PATHWAYS TO A SUSTAINABLE PORT
Mission:

The Port of Rotterdam Authority creates **economic and social value** by working together with clients and stakeholders on the realisation of **sustainable growth** in Rotterdam’s world-class port.
Port in figures

Port of Rotterdam engine of the economy

- Total port area 12,643 ha (net 6,046 ha)
- Total employment 180,000 people*
- Total added value ± € 23 billion (3.3% GNP)*
- 3,000 companies
- Largest port in Europe, 10th port worldwide
- Throughput 467.4 mln tons; 13.7 million TEU (containers)
- Depth up to 75 ft (= 24 m)
- Visits: 29,646 sea-going vessels
  105,000 inland navigation

* source: Erasmus University
Port is dominated by fossil energy and logistics

- Liquid bulk: 6%
- Containers: 46%
- Dry bulk: 31%
- Breakbulk: 17%

2017

24 November 2018
THE WORLD AGREES

... reach global peaking of greenhouse gas emissions as soon as possible ... rapid reductions as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century ...
Warming versus cumulative CO₂-emissions

...limiting total human-induced warming to less than 2°C relative to the period 1861–1880 ... would require cumulative CO₂ emissions from all anthropogenic sources since 1870 to remain below about 2900 GtCO₂... About 1900 Gt CO₂ had already been emitted by 2011.

Source: IPCC, Climate Change 2014 synthesis report
Current CO$_2$ emission $\sim$35 Gtons / yr

Source: IPCC, Climate Change 2014 synthesis report
The Netherlands emits ~0.5% of worldwide CO₂ emission

Energy sector and industry are responsible for 30% resp. 22% of CO$_2$ emissions in The Netherlands

Uitstoot koolstofdioxide naar sector

- Energiebedrijven
- Grote industrieën
- Wegverkeer
- Gebouwde omgeving
- Overig
- Landbouw

Bron: CBS, RIVM/Emissieregistratie
Energy demand will almost half, while emissions are reduced by ~85%

Investment of ~15 bln euro / yr needed to reduce emissions by 85% in 2040

This amounts to ~120 euro per ton CO₂ reduced

Source: McKinsey - Accelerating the energy transition: cost or opportunity?
CO₂ emission in the port is ~ 32 mln tons

Has increased since 2012 because of two new coal fired power plants

Will decrease from 2017 onwards because of closure of old coal fired power plants
THE PORT INDUSTRY IS CARBON INTENSIVE

- Crude oil
- Oil Products
- Coal
- LNG
- Waste
- Biomass

- Fuel & Feedstock
- Products
- Natural Gas
- Electricity

> 30 refinery processes
> 40 petrochemical processes
> 70 electricity generation units

20% of the Netherlands’ total CO₂ emissions
Products:

fuel

5 refineries in Rotterdam:

- Shell
- BP
- Exxon
- Gunvor

Total capacity:

- 1 million barrels per day
- 50 million tonnes per year
Products: Chemistry

Chemical industry in Rotterdam/Moerdijk

• Salt - Chlorine
• Olefins: Ethylene, Propylene, Butylene
• Aromatics: Benzene, Ortho-xylene and Paraxylene
2017

DECARBONISE PORT INDUSTRY

PATHWAYS TO A DECARBONISED PORT

30 Mton CO₂ emissions
[- 20% NL]

2018

DECARBONISE PORT TRANSPORT

To…RTM …From

25 Mton CO₂ emissions
PATHWAYS TO DECARBONISED PORT INDUSTRY

CLOSED CARBON CYCLE

BIOMASS AND CCS

TECHNOLOGICAL PROGRESS

BUSINESS AS USUAL

PARIS AGREEMENT

"Decarbonization pathways for the industrial cluster of the Port of Rotterdam" Wuppertal Institute. Simplified for clarity reasons.
Decarbonization pathways for the industrial cluster of the Port of Rotterdam

**SLOW ADOPTION OF BEST AVAILABLE TECHNOLOGIES**
- Power to heat
- Reinvestments in refineries and petrochemical plants
- Heat grid extension
- Water electrolysis (H₂ production)

**WIDESCALE IMPLEMENTATION OF PARIS AGREEMENT**
- Increased share of renewable electricity (wind / solar)
- Rapid adoption of best available technologies (energy efficiency)
- Large scale availability of 100% renewable electricity production
- Water electrolysis (H₂ production)

