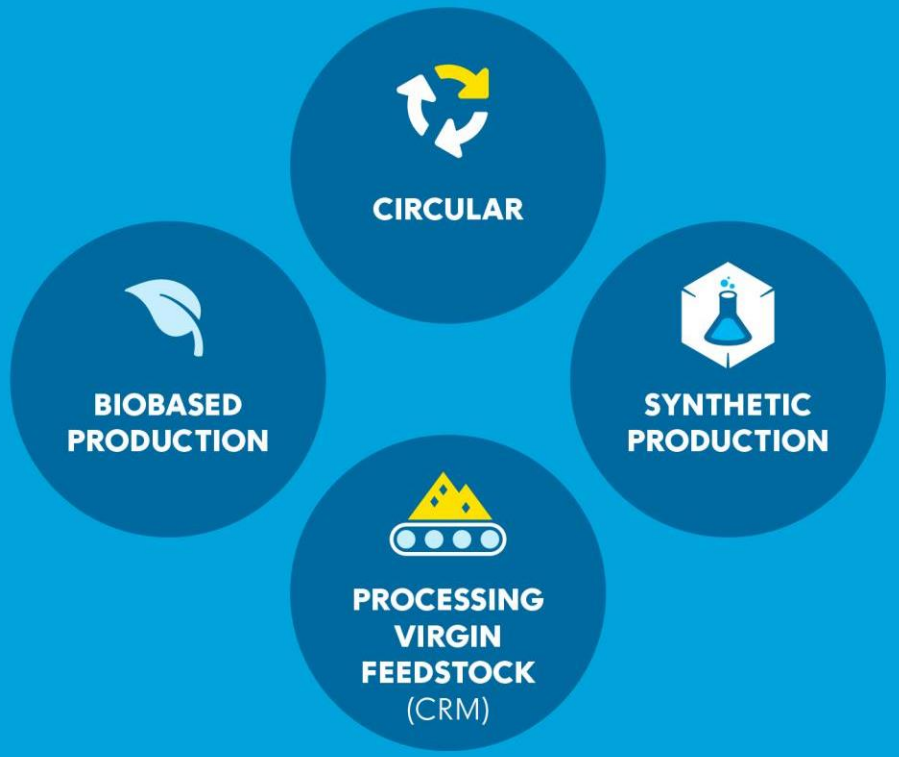
Port of Rotterdam

A NEW FEEDSTOCK AND FUEL SYSTEM

3

What

How



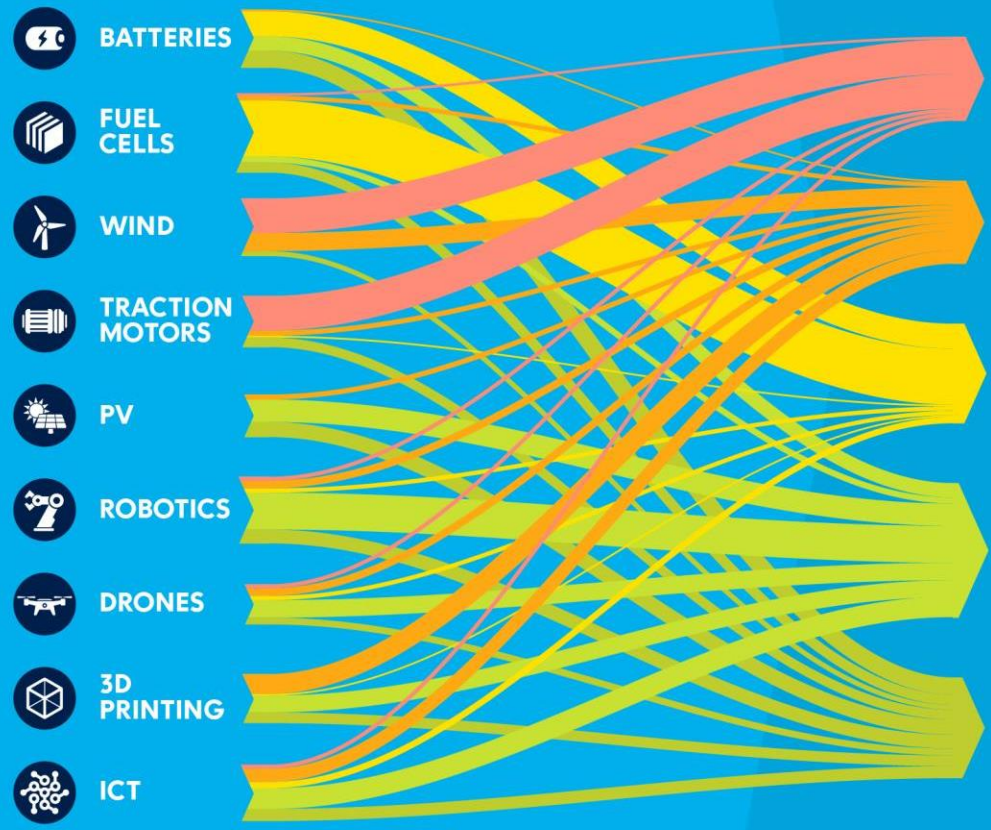
ZOOMING IN ON THE NETHERLANDS SECURITY OF SUPPLY

Focus on key technologies and specific CRM

Focus areas

- Energy transition
- Digitalisation
- Air & Space
- Defense

Key technologies

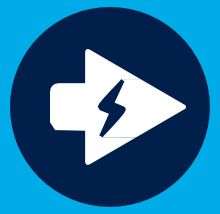


Critical Raw Materials

Very high	LREEs HREEs
High	Magnesium Niobium Germanium Borates Scandium
Moderate	Strontium Cobalt PGMs Natural graphite
Low	Indium Vanadium Lithium Tungsten Titanium Gallium, Hafnium Silicon metal
Very low	Manganese Chromium Zirconium Tellurium Nickel Copper

