

An EU strategy for CCS and CCU: Safeguarding European industrial competitiveness

10 February 2022

Zero Emissions Platform

An EU strategy for CCS and CCU: Safeguarding European industrial competitiveness



Introduction – *Jonas Helseth, ZEP Vice-Chair and Director, Bellona Europa*

An EU strategy for CCS and CCU

- Florence Delprat-Jannaud, ZEP Vice-Chair and CCS Program Manager, IFPEN
- Bram Sommer, Advisor of Public and Regulatory Affairs, Port of Rotterdam
- Arthur Heberle, Head of Technology, New Business, Mitsubishi Power Europe

Q&A – *Chaired by Lucie Boost, ZEP External Relations Group Co-Chair and EU Affairs Manager, Equinor*

Zero Emissions Platform

- Advisor to the European Commission on the deployment of CCS and CCU
- Broad membership basis
- Go-to organisation to liaise with the European Commission and Parliament – good cooperation with Member State governments

Output

- High-level meetings with stakeholders
- Technical reports with a focus on policy
- Position papers on timely issues
- And more!

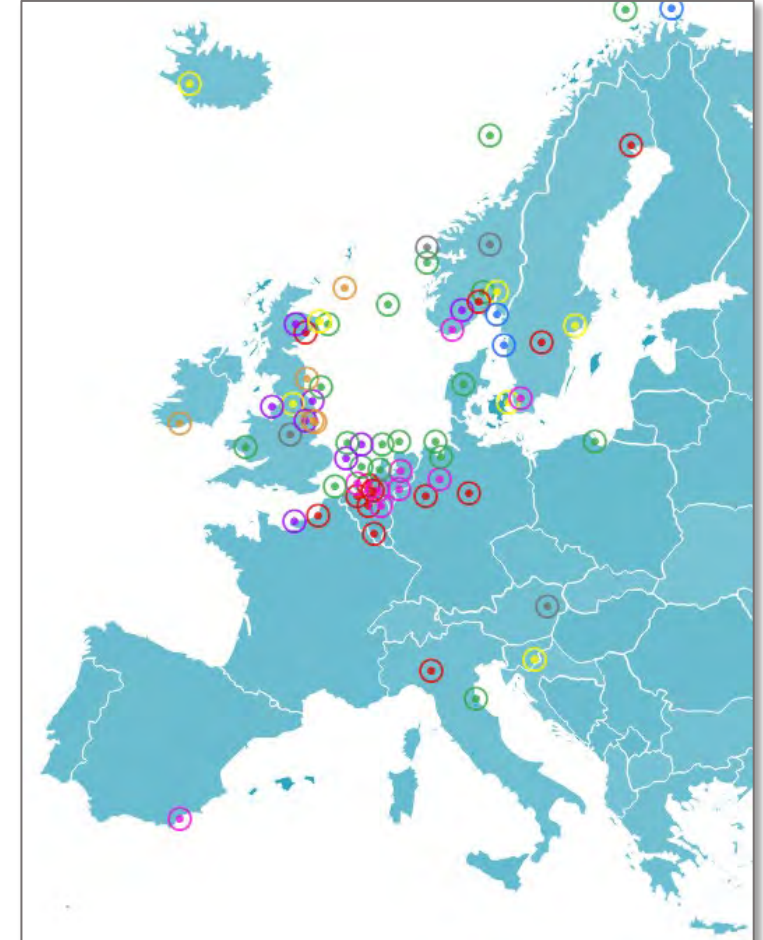


Market-ready CCS and CCU projects – the 2020s are crucial

- More than 50 ‘market-ready’ CCS and CCU projects along the whole value chain, including low-carbon hydrogen and CDR
- Enable CO2 emitters across Europe to reach safe geological storage of CO2 => **European, open-access cross-border CO2 transport and storage infrastructure is crucial**
- Urgency to deploy, make technologies investable, and scale up

European Commission: “Zero or very low carbon technologies, including hydrogen and CCUS, will need to be developed and tested at scale in this decade”

- **There is a need for an EU strategy for CCS and CCU – with focus on cross-border CO2 infrastructure**



CCS - AN ENABLER FOR EU INDUSTRY DECARBONISATION

Jonas M. Helseth
Director
Bellona Europa

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09/02 – 2022

BELLONA & A LONG ENGAGEMENT WITH CCS

Bellona Norway

- Oslo



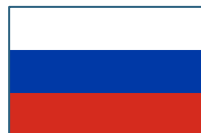
Bellona Europa

- Brussels
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- Berlin



Bellona Russia

- St Petersburg
- Murmansk



Co-funded by the NER 300 programme of the European Union

BELLONA & A



WITH CCS

Bellona Norway

- Oslo



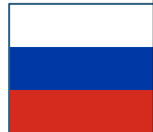
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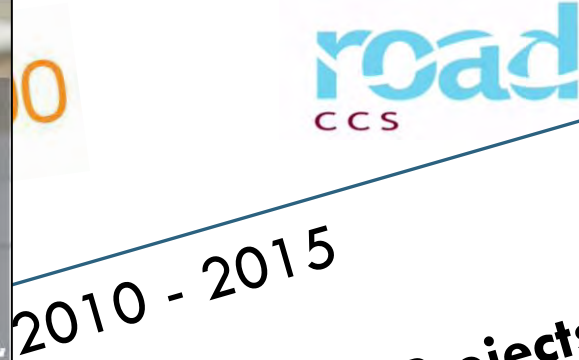


Bellona Russia

- St Petersburg
- Murmansk



MANUFACTURING OUR FUTURE: INDUSTRIES, EUROPEAN REGIONS AND CLIMATE ACTION
CO₂ Networks for the Ruhr, Rotterdam, Antwerp & the greater Oslo Fjord