**98% CO₂ reduction 2050 vs. 2013**
- Synthetic chemicals from waste streams
- Power to heat & geothermal heat
- Carbon capture and storage

**75% CO₂ reduction 2050 vs. 2013**
- Large scale CCS (for power plants and refineries)
- Large scale availability of sustainable biomass
- Reinvestments in refineries and petrochemical plants
- (Small scale) power to heat

**30% CO₂ reduction 2050 vs. 2013**
- Synthetic fuel & biobased production
- Reinvestments in refineries and petrochemical plants
- Large scale availability of 100% renewable electricity production
- Water electrolysis (H₂ production)
- (Small scale) power to heat

"Decarbonization pathways for the industrial cluster of the Port of Rotterdam" Wuppertal Institute. Simplified for clarity reasons.
CO\textsubscript{2} Emissions Transport, worldwide

- 23% of global CO\textsubscript{2} emissions
- 30% caused by transport of goods
- 2.5% by deep sea shipping

Source: IMO 3rd GHG Study 2014
CO₂ Emissions Transport, Rotterdam related

- Maritime Transport: 87%
- Berthed Ships: 2%
- Hinterland Transport: 9%
- Container Handling: 1%
- Other: 1%

25 Mton CO₂ emissions annually
PATHWAYS TO DECARBONISE TRANSPORT.

PORT OF ROTTERDAM

RETAIL LOCATION

CO₂ NEUTRAL TRANSPORT
MAKE IT HAPPEN.

Port of Rotterdam
HOW?
“In 3 steps towards a sustainable industrial cluster Rotterdam-Moerdijk”

1. **2018-2025**: reduction of CO₂ emissions (efficiency, networks for residual heat & steam, CCUS); innovation for steps 2 & 3

2. **2020-2030**: Towards a new energy system for the industry (electrification, hydrogen)

3. **2030-2050**: Towards new systems for raw materials (industry) and fuels (transport)
Towards CO₂-neutral

**STEP 1**
**NOW – 2025**
Efficiency; Infra for Heat, Steam, CCUS; Innovation for Step 2 & 3

**STEP 2**
**2020 – 2030**
Towards a new energy system

**STEP 3**
**2030 – 2050**
Towards a new system for raw materials and fuels

**THE GOAL**
**2050**
Limit global warming to 1.5°C to 2°C

**NOW**
- Efficiency at plants
- Heat network
- Steam network Botlek
- Connection windfarms North Sea
- Porthos (CCUS)
- Cold ironing
- Efficiency shipping industry

**COMING SOON**
- CCU: mineralization, green houses

**PRODUCTION WIND TURBINES**
- Windfarms onshore
- North Sea wind power hub
- Solar panels
- Power to hydrogen

**ENLARGING ELECTRICITY NETWORK**
- Windfarms offshore
- Power to heat
- Blue hydrogen
- Hydrogen network
- Geothermics
- Energy storage

**WASTE-TO-CHEMICALS**
- Pilot circular economy
- Bio-kerosene
- Zero emission inland shipping (electric, hydrogen)

**WASTE**

**BIO**
- E → hydrogen

**FUELS**

**CHEMICALS**
Funnel energy transition projects

exploring
conceptualising
elaboration
feasibility studies
preparation
realisation

WATERSTOF
NSWP
BIO LNG
BIORAFFINAGE

NSWP
GROENE CORRIDOR
EMISSIELOOS VAREN

GROENE CORRIDOR
EMISSIELOOS VAREN

CCUS
WASTE-TO-CHEMICALS
AANLANDING TENNET KABEL WIND-OP-ZEE

WASTE-TO-CHEMICALS
AANLANDING TENNET KABEL WIND-OP-ZEE

BIOPORT HOLLAND

BIOPORT HOLLAND

BIOPORT HOLLAND

DRIJVENDE ZONNEPANELEN

DRIJVENDE ZONNEPANELEN

DRIJVENDE ZONNEPANELEN

OFFSHORE CENTER ROTTERDAM

OFFSHORE CENTER ROTTERDAM

OFFSHORE CENTER ROTTERDAM

VONDELINGEN-WARMTE

VONDELINGEN-WARMTE

VONDELINGEN-WARMTE
Examples of projects
Warmtealliantie Zuid-Holland

Vijf partners werken aan een warmtenet voor een betaalbare, betrouwbare en CO₂-arme warmtevoorziening