SECURITY OF SUPPLY

Focus on key technologies and specific CRM – focus areas



Energy transition

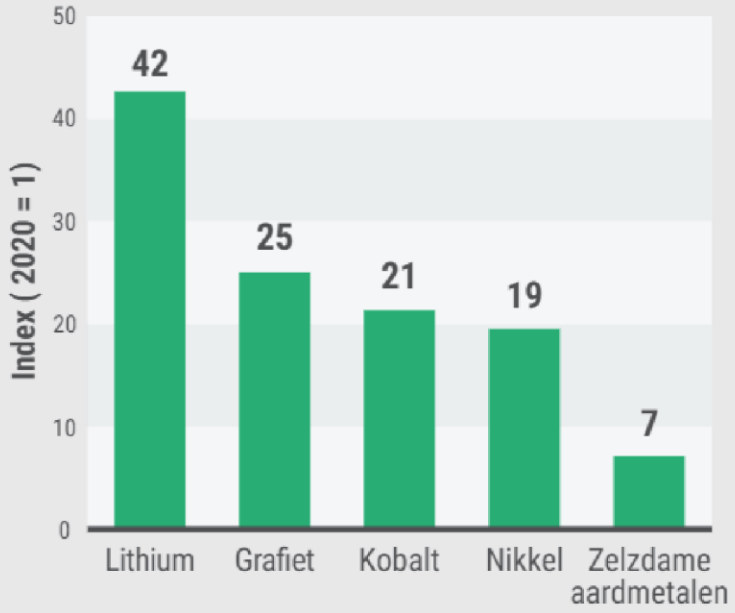
Digitalisation

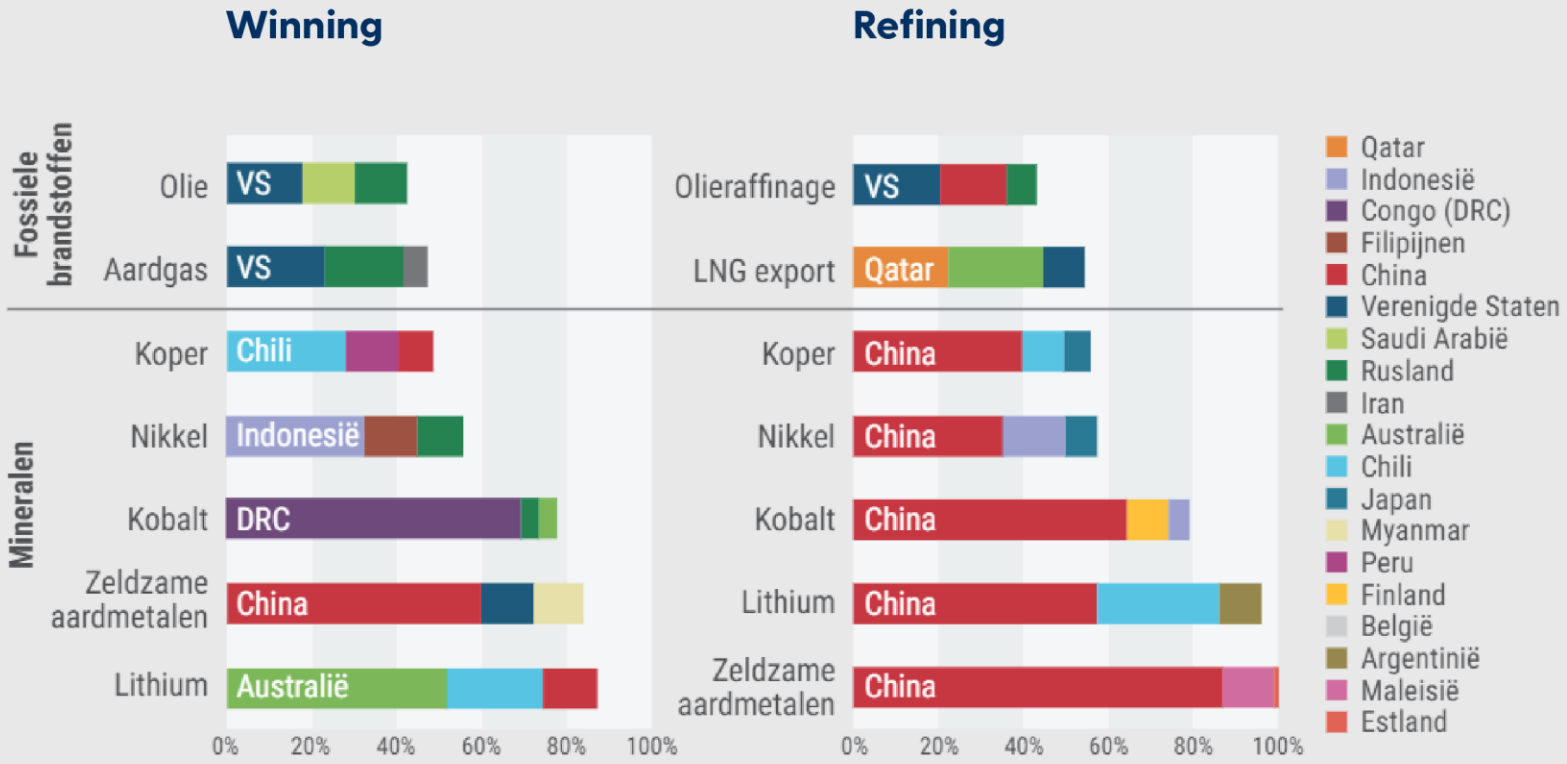
Air & Space

Defense

MAJORITY OF REFINING TAKES PLACE IN CHINA CREATING STRONG DEPENDENCE ON THIS COUNTRY

Demand 2040 of materials needed to reach Paris Climate Agreement
(compared to 2020)





TIMELINE

China has utilized this position to influence the CRM market

2021

Export controls on graphite

2022

Export restrictions on Lithium

2023

August

Export controls Gallium and Germanium

December

- Export controls on Graphite
- Export ban on Rare earth magnet manufacturing technology

2024

September

Export controls Antimony

Export ban

Gallium, Germanium and Antimony to the United States (semi-conductor, solar panels and defence industry get impacted)

2025

Proposed restrictions

On advanced battery and mineral processing technologies

CRITICAL RAW MATERIALS AND THE EU

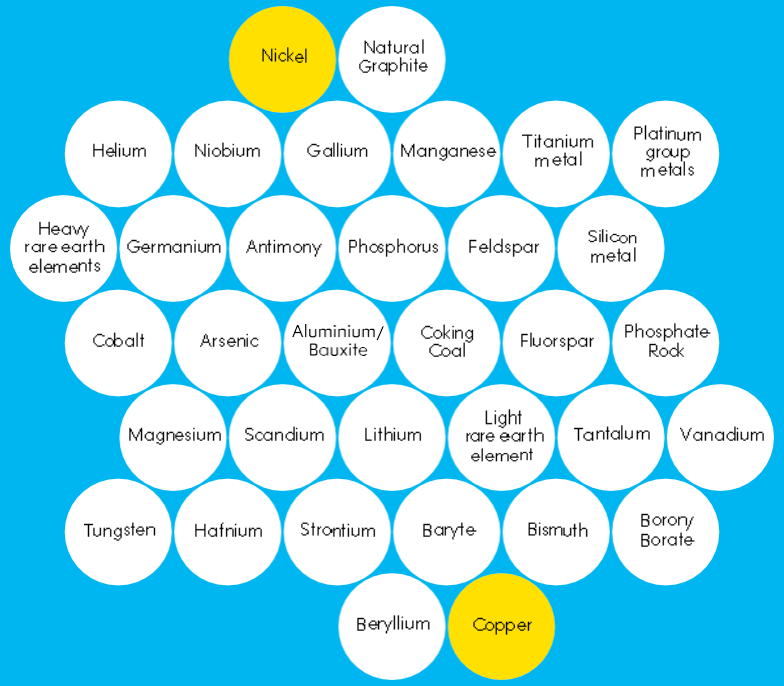
Importance

Critical raw materials (CRMs) are raw materials of **high economic importance** for the EU, with a **high risk of supply disruption** due to their concentration of sources and lack of good, affordable substitutes.

Strategic materials are

A. important to a nation's economy and/or defense,
B. demand is expected to increase substantially.

Materials



Eu critical raw materials act

2030 consumption

10% extraction
25% recycling
40% processing in EU

Max. 65% of any CRM imported from a single country

COLLABORATION IN IMPORT

Through

- Government to government
- Business to business
- Knowledge to knowledge

Based on existing renewable energy relations

CSR: our ambition is to have a positive impact

VALUE CHAIN

STRENGTHEN LOGISTICS, AND HANDLING FACILITIES IN ROTTERDAM

2

- Companies active in Critical Raw Materials
- Companies active in Construction Materials
- Other dry & breakbulk terminals

ONGOING DEVELOPMENT OF FACILITIES

Using our landlord role. EU aims at 15 processing facilities for CRM in the EU in 2030