2010 - 2015

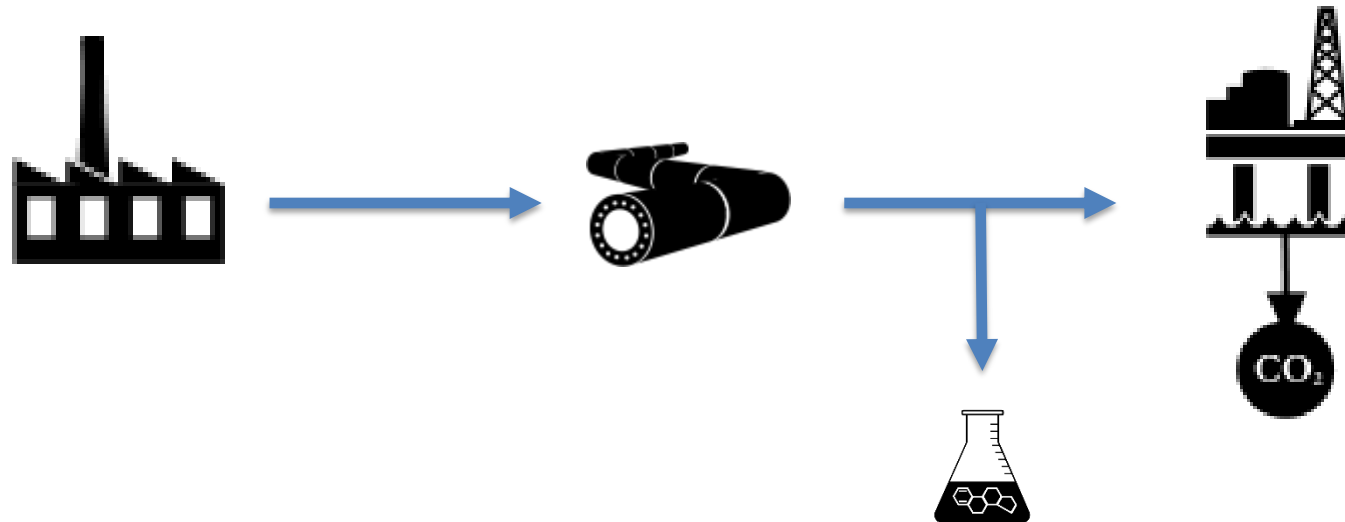
All Electricity Projects

Near exclusively linked to coal

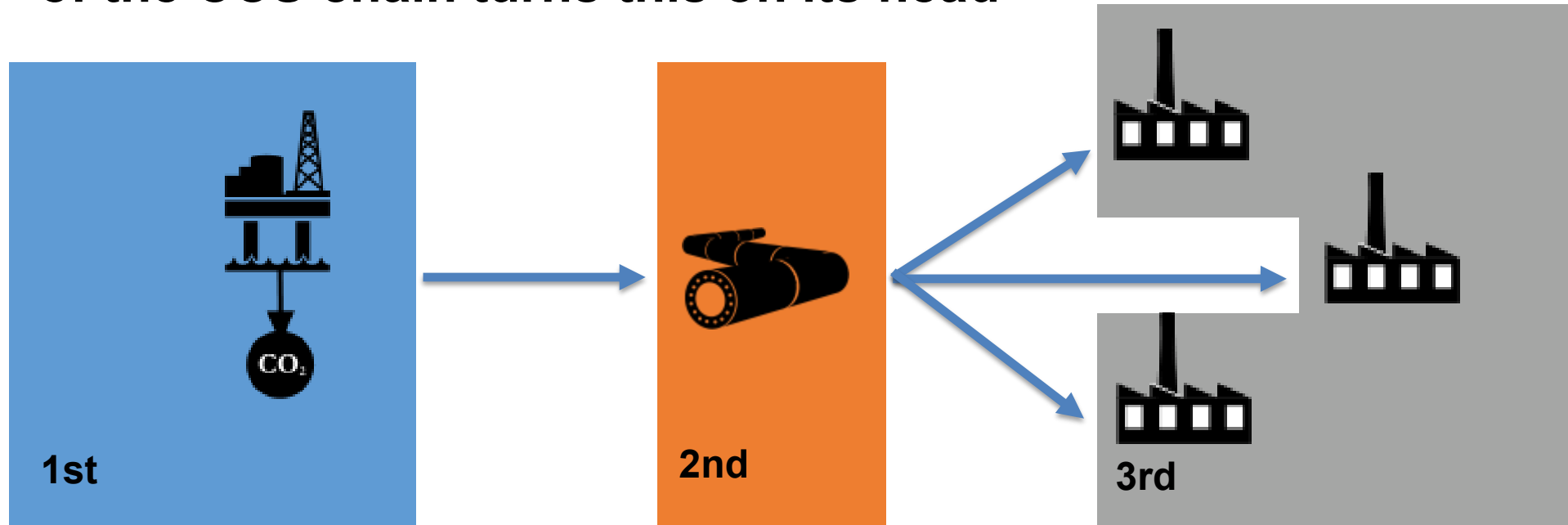
Large investments with counterparty risk

NER 300 programme
European Union

The CCS value chain...



Reviewing the investment and delivery profile of each part of the CCS chain turns this on its head



INDUSTRIAL CCS



Waste incineration



CO₂ Removal (CDR)



Steel



Cement



Chemicals



'Blue' Hydrogen

Alternatives to Primary Production & Decarbonisation

- Direct Electrification
- Clean Hydrogen
- Circularity (increased reuse and recycling)
- Efficiency improvements

Bellona.org > Latest News > Carbon Capture and Storage > PRESS RELEASE: Well-timed new report shows CCS as only way to reconcile the desire for a strong EU industry with the Union's climate ambitions

Carbon Capture and Storage

PRESS RELEASE: Well-timed new report shows CCS as only way to reconcile the desire for a strong EU industry with the Union's climate ambitions

The Zero Emissions Platform (ZEP) – an EU Technology Platform consisting of a coalition of stakeholders working to promote CO2 Capture and Storage (CCS), and of which Bellona is a founding member – has released a new report on the application of CCS in EU energy-intensive industries.

Subjects

- Air Pollution
- Arctic
- Carbon Capture and Storage
- Carbon Dioxide Removal
- Climate change
- European Union
- Fossil fuels
- Future energy system
- Industrial Pollution
- Nuclear issues
- Organization
- Plastic Pollution
- Renewable energy
- Russian human rights issues
- Transition
- Transport
- ZECS

Published on July 1, 2013 by [Bellona](#)

The report, which was published by the Platform today, shows that direct emissions from EU industries in 2010 accounted for 25 % of total EU CO₂ emissions, and that energy efficiency measures will not be sufficient to reduce those emissions significantly. CCS continues to stand out as the only technology available to deliver deep emission cuts; a failure to deploy CCS in those sectors would therefore undermine the EU's ability to meet its own long-term climate ambitions while retaining a strong industrial base.



Bellona led the work on the report

The industries covered in the report are steel, cement, refineries and chemicals. Bellona has for more than a year led ZEP's work with this report, which has involved a number of stakeholders from outside the Platform, mainly representatives from the relevant industries themselves. The report provides a high-level overview of the challenges and opportunities for CCS in relevant EU energy-intensive industries, as well as a set of recommendations to EU policy makers on how to pave the way for large-scale deployment.

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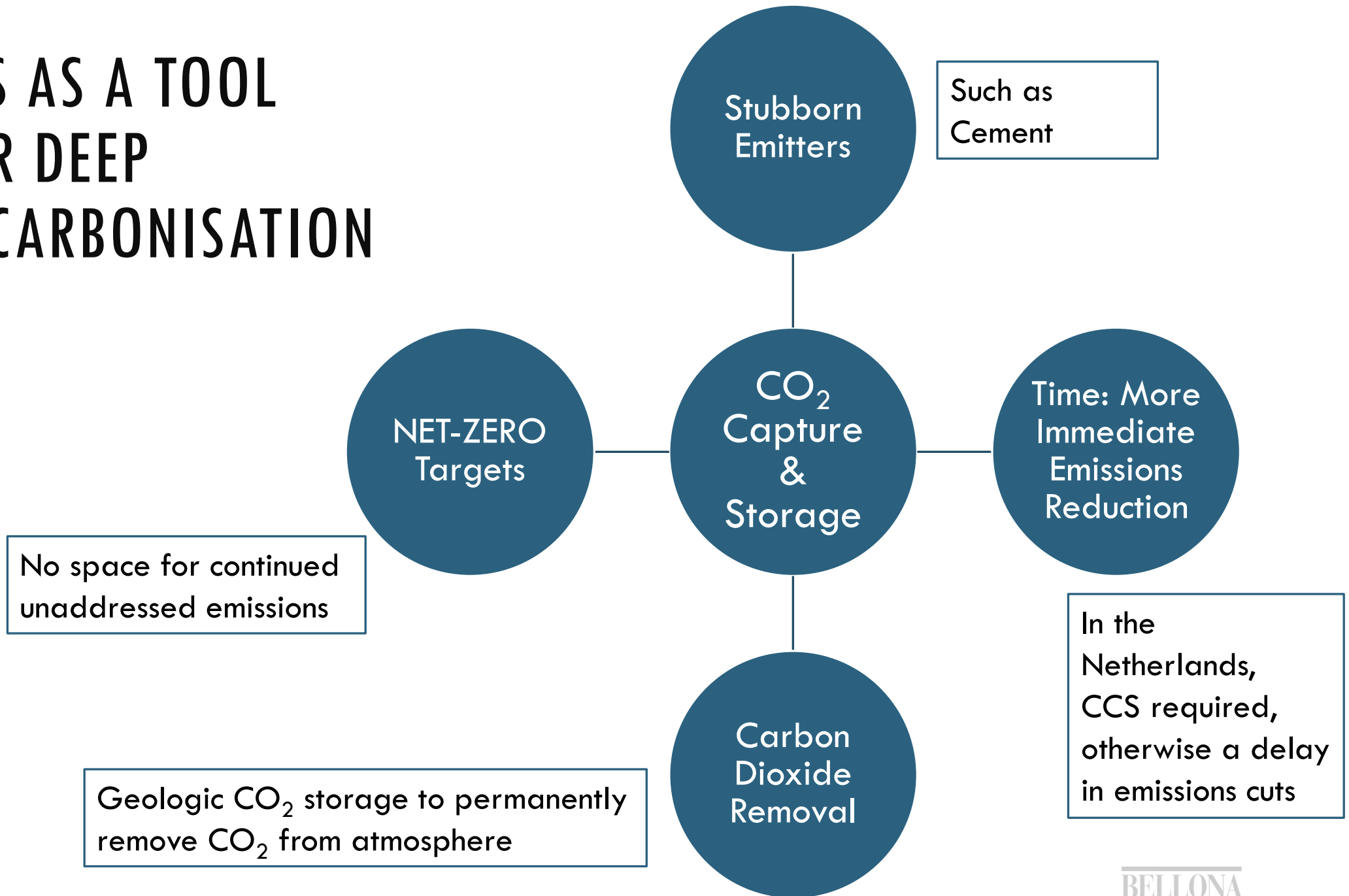
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Climate solutions for EU Industry: interaction between electrification, CO₂ use and CO₂ storage

