CSLF PROJECT SUBMISSION FORM

PROJECT TITLE:
Porthos CO_2 transport and storage

PROJECT LOCATION:
Rotterdam, South Holland province, the Netherlands

PROJECT GOAL:
Porthos is developing a project in which CO_2 from industry in the Port of Rotterdam is transported and stored in empty gas fields beneath the North Sea.

PROJECT OBJECTIVES AND ANTICIPATED OUTCOMES:

- The CO_2 that will be transported and stored by Porthos, will be captured by various companies. The companies will supply their CO_2 to a collective pipeline that runs through the Rotterdam port area. The CO_2 will then be pressurized in a compressor station.
- The CO_2 will be transported through an offshore pipeline to a platform in the North Sea, approximately 20 km off the coast. From this platform, the CO_2 will be pumped in empty gas fields. The empty gas fields are situated in a sealed reservoir of porous sandstone, more than 3 km beneath the North Sea.
- Porthos will store around 37 Mton CO2, approximately 2.5 Mton CO2 per year for 15 years.

PROJECT DESCRIPTION AND RELEVANCE (non-technical):

Porthos is developing a project in which CO_2 is transported and stored in empty gas fields under the North Sea. The project aims to construct a pipeline in the Rotterdam port area, to which multiple companies can connect. The Porthos infrastructure is set up as an open access and non-discriminatory system.

Porthos offers companies the opportunity to reduce their CO_2 emissions during the period in which they have not yet made the transition to biobased, renewable or circular. This enables companies to contribute to the Netherlands' climate objectives and to the energy transition, even if the alternatives are still not sufficiently available or developed.

What makes Porthos special is that it is one of the first CCUS projects to focus on the storage of CO_2 from multiple companies and to use an open access approach. The system will be established as a kind of utility infrastructure for use by various companies. This means that considerable cost advantages can be obtained compared with stand-alone projects.

PROJECT DESCRIPTION (technical):

Technical components:

Onshore transport

The collective pipeline running through the Rotterdam port area is approximately 30 km long and extends from the eastern end of Oude Maas in the Botlek area, through the Europoort area to the compressor station at Maasvlakte.

The collected CO_2 will flow in a gaseous state at a pressure of 35 bar through the pipeline, which has a diameter of approximately 108 cm (42 inches).

The new pipeline will be housed in the existing pipeline corridor and will be entrenched section by section. The pipeline corridor ranges in width between 10 and 45 m.

Compressor station
The compressor site at Maasvlakte has a surface area of roughly 2 ha and includes several buildings on the grounds.

The entire site is supplied with power from the electrical substation. The pumping station houses the cooling water pumps that are used to cool the compressors.

At the compressor building, three compressors jointly bring the CO_2 to a maximum pressure of 130 bar for subsequent transmission to the offshore platform.

Offshore transport
From the compressor station, a 22 km pipeline with a diameter of approximately 40 cm (16 inches) transports the CO_2 to the P18-A platform out on the North Sea. The maximum pressure in this pipeline is 130 bar, and the CO_2 is in a gaseous state with the characteristics of a liquid.

The former gas platform P18-A will be re-used for the storage of CO_2. The platform will be fitted with the facilities required to transport the collected CO_2 to the injection wells. In addition, various technical systems will be installed for monitoring and remote control of the system.

Storage
The collected CO_2 is stored in the pores of the sandstone substratum, which used to contain natural gas. For millions of years, this gas was hermetically trapped under high pressure between a nonpermeable layer of caprock and sealing plane faults. The local pressure in this field, which gradually decreased during gas extraction, will once again rise as a result of CO_2 injection. The reservoir will be consistently monitored and checked to ensure that local pressure never exceeds the values recorded when gas extraction first started.

The CO2 from the pipeline will be injected into the depleted gas fields under P18-A via wells. The wells are metal casings that are anchored to the rock all the way down to the reservoir in the substratum. To make the existing facility suitable for CO_2 injection, the well will be fitted with a new inner tube. The wells will also have monitoring equipment that checks the local pressure and temperature during CO_2 injection. Once CO_2 injection has been completed – when the reservoir is full and at the correct ultimate pressure – the wells will be sealed with plugs.

Status
Porthos is currently working on the technical details, permit procedures, FID deliverables and European tenders for the construction of the compressor station and offshore pipeline.

Porthos expects to take a final investment decision in the second half of 2022. As soon as the investment decision has been taken, the construction of the infrastructure will start. The system is expected to be operational by 2024/2025.

NOVEL ASPECTS OF PROJECT

Open Access
What makes Porthos special is that it is one of the first CCUS projects to focus on the storage of CO_2 from multiple companies and to use an open access approach. The system will be established as a kind of utility infrastructure for use by various companies.

Financing mechanism (national SDE++ for CCS)
Porthos is obtaining financial support for the costs made in preparing the project and for the infrastructure investment. Various funds are available and will be examined, including funds from the national government and the European Union.

For the preparatory studies, Porthos received a grant of € 1.2 million from RVO (Netherlands Enterprise Agency) in 2018 and a grant of € 6.5 million from the European Commission in 2019. In 2021, Porthos received a subsidy of € 102 million from Brussels for the realization of the infrastructure.