3

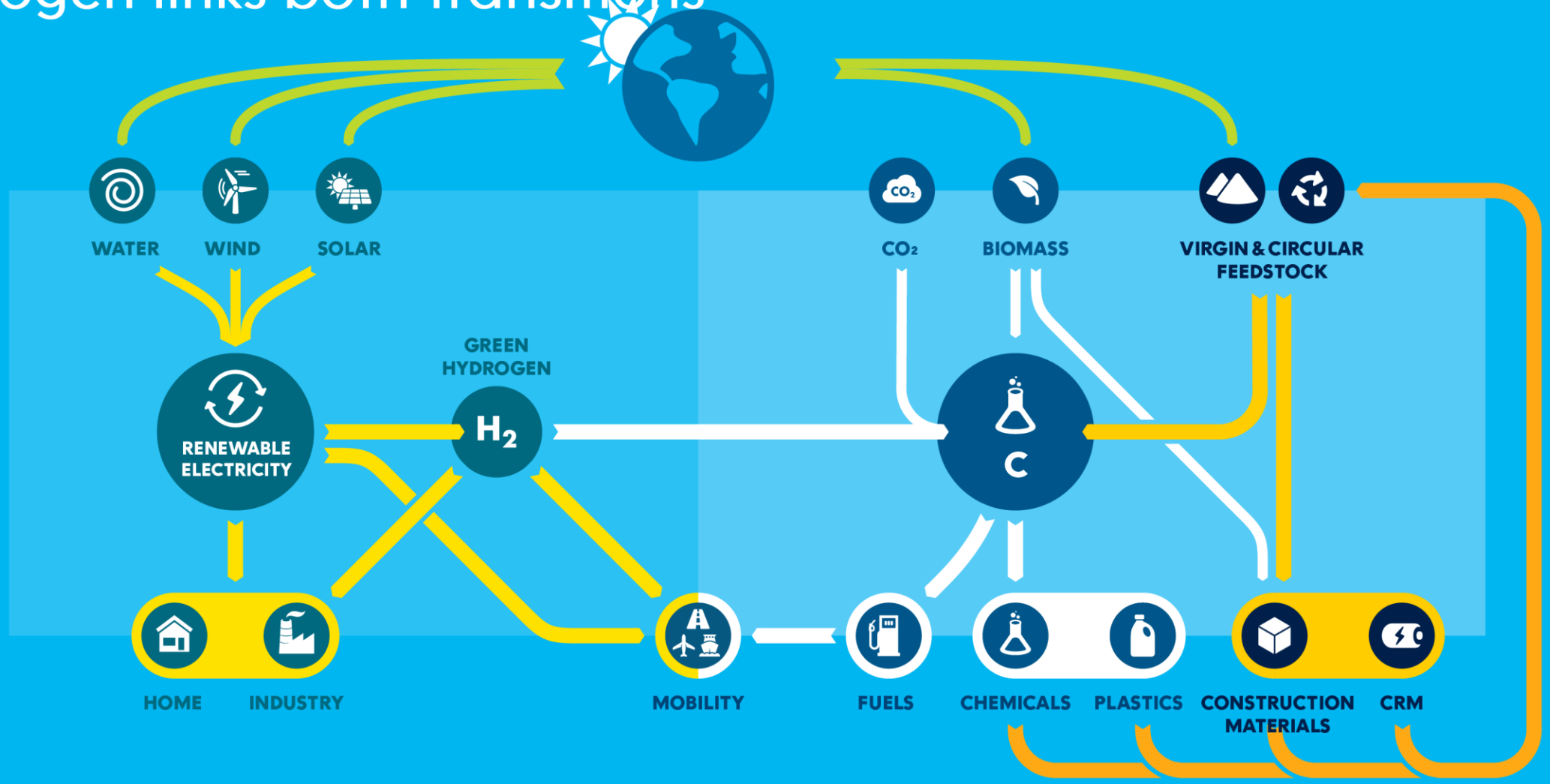
Processing facilities
Production and refining virgin CRM

Circular facilities
Recycling and recovery of used CRM

Port of Rotterdam

THE ENERGY & FEEDSTOCK TRANSITION ARE CONNECTED

Hydrogen links both transitions



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

NH_3

Clean ammonia

One existing terminal. 5 new terminals announced.

Bio ammonia delivery from US to Germany completed successfully

Ammonia bunker pilot successfully completed.

CH_3OH

Clean methanol

Multiple existing terminals. Already a European methanol hub.

Commercial bunkering of methanol already available in the port.

LH_2

Liquid hydrogen

2 Feasibility studies for new terminal completed.

LH_2 bunkering is currently being studied for several clients in the port.

LOHC

Liquid organic hydrogen carrier

Conversion of 2 existing terminals.

•••

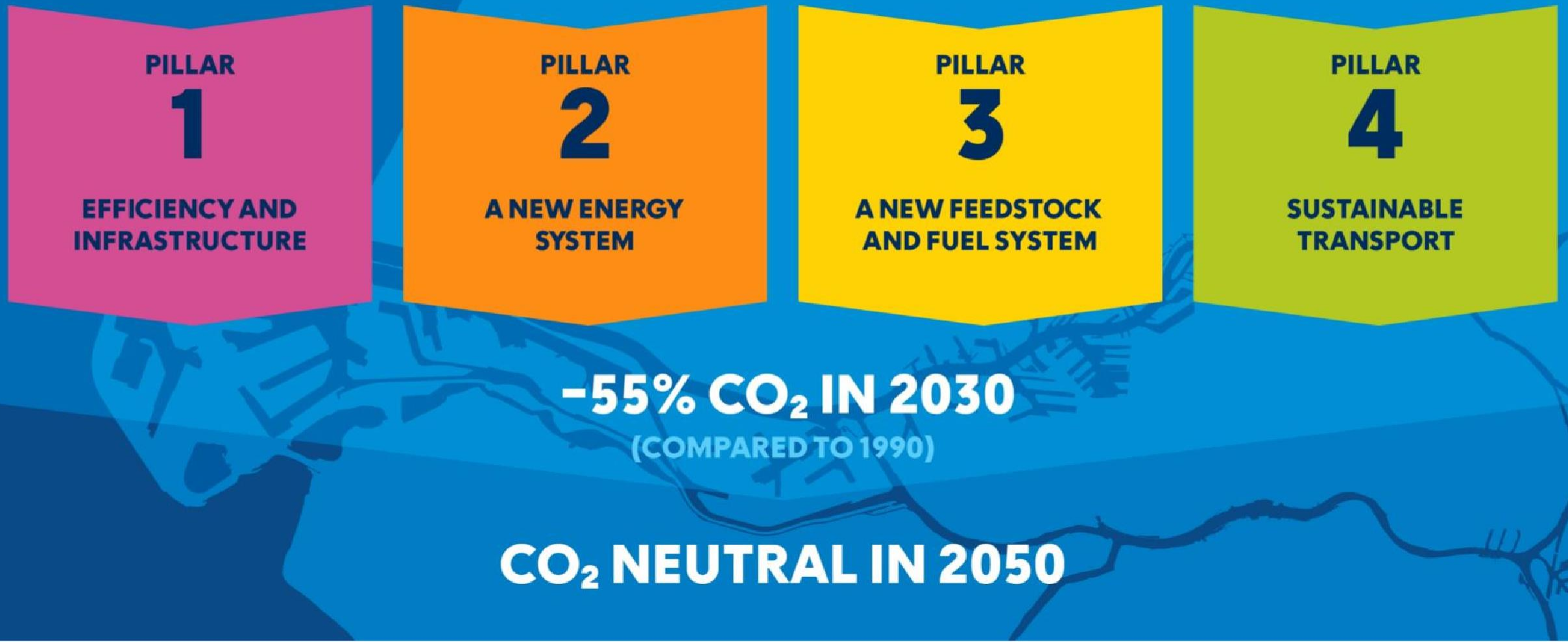
Other

Other technologies are also being explored (e.g. NaBH2).

Sustainable Aviation Fuel (SAF) is also handled at Port of Rotterdam, it is considered a hydrogen based fuel and not per se a carrier

Our governance model also enables us to play a leading role rising to the challenges of the Energy Transition

Energy Transition Strategy



Port of Rotterdam

PORT OF ROTTERDAM

CONNECTING THE WORLD

PORT AREA
42 KM

ROAD
29%

BARGE
47%

RAIL
8%

PIPELINE
16%

MODAL SPLIT

90,000
INLAND
VESSELS
PER YEAR

28,000
SEA-GOING
VESSELS
PER YEAR

LARGEST BIO-FUELS
CLUSTER GLOBALLY

10MT / YEAR
2ND LARGEST
BUNKER HUB GLOBALLY

439
MILLION TONNES
OF FREIGHT THROUGHPUT

13%
OF TOTAL EU
ENERGY DEMAND

CA. 193,000
DIRECT & INDIRECT JOBS

Port of Rotterdam

OUR JOINT CHALLENGE

TRANSPORT EMISSIONS TO NET ZERO IN 2050

Presenter Notes
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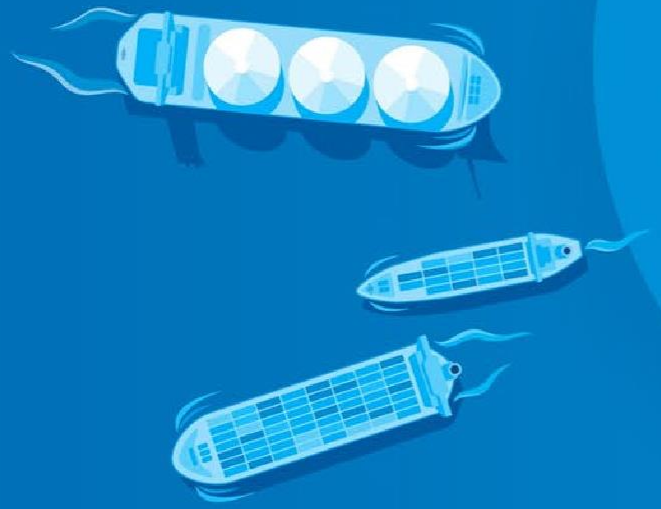
MARINE
DEEP SEA
SHORT SEA