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CCS AS A TOOL FOR DEEP DECARBONISATION



CO₂ NETWORK AS A PUBLIC GOOD

*In the early 19th century, London planned to expand its sewage system, yet faced widespread public opposition. Particularly wealthier people, living uphill, did not see why a general sewage system was needed and hence did not want to pay to improve the property of private individuals ‘downhill’. In fact, **sewage was not seen as a public good**, and so the government initially considered it improper to use public money. **It took several cholera epidemics, thousands of deaths, and the ‘Great Stink’ of 1858 for London to finally modernize and upgrade its sewage system, at last stopping the unchecked dumping of human waste into the city and the river Thames.***



“[The principle] was of diverting the cause of the mischief to a locality where it can do no mischief.”

Sir Joseph Bazalgette, Civil Engineer



CO₂ STORAGE CLUSTER – LOW COUNTRIES



Netherlands



2030 Industrial – 14 Mt CO₂
CCS is capped 7.2Mt CO₂
Chemicals, Hydrogen & Waste



Belgium



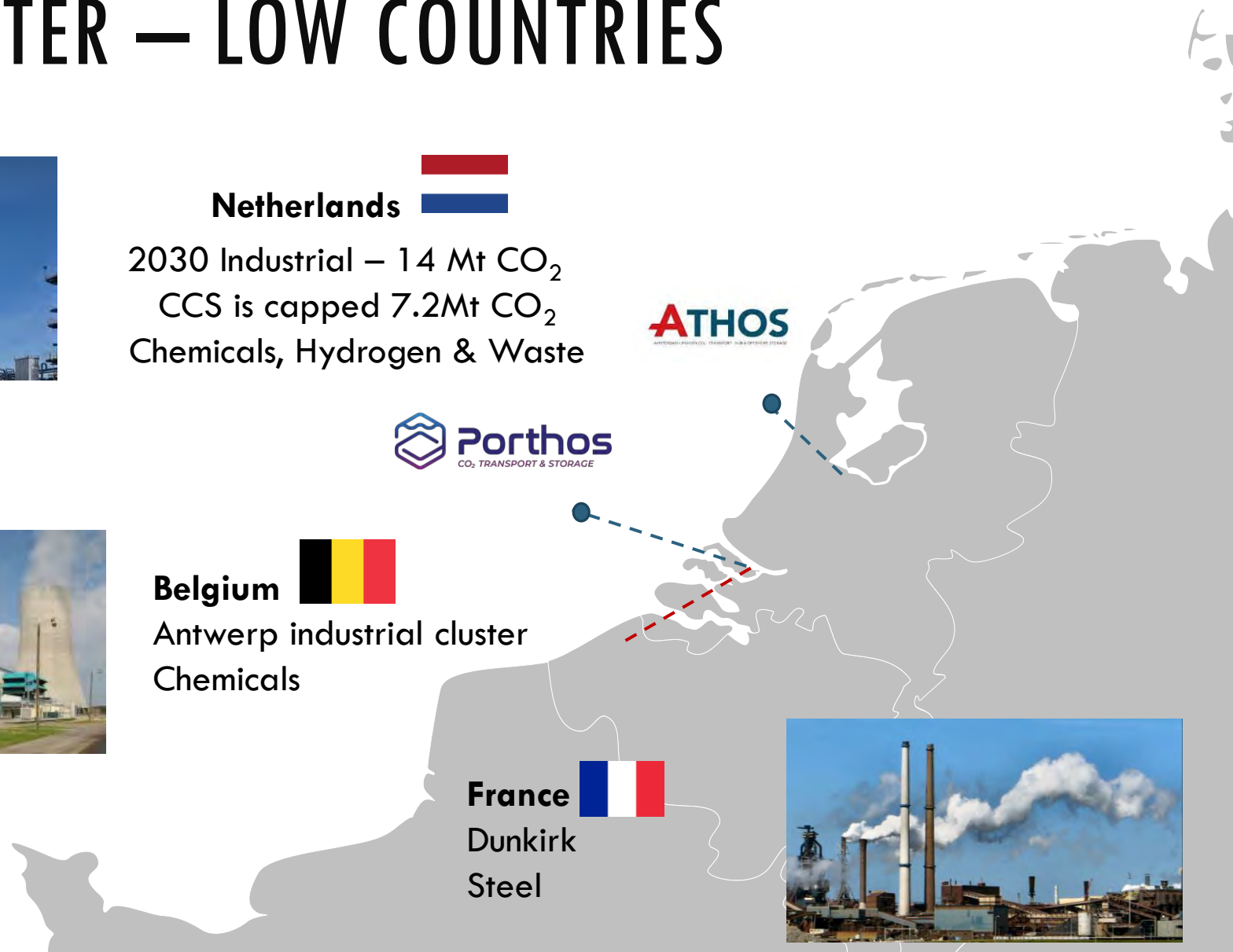
Antwerp industrial cluster
Chemicals



France



Dunkirk
Steel



WHERE NEXT FOR CCS IN EUROPE ?

2020 – 2030

- Moving from “demonstration” to commercial deployment
- First multinational CO₂ networks with multiple CO₂ sources and stores

Innovation fund

- € 20 billion of support over 2020-2030

ETS – Price on CO₂

- CO₂ price above €90, more than tripled in 2021.

CBAM – Carbon Boarder Adjustment Mechanism

- Reduction in free emissions allocations

Regions with access to CO₂ transport and storage

- Will be more competitive in receiving inward investment
- Will have more tools to reach ever more stringent emission targets

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Carbon Capture and Storage, Carbon Dioxide Removal, European Union

Press Release: EU Innovation Fund decision is moving the goal post for industrial decarbonisation

Bellona would like to congratulate the Commission on today's decision on the first Innovation Fund Call for Large-Scale projects, which includes funds for large-scale decarbonisation of major emitters in the steel, cement, chemicals and CHP sectors, at a scale unseen for all those sectors.

Published on November 16, 2021 by [Bellona Europa](#)

With today's €1.1bn Innovation Fund decision, the EU moves the goalpost for climate action in industry – to where it needs to be

As a European NGO that has worked ceaselessly toward such a development for decades, Bellona is very pleased to see the European Commission today moving the goal post for industrial decarbonisation in a number of EU countries including France, Italy and the Nordic countries, across a number of key industry sectors.

Bellona would like to congratulate the Commission on today's decision on the first Innovation Fund Call for Large-Scale projects, which includes funds for large-scale decarbonisation of major emitters in the steel, cement, chemicals and CHP sectors, at a scale unseen for all those sectors.

Notably, a scale that occurs with a timeline that induces hope for the rapid, scalable industrial decarbonisation Europe needs, to stay within its carbon budget. This decision is a crucial signal to industry and its employees that climate ambition does not mean tens of thousands of jobs lost; that the EU is prepared to enable the operation of key economic activities in a carbon-constrained world.

Once those projects become operational, there is nowhere left to hide for those who fail to act.