Port of Rotterdam  |  Gasunie  |  Warmtebedrijf Rotterdam  |  Eneco

Invoegen
Onshore pipeline (33 km)

Offshore pipeline (21 km)

Compressor station

Storage fields (37 Mton)

CCU: existing pipeline to greenhouses

CCUS
**Opslagvelden**
P18-4 en P18-2 (max. 37 Mton)

**Offshore pipeline**
21 km uit de kust

**Compressorstation**
2 locatie mogelijkheden

**Pijpleiding op land**
2 mogelijke tracés

**Levering CO2 aan tuinders**
doors OCAP
CCS has substantial share in VHKA

- 7 Mton CCS is over 14% of the total Dutch CO\textsubscript{2} reduction in 2030
- 7.3 Mton ‘other industry’ comprises:
  - Electrification and hydrogen (4)
  - Extra efficiency (2)
  - Reduction in laughing gas (1)
  - Recycling, CCU, bio-based chemistry (1)
CCUS: cost efficient, large volumes, rapidly operational

Kosteneffectiviteit en potentieel van CO₂ besparingsmaatregelen in 2030

Bron: Nationale kosten energietransitie in 2030, PBL 2018
Public-private partnerships are needed for CCUS

**Public companies**
*Infrastructure initiators & investors*

**Private companies**
*Invest in capture, pay for transport and storage*

**Public parties**
*Mandate, bridge costs for CCUS - ETS, long-term responsibility CO2*

24-11-2018
Klik op het icoontje om een nieuwe afbeelding in te voegen.
Zoek en selecteer de gewenste afbeelding. Klik op 'Invoegen'.

24 november 2018
Offshore wind energy and Port of Rotterdam

Current situation

- >6 GW installed generation capacity (fossil based)
- Security of Supply: Dutch High Voltage Grid >99,99%
- Grid is future proof and ready for 2030 offshore wind targets
- Port of Rotterdam part of the offshore wind coalition*

Projection offshore wind 2030 by Ministry of Economic Affairs, Source: https://www.rvo.nl/file/presentatie-regiosessies-ezkpdf

Phase I: to 2023

- 3,500 MW: 5 x 700 MW
- Hollandse Kust (Zuid) to Maasvlakte, Port of Rotterdam, 1.4 GW
- Standardized concept
- AC connections
Phase II: 2024 - 2030

- Additional 7,000 MW
- Energy Agenda/Coalition Agreement
- Maasvlakte, Port of Rotterdam preferred location for connecting “Hollandse Kust (West)” and “IJmuiden Ver” (4.7 GW)*

*Source: VERKENNING AANLANDING NETTEN OP ZEE 2030
North Sea Wind Power Hub

The Power Link Island: a modular approach

- Far shore becomes near shore
- Distribution point for different countries
- Space for multiple converters (AC→DC)
- Power to Gas
Power-to-hydrogen and power-to-gas-to-chemicals

Electrification of the industry: using sustainable electricity hydrogen, syngas and other base chemicals can be produced

Green hydrogen production is close to being competitive: projects of 100 MW are being announced in several regions in The Netherlands

However, production of syngas and other chemicals will take until ~2030 to reach maturity
Reduction CO₂ emission 2015 - 2030 - 2050

- Closure of old Coal Fired Power Plants (2017)
- Closure of new Coal Fired Power Plants (2030)
- Closure of Gas Fired Power Plants (including CHP)
- Energy efficiency
- Diminishing demand
- CCUS
- Renewable Energy (Power-to-heat and Electricity)*
- Renewable Feedstock (Bio and Waste)**
- Geothermal Energy

49% REDUCTION AS COMPARED TO 1990

* Includes Power-to-heat, as well as using Renewable Electricity to power machines.

** Includes Bio-to-chem, Waste-to-chem as well as Recycling. In a later stadium also Power-to-hydrogen-to-chem.
The Port of Rotterdam has the ambition to be frontrunner

- Rotterdam has the ambition to be Europe’s energy transition fieldlab, frontrunner and flagship region
- ‘Renewing the existing’ and ‘Supporting the new’ together will help us to realise the Paris Agreement goals
QUESTIONS?