PORT AREA
-20% CO_2 BY 2030
(SHIPPING, COMPARED TO 2019)

INLAND
RAIL
BARGE
ROAD



OUTSIDE PORT AREA
IMPACT BEYOND PORT AREA

Port of Rotterdam

Presenter Notes
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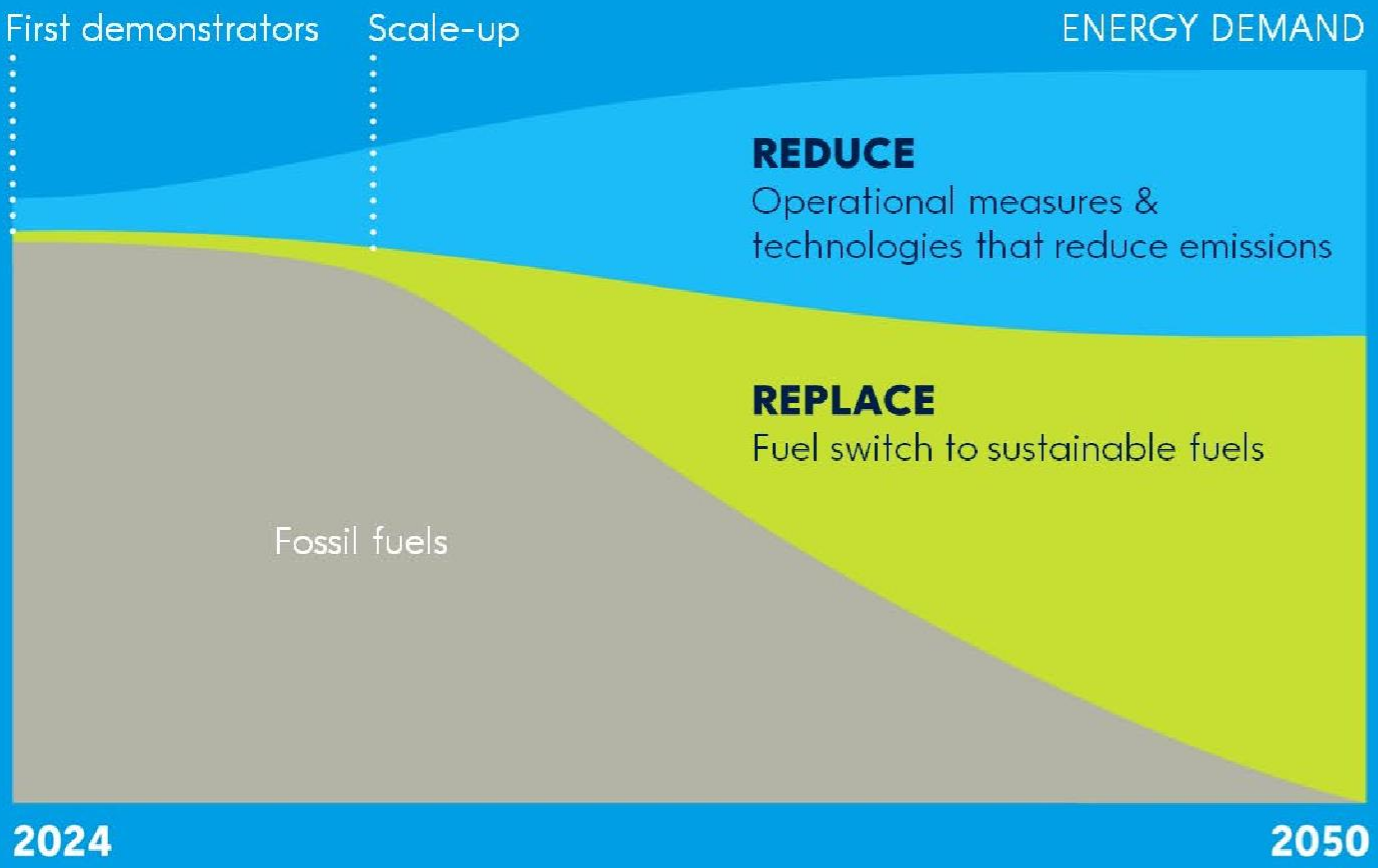
DUAL PATHWAY

TO ACHIEVE NET ZERO WE MUST REDUCE & REPLACE FOSSIL FUELS



Any sustainable alternative needs to be:

ALLOWED
Safety & regulations

AVAILABLE
Technology, infrastructure & energy

AFFORDABLE
Competitive at scale

Port of Rotterdam

REPLACE: WORKING TOWARDS A MULTIFUEL FUTURE

ALL FUELS FACE CHALLENGES

Import & Production

Bunkering

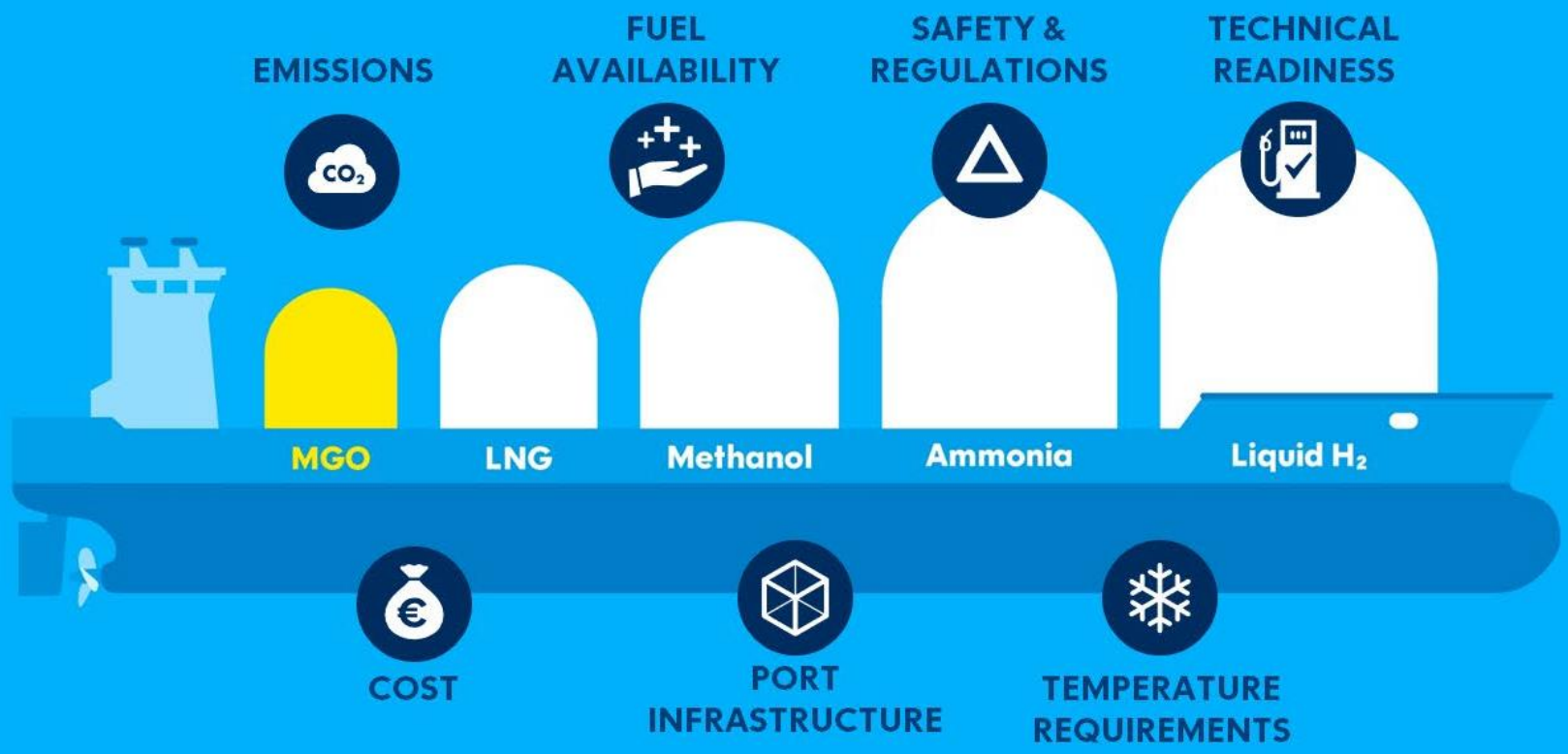


Image: Volumetric energy density of different fuels

Port of Rotterdam

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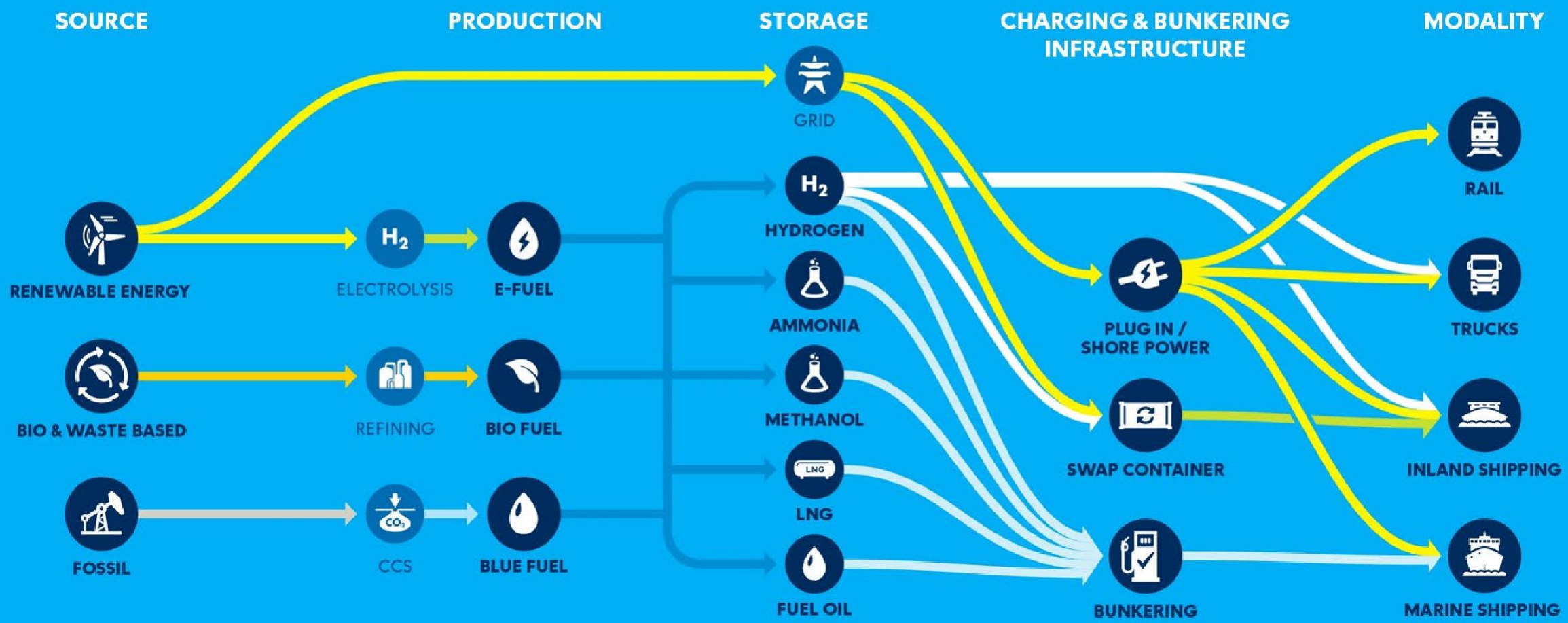
Cover slide, template

REPLACE: WORKING TOWARDS A MULTI-FUEL FUTURE

PATHWAYS TO SUSTAINABLE FUELS FOR ALL MODALITIES



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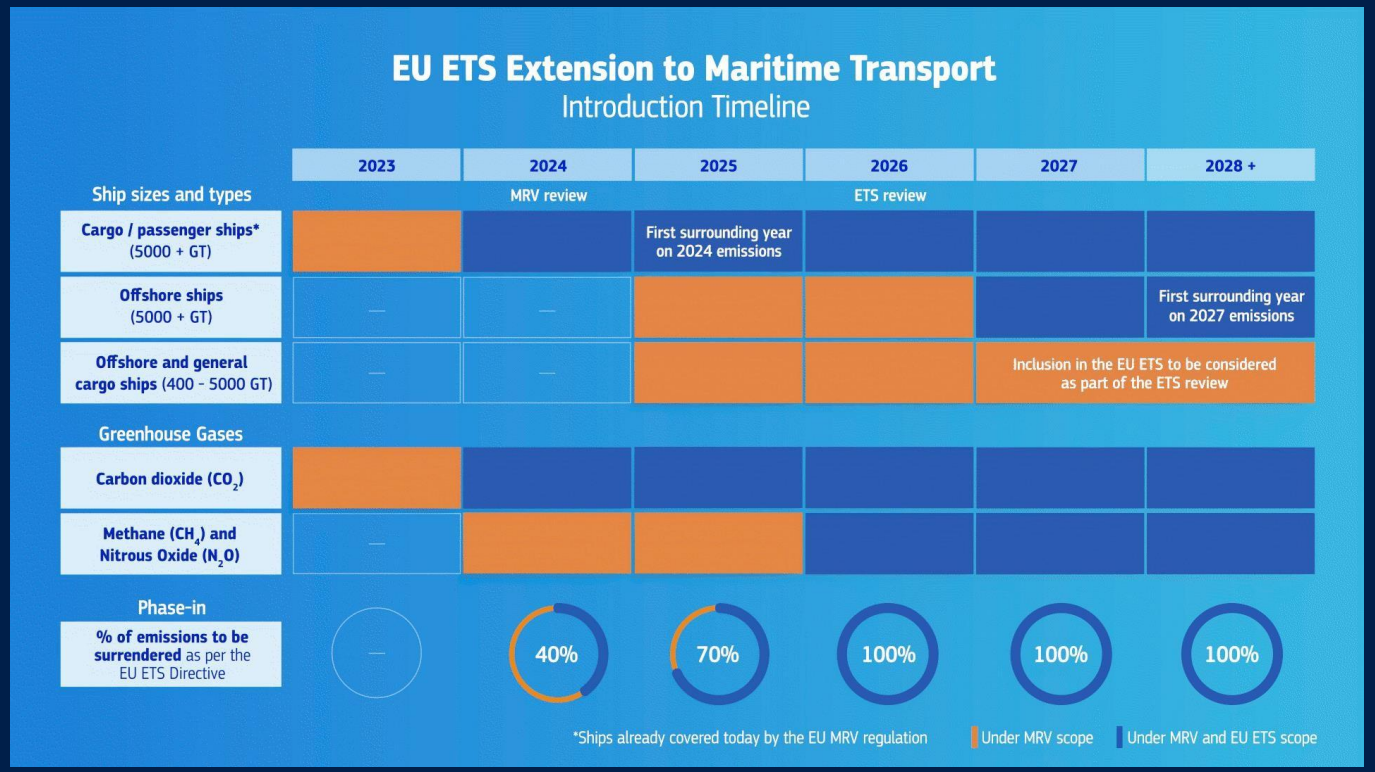
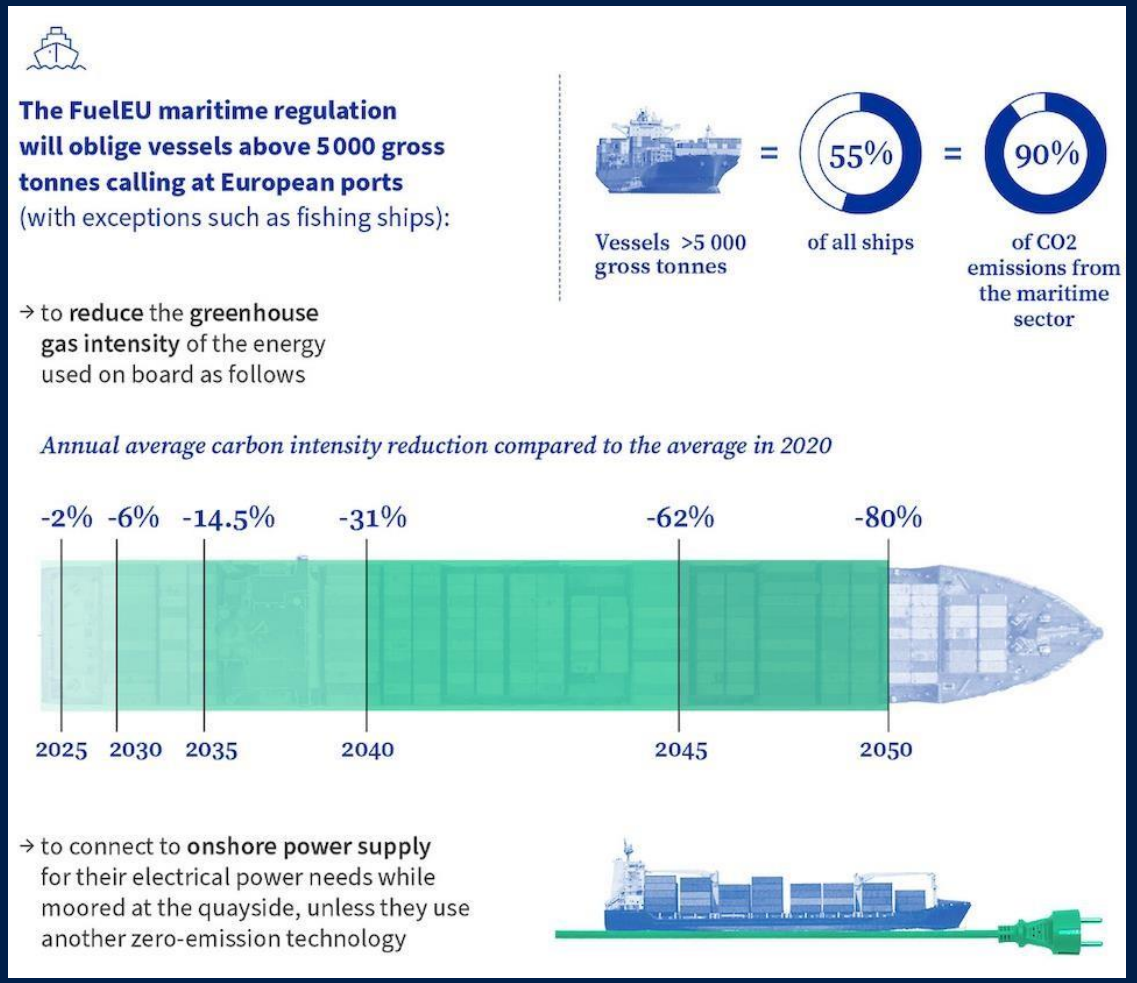
REGULATIONS AS KEY DRIVER IN THE TRANSITION