Credit: Getty Images Pro

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- Renewable energy
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Bellona's CCS Web

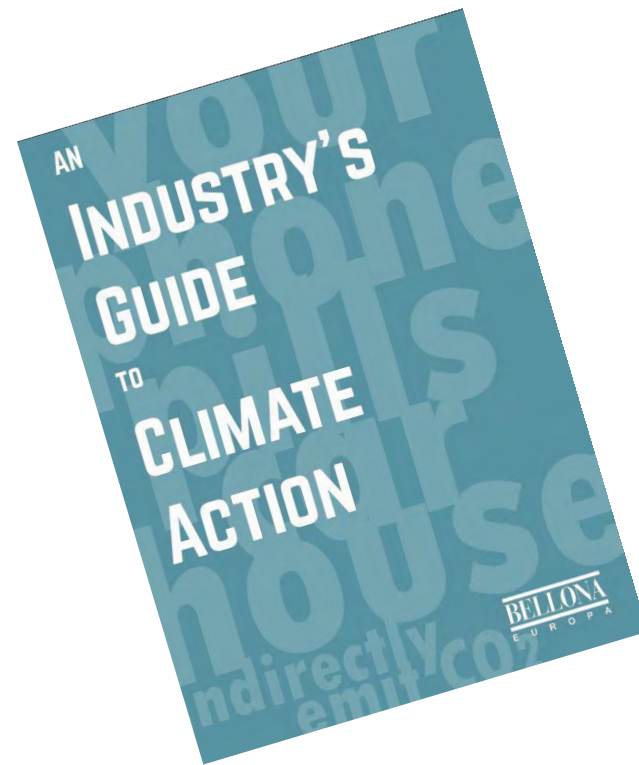
BELLONA

THANK YOU!

Any questions?

Jonas@bellona.org

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[@jonashelseth](https://twitter.com/jonashelseth) /
[@Bellona_EU](https://twitter.com/Bellona_EU)



An EU strategy for CCS and CCU: Safeguarding European industrial competitiveness



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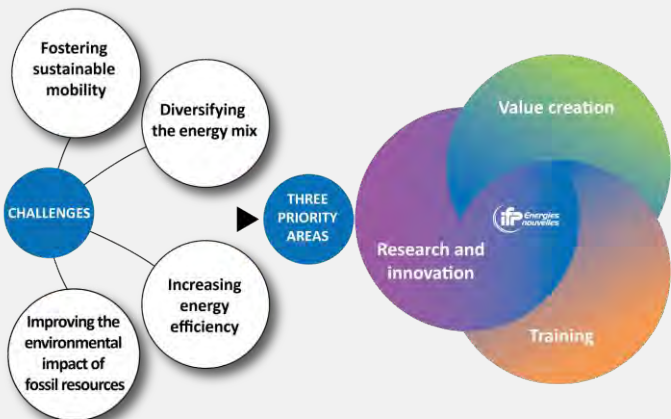
Q&A – *Chaired by Lucie Boost, ZEP External Relations Group Co-Chair and EU Affairs Manager, Equinor*

Carbon Capture Utilization and Storage

@ IFPEN

va

Context
Climate change and ecological transition

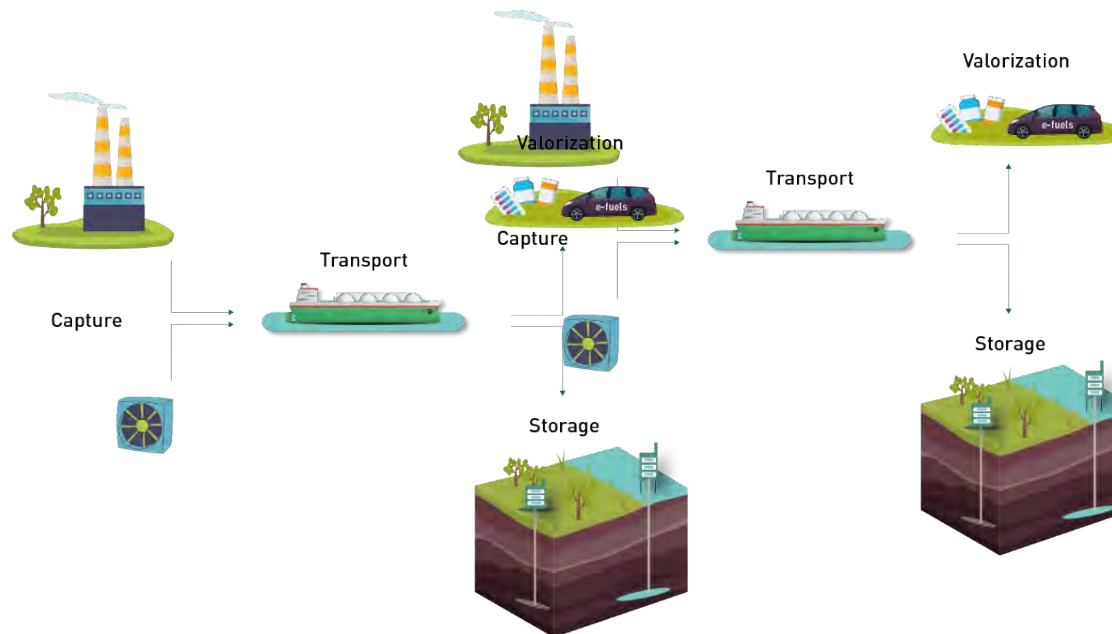


Capture

- ✓ *Industry*
- ✓ *Power*
- ✓ *Air*

Compression/Transport/Wells

- ✓ *Compression process*
- ✓ *Impact of impurities*
- ✓ *Well integrity*



Storage

- ✓ *Onshore/Offshore*
- ✓ *Depleted O&G fields*
- ✓ *Saline aquifers*

Utilisation

- ✓ *CO₂ conversion*

Scenarios/Economy/LCA

- ✓ *Site*
- ✓ *Territory*
- ✓ *State*

Emissions control

- ✓ *Leakage detection*
- ✓ *Air quality*

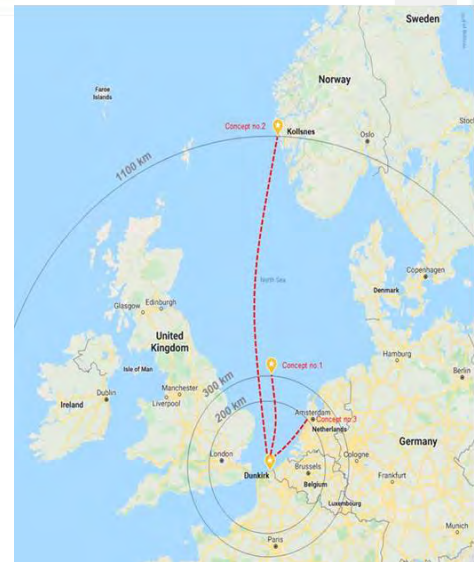
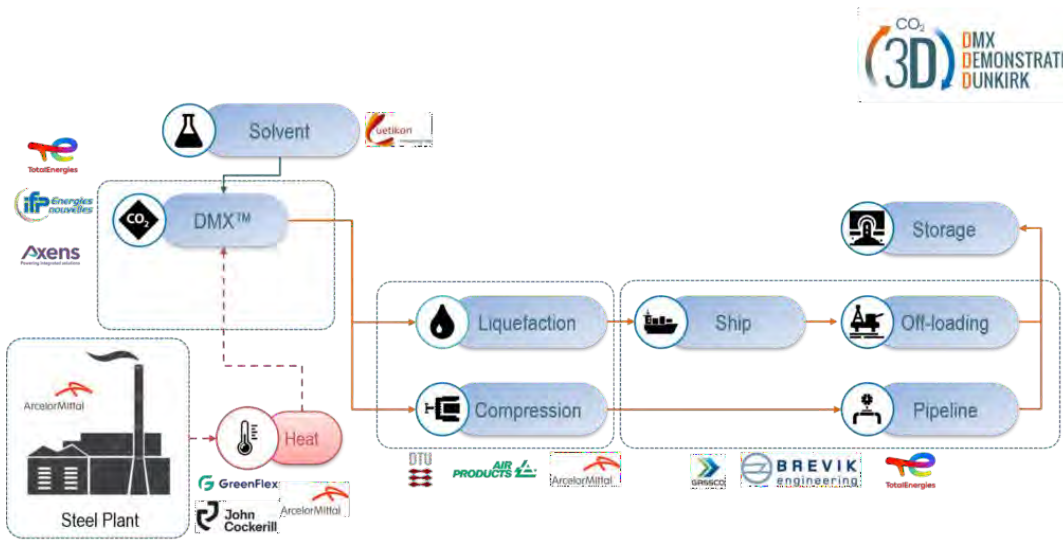


Objectives (2019 - 2023)