The Porthos customers were granted a national SDE++ subsidy in the spring of 2021. The SDE++ subsidy is necessary to bridge the difference in costs for ETS and the total costs for capture, transport and storage of CO_2. This helps the companies to remain competitive while contributing to achieving the Dutch Climate Agreement objectives.

PROJECT TIMELINE:

Milestones
- April 2018: Completion of feasibility study
- Spring 2018-early 2019: Concept select phase
- Early 2019: Start FEED phase: technical development of the transport and storage infrastructure
- February-March 2019: Expression of Interest by companies
- June 2019: Adoption of Memorandum on Scope and Level of Detail
- July 2019: Wim van Lieshout new project director
- July 2019: Final award of € 6,5 million CEF subsidy by European Commission for preparatory studies
- Autumn 2019: Signing of Joint Development Agreement 1 with companies
- September 2020: Completion of Environmental Impact Assessment
- Autumn 2020: Signing of Joint Development Agreement 2 with companies
- February 2021: Final award of € 102 million CEF subsidy by European Commission for construction works
- Autumn 2021: Signing of transport and storage contracts with companies

Planning
- Second half of 2022: Final investment decision
- 2023: Start construction of the system
- 2024/2025: System operational

INFORMATION AVAILABILITY:

1) Formal: we update our website (www.porthosCO2.nl) and social media (LinkedIn) continuously with the latest news/milestones
2) Informal: Porthos is an active participant in national/international discussion panels and thinktanks, where we present as often as possible our project to help other organisations/countries to develop their own CCS strategy. We are an active source for

information, on the technical aspects of CCS, as well on the regulatory framework in the Netherlands.

PROJECT CONTACTS:
All requests and questions regarding Porthos can be sent to: info@porthosCO2.nl.

Please also provide an answer to the following question:
What restrictions, issues, or costs will be assumed by any visitors to the project site?

OTHER PROJECT PARTICIPANTS:

Porthos CO_2 Transport and Storage C.V. (Project team)
Port of Rotterdam Authority (shareholder)
Energie Beheer Nederland (EBN) (shareholder)
Gasunie (shareholder)

PROJECT WEBSITES:

www.porthosCO2.nl

PROJECT NOMINATORS:
Delegates from at least two CSLF Member countries must inform the CSLF Secretariat (cslfsecretariat@hq.doe.gov) that they support the nomination of the project for CSLF recognition.

Netherlands
Norway

CSLF Project Elements Checklist

(Please check all of the following areas that your project will address.)

GENERAL

Project Scale	
Feasibility	
Pilot	
Demonstration	
Commercial	X

CAPTURE TECHNOLOGIES

Capture Type	
Pre-combustion capture	
Post-combustion capture	
Oxyfuel combustion	
Industrial applications	
Technology	
Advance the capture technology	
Advance plant design for capture efficiency (e.g., boiler, turbine design)	
Improved fuel handling and air separation processes technology	
Improved combustion and flue gas science	
Advance purification and compression technology	
Polygeneration optimization	

TRANSPORT

General	
Tanker Transport	
Pipeline Transport	X
Ship transport	
Specifications for impurities from various processes	X
Regulations, standards and safety protocols, including response and remediation	X

STORAGE AND MONITORING

Storage Complex Type	
Saline formations	
Unconventional reservoirs (e.g., basalt, shale)	
Unmineable coal formations	
EOR and/or EGR	
Depleted oil and gas fields	X
Storage complex characterization	
CO_2-water-rock (or coal) interactions	X
Impact of the quality of CO_2 on storage	X
Improved modeling of complex	X
Effects of CO_2 rock/water interactions and induced changes in temperature, pressure and stress on permeability, injectivity, migration, trapping and capacity.	X
Pressure management (e.g. production of formation water)	X
Monitoring the storage complex including risk assessment	
Development of new or improved CO_2 monitoring technologies	X
Improve baseline monitoring and distinguish between natural and anthropogenic CO_2	X
Development of risk minimization/mitigation methods and strategies, including leakage	X
Improve well integrity, well abandonment practices, and/or remediation of existing wells	X

CSLF Project Elements Checklist

(Please check all of the following areas that your project will address.)

CARBON UTILIZATION TECHNOLOGIES (MUST PROVIDE A VALID LCA INDICATING ACTUAL NET REDUCTION COMPARED TO A BASELINE)

Utilization Type	
Thermochemical	
Electrochemical	
Mineralization	
Biological	
Technology	
Advance catalysis	
Advance electrochemistry	
Process intensification	
Mineralization-building materials	
Mineralization-novel designs	
Mineralization-increased CO2 uptake	
Biological-Algae-open system	
Biological-Algae-closed system	

CARBON DIOXIDE REMOVAL TECHNOLOGIES (MUST PROVIDE A VALID LCA INDICATING ACTUAL NET REDUCTION)

CDR Type	
Direct air capture (DAC)	
Bioenergy with CCS	
Mineralization (Surficial and Ex Situ)	
Technology	
DAC-solid sorbent	
DAC-solvent	
DAC-Novel or hybrid	
BECCS-power	
BECCS-fuels and chemicals	
Mineralization-mine tailings and wastes	
Mineralization-minerals	
Mineralization-Improved kinetics	
Mineralization-processing	
Mineralization-products	