AFIR & RED



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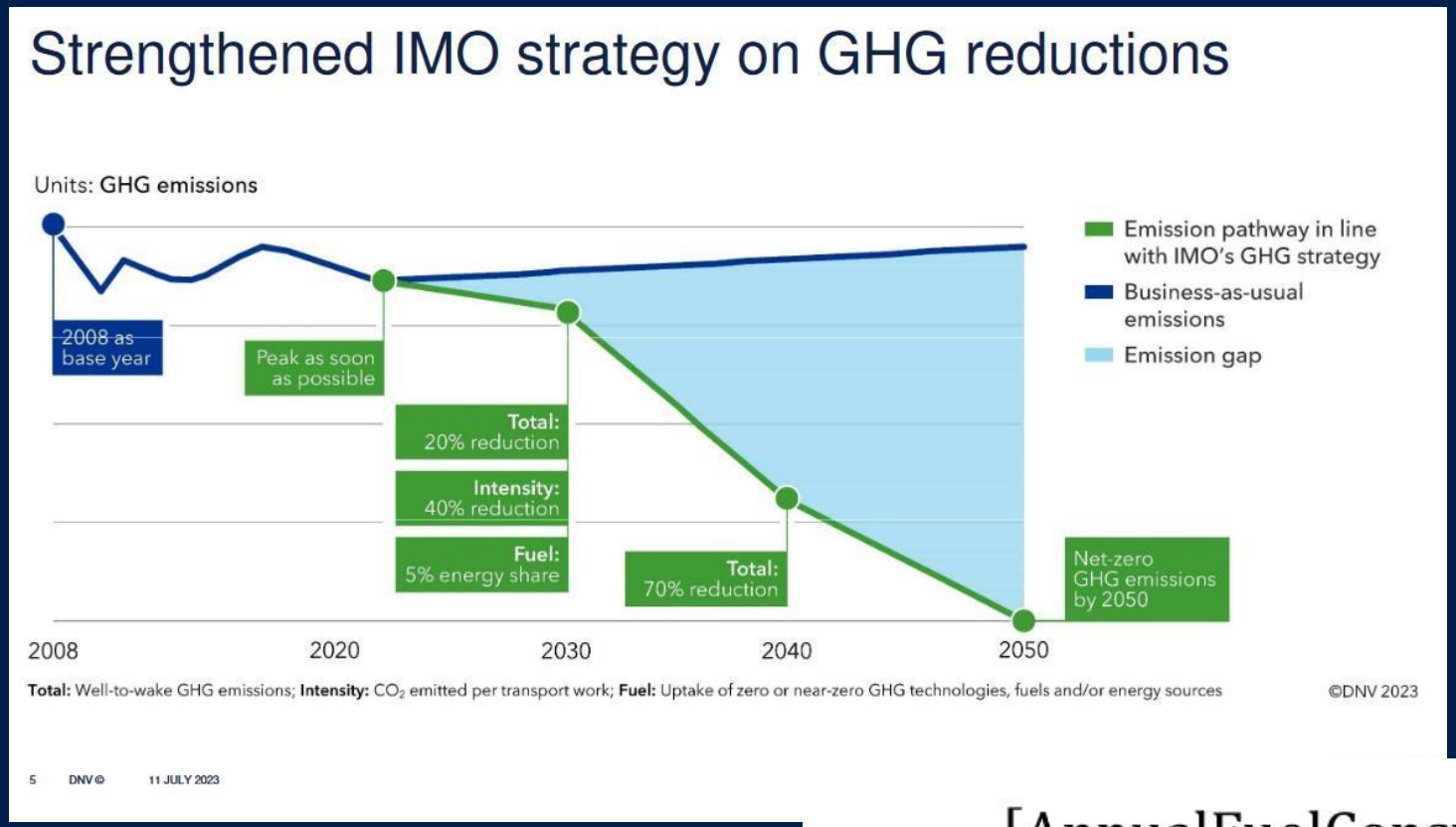
REGULATIONS AS KEY DRIVER IN THE TRANSITION



EEDI & EEXI

$$\mathbf{CII} = \frac{[\mathrm{AnnualFuelConsumtion}] \times [\mathrm{CO2emissionsfactor}]}{\mathrm{TransportWork} : [\mathrm{DistSailed}] \times [\mathrm{Capacity}]}$$