- Demonstrate the DMX™ process
 - Construct a plant for CO₂ capture (0.5 tCO₂ capture/h) to treat Blast Furnace gas of Arcelormittal steel plant
- Prepare a first CCS large-scale demonstrator (> 1M tCO₂eq/y)
- Study the CCS hub 2035 Dunkirk-North Sea (10 MtCO₂eq/y)

B E N E F I T S

- Low steam energy consumption: from 2.3 to 2.9 GJ/tCO₂ depending on application and capture rate
- Thermally stable solvent with low degradation rate
- CO₂ produced readily under pressure up to 5 barg for significant compression cost savings
- High capture rate achievable (>90%) and high purity of produced CO₂ (>99%)
- -30% of CO₂ capture costs



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CO₂ reduction through storage beneath the North Sea



Bram Sommer 09-02-2022



Co-financed by the
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of the European Union

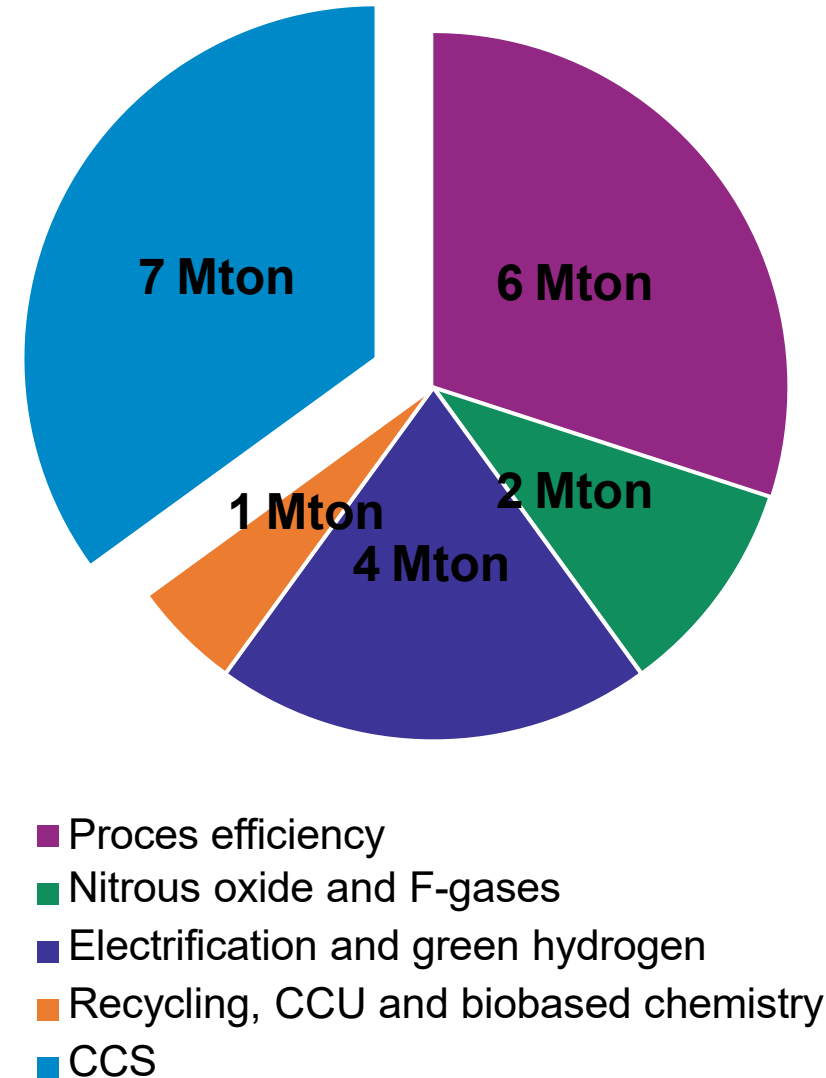


Porthos
CO₂ TRANSPORT & STORAGE

Situation in the Netherlands

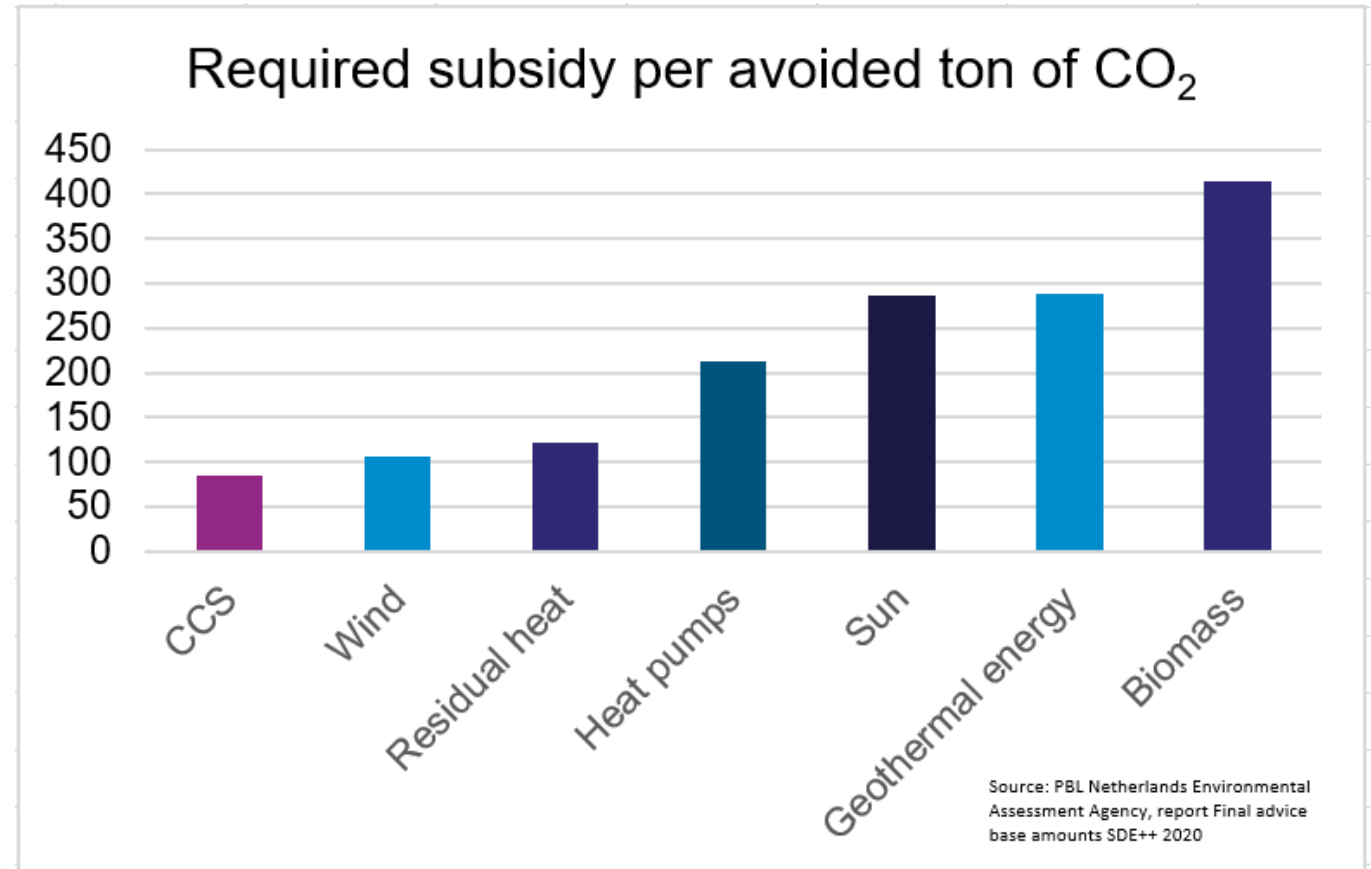
Effect of the Paris Agreement in the Netherlands:

- Ambition: 49% CO₂ reduction by 2030, compared to 1990
- Industry: 14.3 Mton reduction, in addition to the previously agreed 6 Mton by efficiency improvement
- Starting point PBL Netherlands Environmental Assessment Agency: 7.2 Mton CCS in 2030 = **50%** industry