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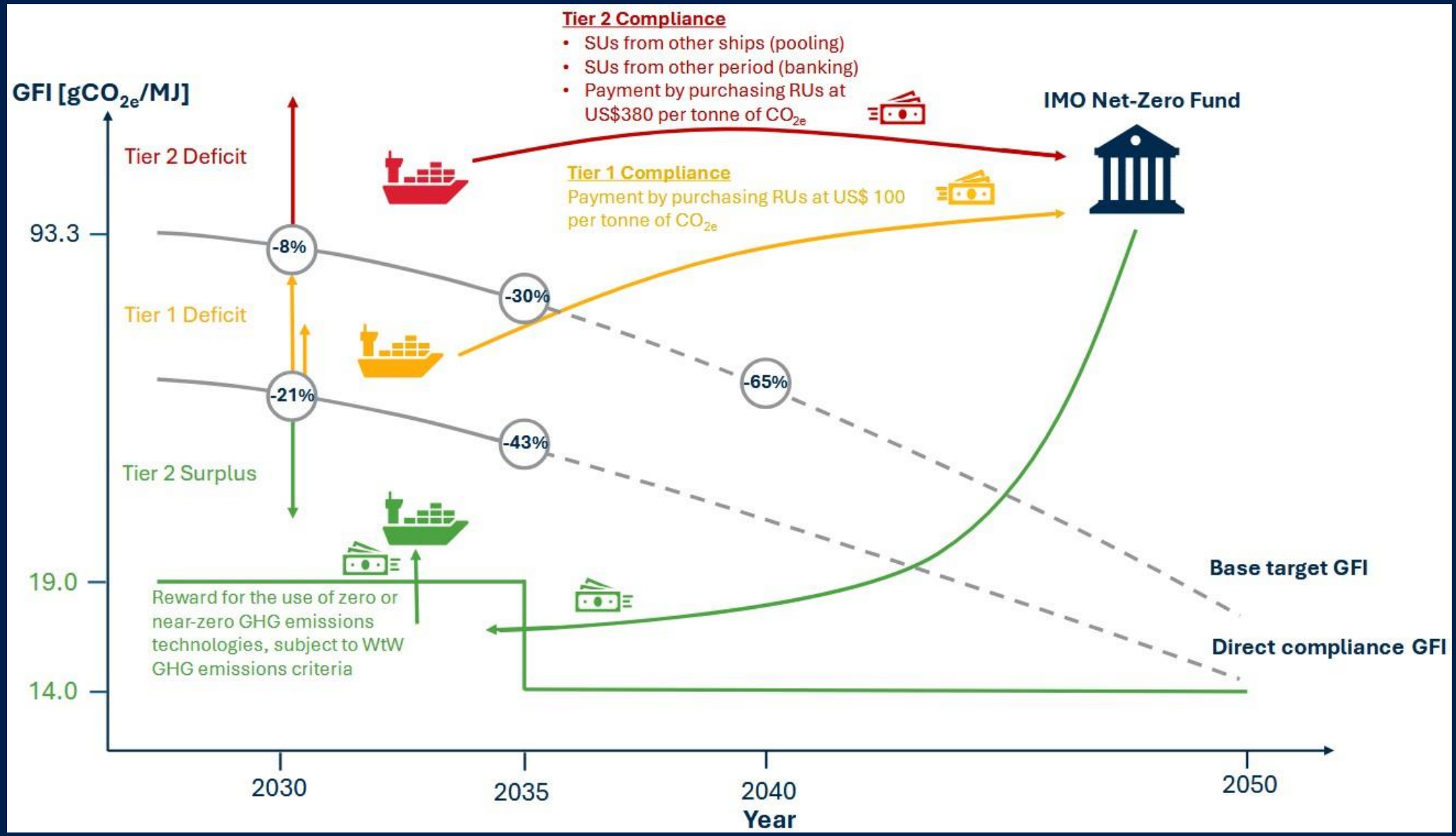
IMO



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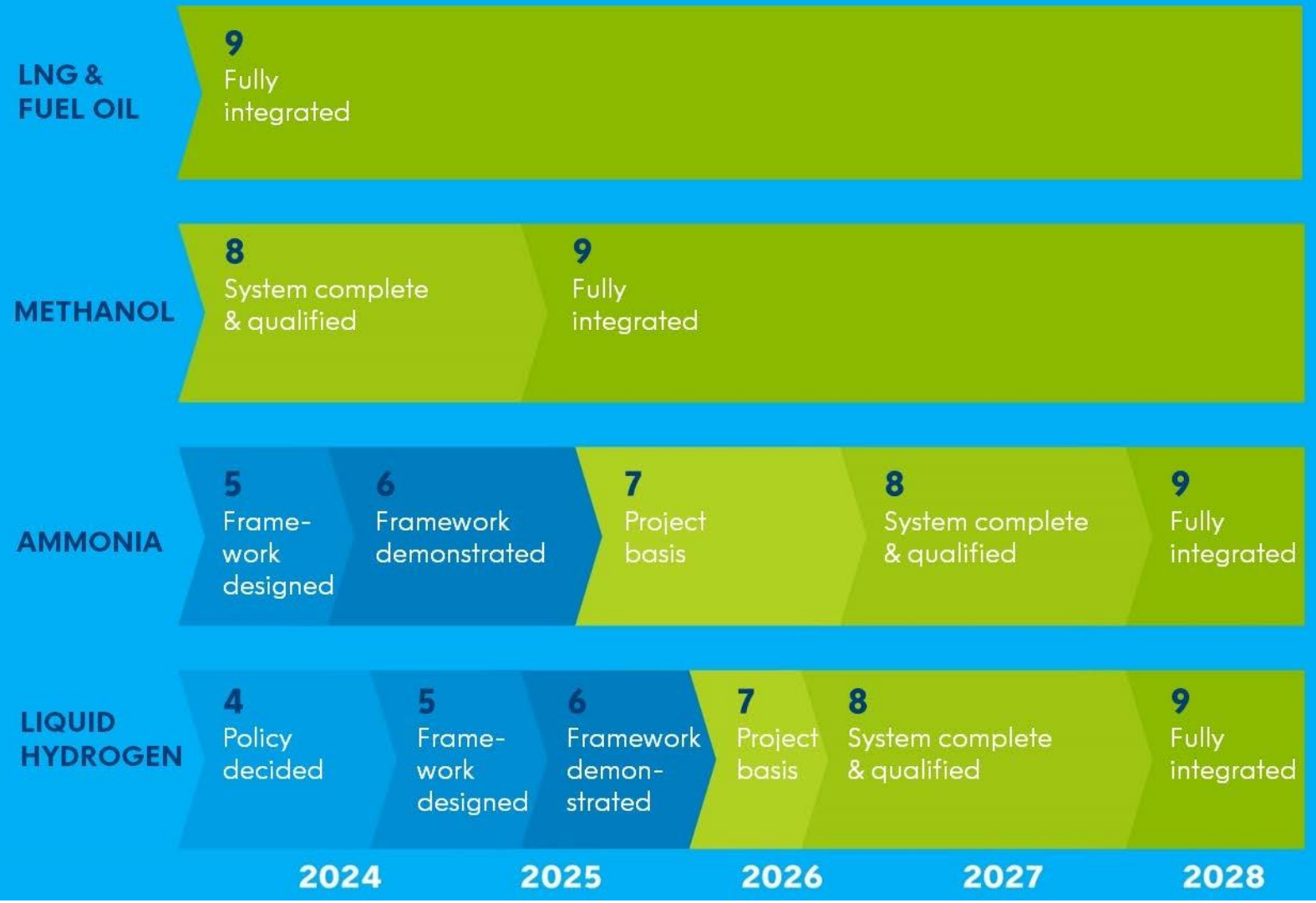
PROJECTED PORT READINESS FOR BUNKERING

Port Readiness Level (PRL) for marine fuel

Research	PRL 1	Fuel relevance assessed
	PRL 2	Interest of port stakeholders determined
	PRL 3	Sufficient information gathered
Development	PRL 4	Policy for bunkering specific fuel decided, roadmap developed
	PRL 5	Framework for bunkering and associated activities of a specific fuel designed
	PRL 6	Framework for bunkering specific fuel demonstrated in a protected environment
Deployment	PRL 7	Bunkering of specific fuel established on a project base in an operating environment
	PRL 8	System for bunkering of specific fuel complete and qualified
	PRL 9	Bunkering of specific fuel integrated in regular port operations



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AMMONIA BUNKER PILOT SUCCESSFULLY COMPLETED

COLD AMMONIA SHIP2SHIP TRANSFER

Rotterdam is EU largest bunker hub, globally 2nd

- First ammonia bunker pilot alongside terminal
- Transfer of **cold ammonia** at -33 °C between 2 gas carriers
- Transfer **outside working hours**
- **No ammonia emission** during operation, **including purging**
- Use & validation of **international standards**
- ~500 tonnes / ~800 m3 NH3 transferred
- 2.5 hours of transfer time

OCI

James Fisher Fendercare

VICTROL

Port of Rotterdam

Trammo®

Lifting Global Trade.
APM TERMINALS

Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping

MAGPIE
SMART GREEN PORTS

Co-funded by the European Union

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METHANOL BUNKERING ON A REGULAR BASIS

1st green methanol bunkering by Laura Maersk in 2023

AMMONIA BUNKER PILOT SUCCESSFULLY COMPLETED

Cold Ammonia ship2ship transfer

SHORE POWER CRUISE TERMINAL

- Opened 31st of March 2025
- 22 months construction time
- Capacity of 10 MW
- 230 meter cable duct for connection flexibility
- Fully concealed when not operational
- Carriage developed for Rotterdam, adopted internationally