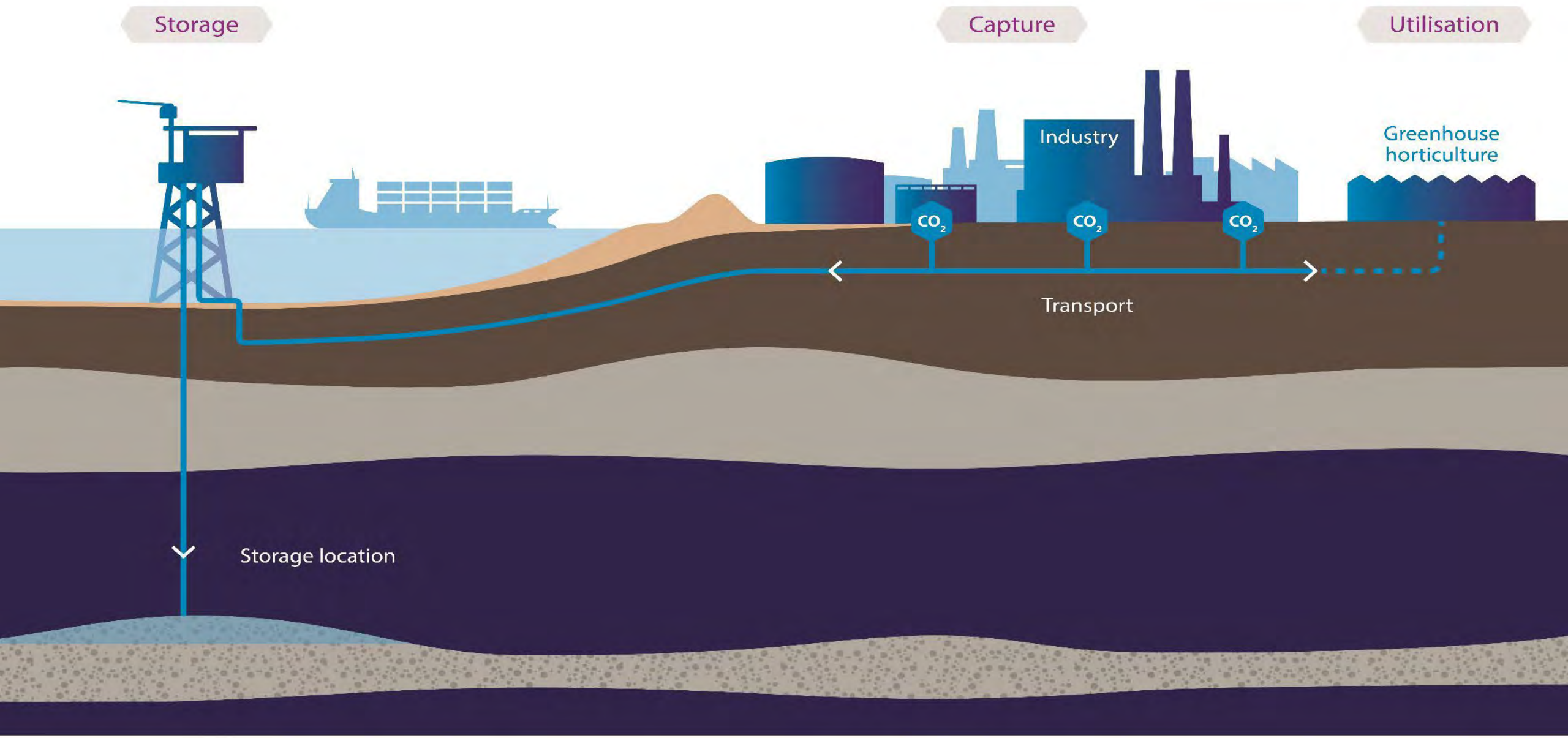


Why CC(U)S?

- Has the potential to reduce **large volumes** of CO₂
- Can be realized in the **short term**, crucial in terms of carbon budget
- It is **cost effective**
- Potential for **utilisation**, mainly in greenhouses
- Important for the development of **hydrogen**: via blue to green
- On the long term: **commodity** for industrial use (circular)



How does CC(U)S work?



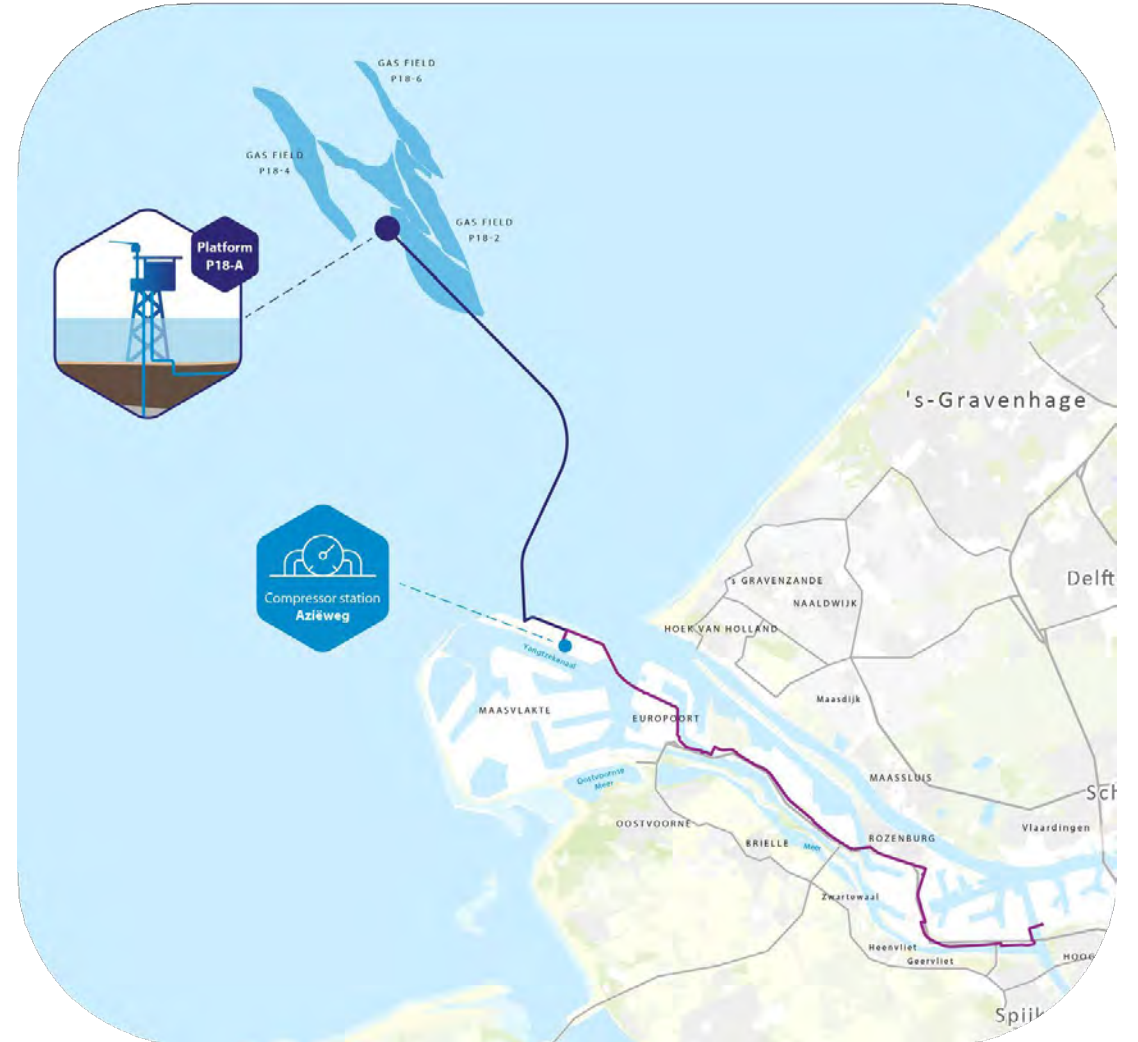
Rotterdam ideal location

- ~ 14% national CO₂ emissions
- Large industrial cluster
- Relatively small area
- Cost effective
- Storage locations offshore
- Combination with other developments in the port, e.g. hydrogen and circular



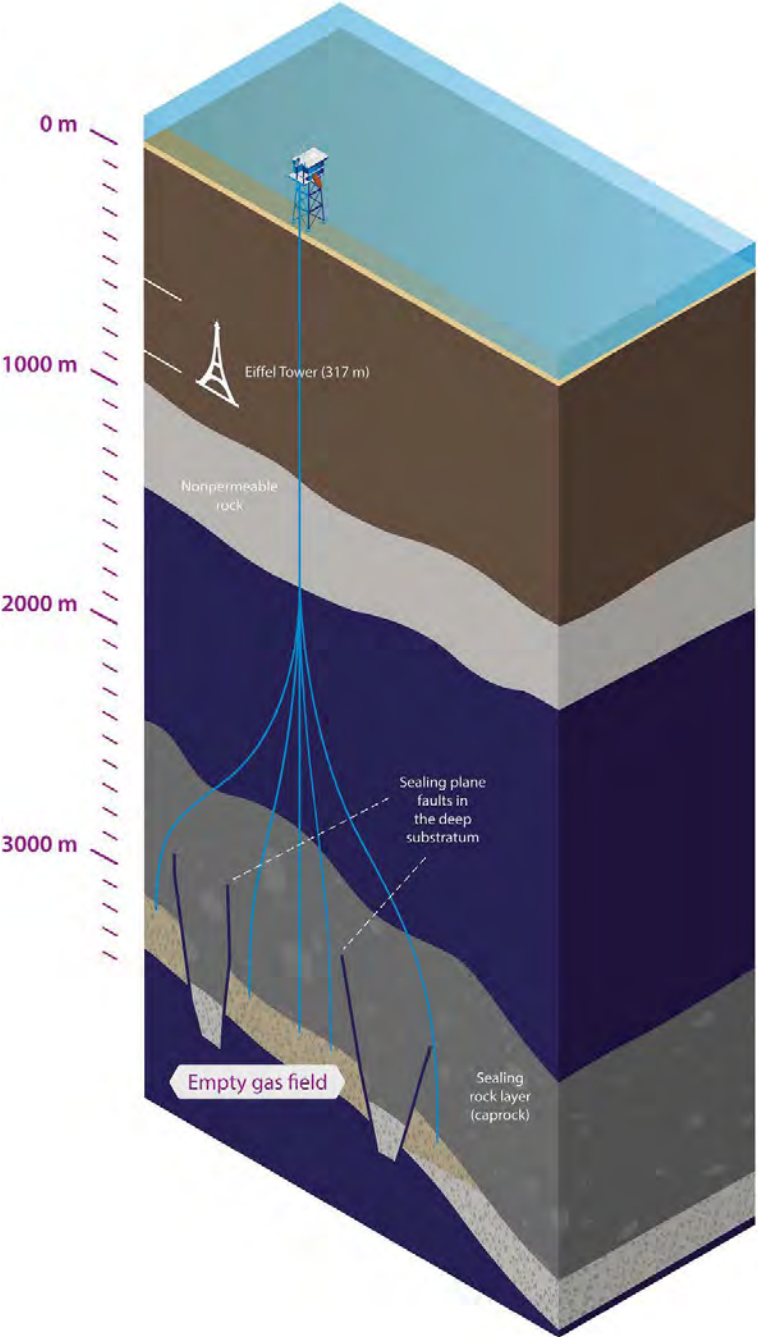
Project overview

- Dutch state-owned parties: EBN, Gasunie, Port of Rotterdam Authority
- Customers: Air Liquide, Air Products, ExxonMobil, Shell
- Capacity P18 fields: ~ 37 Mton
- Storage: ~ 2.5 Mton per year
- CAPEX: ~ € 450-500 million
- Planning: final investment decision in 2022, operational in 2024





Storage



Public-private partnership for a successful project

State owned companies

Lead role,
invest in infrastructure



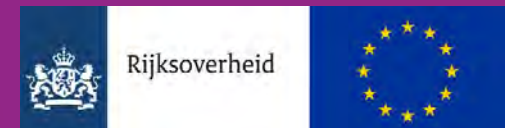
Private companies

Invest in capture,
pay for storage



Public authorities

Funding, mandate,
responsibility



CEF funding



The World News Monitor Business Information for Sustainable Development

102 million euros in funding on the horizon for Porthos carbon storage project

Hellenic Shipping News | Oct 6, 2020 at 2:00 AM



- The European Commission has proposed awarding 102 million euros in funding to the Porthos project.
- The European Commission wants to financially support the construction of Porthos because the capture and sequestration of CO2 (known as Carbon Capture and Storage, CCS) is widely seen as a necessary measure to keep global warming below 2 degrees Celsius.
- The precise amount of this fee is determined by the costs incurred by Porthos for the system's construction and exploitation (including the energy costs for the pressurised injection of CO2 in the deeper substrate).

ship.energy EC proposes €102 million funding for Porthos carbon capture project

The project will store CO2 supplied by the Rotterdam operators of Air Liquide, Air Products, ExxonMobil and Shell in the North Sea seabed



100 miljoen subsidie voor opslaan CO2 in de Noordzee



VRIDAG 2 OKTOBER 2020, 15:04 W 2 OKT 2020, 15:04

De Europese Commissie wil 102 miljoen euro uittrekken aan subsidie voor de ondergrondse opslag van CO2 onder de Noordzee. Dat zou moeten gebeuren in lege gasvelden voor de kust van Hoek van Holland.

UTILITIES



Publicatie 5 Okt 2020
Categorie Utilities
Soort Nieuws
Tags CCUS, Porthos



€102m proposed for Porthos CCS project

By Molly Burgess | 12 October 2020

The European Commission has proposed a €102m award to a Netherlands-based carbon capture and storage project, as part of a necessary measure to keep global warming below 2 degrees Celsius.

If endorsed by the European Parliament, Project Porthos will benefit from the new capital that will help to push forward its goals and contribute to the Netherlands' achievement of its climate targets.



▲ De stillades van Shell. Foto: © Airx Kool

Europese subsidie in aantocht voor belangrijk milieuproject van de Rotterdamse haven

Een groot milieuproject in de Rotterdamse haven staat op de nominatie voor meer dan 100 miljoen euro Europese subsidie. Dat is ongeveer een vijfde van de totale kosten van het Porthos-plan.

Leon van Heel 02-10-20, 15:12



Pijpleiding voor CO2

EC wil Rotterdams CO2-opslagproject 102 miljoen euro subsidie geven



De haven van Rotterdam vanuit de lucht met onder meer industriegebied Vondelingenplaat, de Tweede Petroleumhaven en de raffinaderij van Shell.

Het grootste klimaatproject in de haven van Rotterdam is een grote stap dichterbij gekomen. De Europese Commissie wil 102 miljoen subsidie geven voor de aanleg van een systeem voor de afvang en opslag van CO2 van de zwaar vervuulende industrie in de haven.



Europa wil Porthos 102 miljoen euro subsidie geven

CO2-OPSLAG

De Europese Commissie heeft voorgesteld het CO2-opslagproject Porthos 102 miljoen euro subsidie te geven. Het is een project om CO2 van de industrie op te slaan onder de Noordzee. Als het Europees Parlement akkoord gaat, draagt Europa een flink deel van de investering van Porthos van in totaal 450 tot 500 miljoen euro.

NATHALIE VAN HERK

5 oktober 2020 12:04



102 million euros in funding on the horizon for Porthos carbon storage project

The European Commission has proposed awarding 102 million euros in funding to the Porthos project

Oct 5, 2020 - 06:50



The Porthos project centres on the capture and storage of CO2 in the North Sea floor. If the European Parliament endorses this proposal, Europe will bear a substantial share of the investment in Porthos, which totals 450 to 500 million euros.