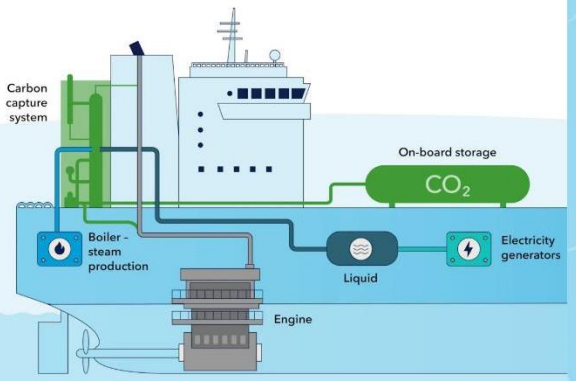
WORKING TOGETHER WITH SAMSKIP ON HYDROGEN

Enabling LH2 bunkering in Rotterdam

Port of Rotterdam

ONBOARD CARBON CAPTURE VALUE CHAIN

Step 1 Capture

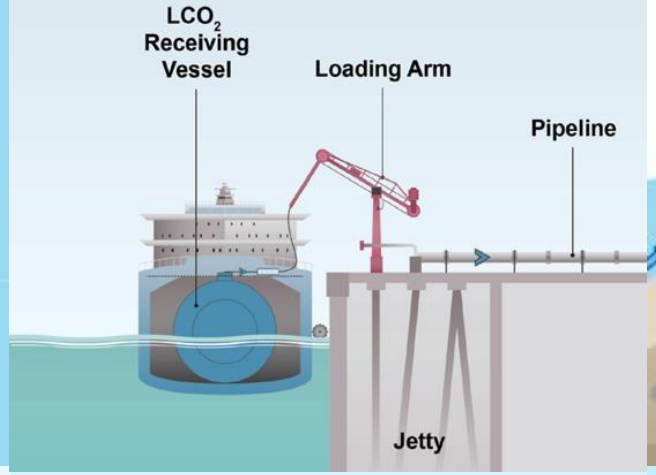


OCC system captures CO_2 from combustion of carbon-based fuels onboard vessels, purifies and liquifies for storage onboard.

Step 2 Offloading

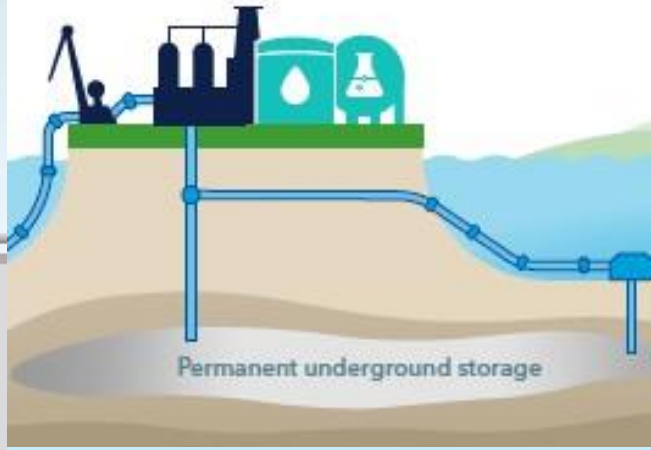
In the port, the LCO_2 is collected by LCO_2 barges.

Step 3 Transport and intermediate storage



The LCO_2 barge offloads the LCO_2 for onshore intermediate storage (and potential purification).

Step 4 Sequestration or utilisation



The LCO_2 is brought offshore for permanent storage or may be utilized in, for example, the production of e-fuels.

INLAND SHIPPING: ZERO EMISSION SERVICES

PAY PER USE

EXCHANGEABLE ENERGY CONTAINERS

DOCKING STATION

AGGREGRATOR

FCR

OPEN ACCESS CHARGING INFRASTRUCTURE

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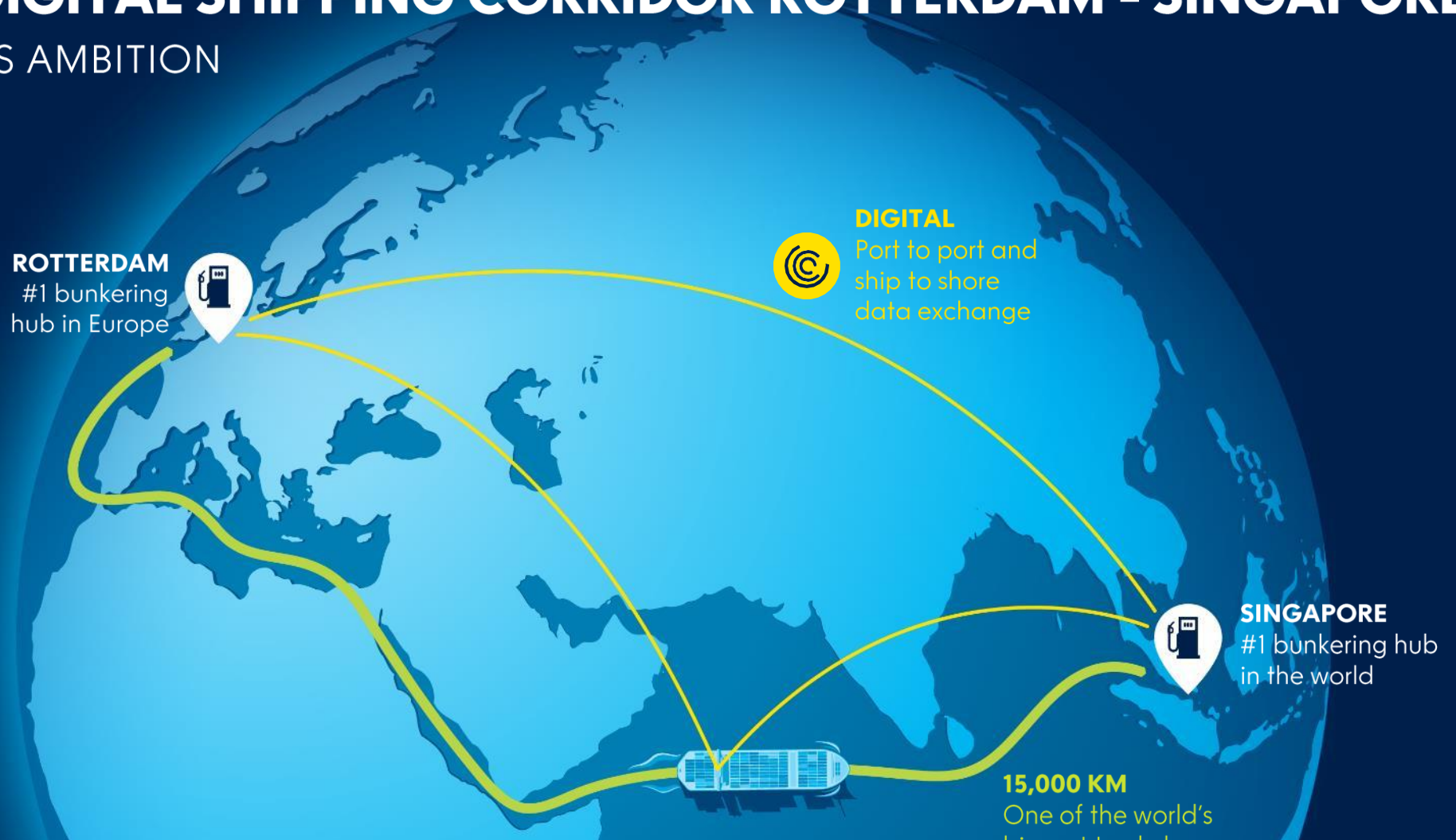
GREEN & DIGITAL SHIPPING CORRIDOR ROTTERDAM - SINGAPORE

ACTION MEETS AMBITION



ROTTERDAM
#1 bunkering hub in Europe

DIGITAL
Port to port and ship to shore data exchange

GREEN
Early commercialization of a sustainable multi-fuel future

SINGAPORE
#1 bunkering hub in the world

15,000 KM
One of the world's biggest trade lanes

Port of Rotterdam
MPA
CMA CGM
MAERSK
ONE
msc
Hapag-Lloyd
bp
SEA-LNG
Gate terminal
PSA
The World's Port of Call
SLNG
SINGAPORE LNG
MARITIME DECARBONISATION
GLOBAL MARITIME FORUM
citi
METHANOL INSTITUTE
YARA
RMI
Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping
CLIFFORD CAPITAL
UNIVERSITY OF OXFORD
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE
NUS National University of Singapore

INDIA & NETHERLANDS

BUILDING THE FUTURE TOGETHER

Port of Rotterdam

THANK YOU AND SEE YOU IN ROTTERDAM

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portofrotterdam.com/containershipping

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