102 miljoen EU-geld voor Porthos project (opslag CO2 in Noordzee)

ROTTERDAM - 03 OKTOBER 2020, 18:10

SDE++ subsidy

Bloomberg Green

Energy & Science

Netherlands Pledges \$2.6 Billion Subsidy to Bury CO₂ Under the Sea

The project at Rotterdam port could capture 2.5 million tons of emissions per year from oil refineries and hydrogen plants



A&E · Clima

Olanda, 2 miliardi da governo per cattura carbonio Rotterdam

Progetto di Shell e Exxon, stoccaggio in giacimenti esauriti

DE TIJD

'Het CO₂ moet naar waar het vandaan komt: de grond in'



L'Echo

"Le CO₂ doit repartir d'où il vient: dans le sol"

TEURACTIV

Dutch government grants €2 billion in subsidies to huge carbon storage project

NOS

Miljardensubsidie voor CO₂-opslag onder Noordzee is rond

RIJNMOND

De hele wereld kijkt naar CO₂-project Rotterdam: 'Als het hier slaagt, gaan anderen volgen'

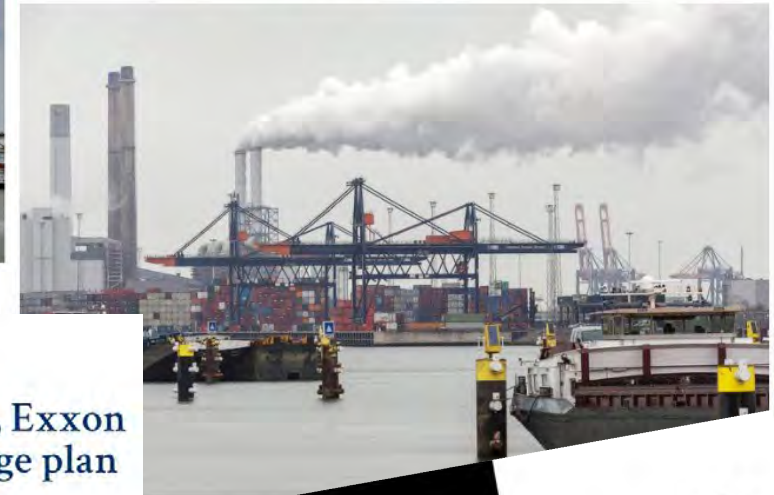


World Oil

Dutch government invites Shell, Exxon to join \$2.6B subsea carbon storage plan

REUTERS

Dutch govt grants \$2.4 billion in subsidies to huge carbon storage project



ALJAZEERA

Economy | Oil and Gas

Dutch g'ovt gives \$2.4bn in subsidies to fund carbon capture plan

The plan, which starts in 2024, aims to reduce emissions in the industrial cluster surrounding Europe's largest port.

zonebourse

Air Liquide au coeur d'un gros projet de captage de CO₂ aux Pays-Bas

I·C·I·S
Independent Domestic
Intelligence Services

Dutch government to provide €2.1bn Porthos CCS subsidy

upstream
ENERGY EXPLORED

OPINION: CCS has role to play in a geared approach to energy transition



Status and planning

- Current
 - Technical development
 - Permit procedures
 - Contracts with customers
- 2022
 - Final Investment Decision (FID)
- 2022-2023
 - Construction of the system
- 2024
 - System operational



Development of CCS in the Netherlands

- Aramis project announced
- Climate ambitions European Union: Fit for 55 → effect on Dutch climate ambitions and CCS?
- SDE++ subsidy → from 2022 more funding available for CCS



Thank you for your attention!

For more information, please visit:
www.porthosCO2.nl



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Co-financed by the
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Porthos
CO₂ TRANSPORT & STORAGE

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An EU strategy for CCS and CCU: Safeguarding
European industrial competitiveness

Carbon Capture ready - Towards a Decarbonized Industry

Zero Emission Platform Brussels Event
during the EU Industry Week Feb 2022, Webinar

Dr. Arthur Heberle
Head of Technology, New Business

Public

9 Feb 2022



Fossil Fuel Industries

Turnkey Projects, Products und Services for:

- ▶ Combined Cycle Gas Turbine Plants (CCGT)
- ▶ Integrated Gasification Combined Cycle (IGCC)
- ▶ Coal-fired Boilers
- ▶ Waste-to-Energy Boilers
- ▶ Industrial Boilers



Decarbonisation of Energy Industry and Industrial Sectors

Turnkey Projects, Products und Services for:

- ▶ Hydrogen Gas Turbines
- ▶ Power-to-X (Heat Pumps, Green Hydrogen)
- ▶ Energy Storage
- ▶ Solid Oxide Fuel Cells
- ▶ Biomass conversion
- ▶ CO₂ capture/utilization
- ▶ Digital Solutions

- **MHI ENGINEERING** with more than **30 years of experience** with KM CDR Process™
- liquid absorption technology using **high performance absorbents** (KS-1™, KS-21™)
- having **global market share of more than 70%** in the market of commercial plants for capturing CO₂ from exhaust gas



MHI (KM CDR Process™)

- Amine type (liquid absorption)
- CO₂ capture rate from exhaust gas: 90% or more
- Captured CO₂ purity: 99.9% or more
- Absorbent: KS-1™, KS-21™
- Absorbent characteristics: Low volatility, stability against degradation, etc.

Share of our technology (approx. 3.9M tons per year) applied to CO₂ capture from exhaust gas (approx. 5M tons per year)

*1: Internal comparison of the main CO₂ capture technologies across three commercialization dimensions.

Drax and MHI have agreed a long-term contract for use of MHI's carbon capture technology at Drax BECCS Project.

(Press Release on 10th June 2021)

- ✓ **World's largest** carbon capture project (**x5** of Petra Nova)
 - ✓ **World's first** negative emission project
 - ✓ **UK's first** carbon capture project at scale



Project Information	
Site Location	North Yorkshire, UK
Project Owner	Drax Power Limited
CO ₂ Source	Biomass Boiler Flue Gas
CO ₂ Capacity	At least 8 million tons (per year)
Capture Process	Advanced KM CDR Process™ KS-21™ Solvent

Necessity of capturing CO₂ from various emission sources at different industrial sectors

- fossil fueled heat/power generation, biomass, LNG liquifaction, cement, steel, shipping (onboard capture), waste-to-energy, production of low-carbon hydrogen
- large-scale and smaller-scale capture plants, modularizing and digitizing
- carbon capture as an essential, commercialized technology brick to provide CO₂ for permanent storage and as sustainable resource, applicable for low-carbon, carbon neutral or negative emissions pathways, for circular economy
- contribution to sustainable flexible power generation ensuring energy supply security → vital for industry and society
- need for CO₂ capture in Europe: 230-430 MT/a by 2030, 930-1200 MT/a by 2050 at 1.5°C (UCL Energy Institute Report 2020) → large-scale CCS deployment required to meet climate targets scenario

Challenges

- climate protection and economy to consider as partners
- different conditions and needs at different regions and industry sectors
- level playing fields to reduce GHG and to initiate business cases
 - driven primarily by national and regional pricing initiatives: increasing costs of CO₂ emissions globally by time, emission trading systems, national and regional carbon taxes, prices and fines
 - business case also depends on carbon price and carbon reduction costs → costs of carbon reduction measures to reduce by time
 - EU funding mechanism, sustainable taxonomy, EU GHG allowances prices, Carbon Border Adjustment Mechanism against carbon leakage
- pan-European CO₂ infrastructures: transportation of captured CO₂ to storage and utilization sites, cross-border networks
- public acceptance and awareness about positive impacts by CCS, CCU



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An EU strategy for CCS and CCU: Safeguarding European industrial competitiveness

Introductory speech – *Jonas Helseth, ZEP Vice-Chair and Director, Bellona Europa*

An EU strategy for CCS and CCU

- Florence Delprat-Jannaud, ZEP Vice-Chair and CCS Program Manager, IFPEN
- Bram Sommer, Advisor of Public and Regulatory Affairs, Port of Rotterdam
- Arthur Heberle, Head of Technology, New Business, Mitsubishi Power Europe

Q&A – *Chaired by Lucie Boost, ZEP External Relations Group Co-Chair and EU Affairs Manager, Equinor*

Q&A

Please submit your questions!

- The 2020s are crucial for a European cost-efficient transition towards climate neutrality
- CO₂ transport and storage infrastructure are vital for European decarbonisation
- An enabling policy and funding framework for CCS and CCU, making it feasible to invest in these technologies and to scale up – the EU Taxonomy is a good starting point
- Political recognition of CCS and CCU – an EU strategy for CCS and CCU

An EU strategy for CCS and CCU: Safeguarding European industrial competitiveness

10 February 2022

Zero Emissions Platform