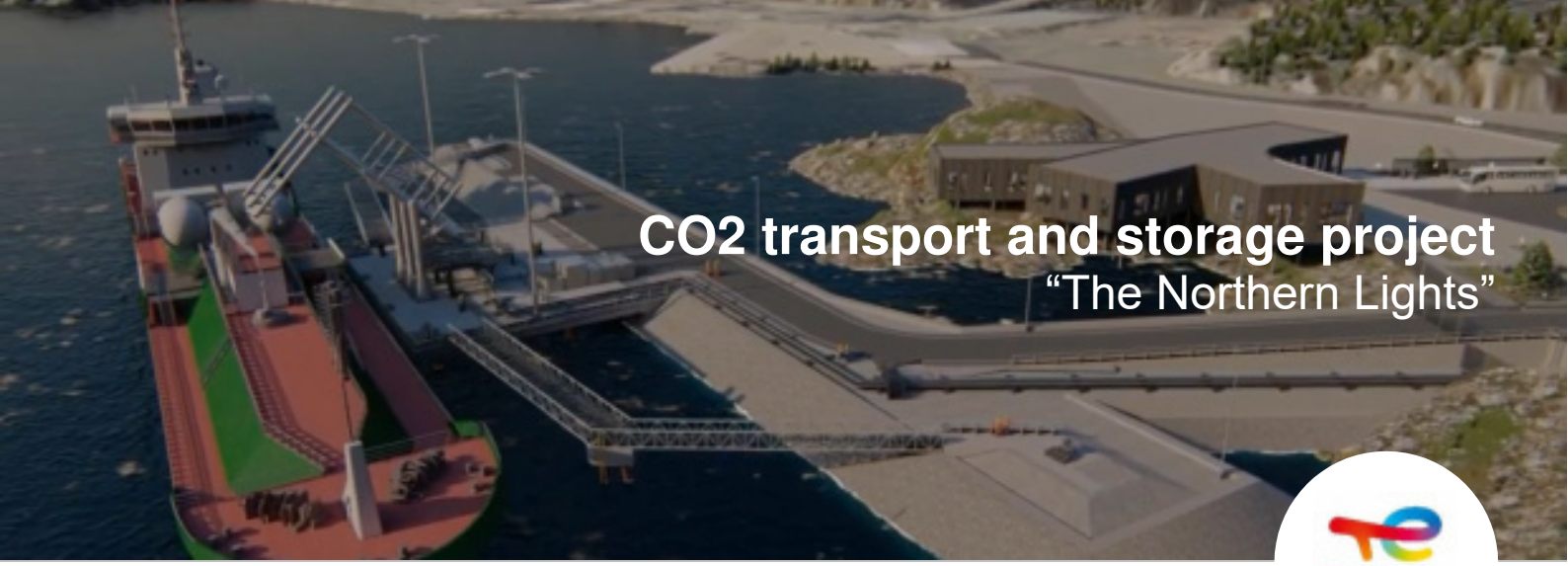

CO2 transport and storage project
"The Northern Lights"

In collaboration with Equinor and Shell, TotalEnergies is developing a project in Norway to transport and store CO2 in underground geological formations located off the Norwegian coast.

Starting date of the project	May 2020
Project Localisation Places of implementation of the project at this stage and targeted geography if replicable.	Implementation of the project in Norway. Project can be replicated in Europe.
Project objectives Type of climate innovation of the project with a description of the problem/issue addressed	The aim of the project is to transport and permanently store the CO2 emitted by two industrial sites in Norway, and by any other European emitter who subscribes to the transport and storage service offered by the project.
Detailed project description	**Background** In 2017, Equinor, Norske Shell and TotalEnergies E&P Norge signed a collaboration agreement, as equal partners, to review the shipping and storage project supported by Gassnova, the CCS arm of the Norwegian government. **The Northern Lights Project** On May 15, 2020, TotalEnergies, in collaboration with Equinor and Shell, made a landmark investment decision to develop Northern Lights, Norway's first commercial offshore CO2 shipping and storage project. This decision was made possible because of the strong support (subsidies) for the project from the Norwegian government. https://www.total.com/media/news/news/historic-investment-decision-transport-and-storage-co2 This project is part of the Carbon Capture and Storage (CCS) industrial chain supported by the Norwegian government (the "Longship" project). It involves the capture of CO2 from two industrial sources: the first being the Norcem site in Brevik of cement manufacturer, Heidelberg Group (Norcem), and the second being the Fortum Oslo Varme waste processing plant in Oslo. In phase one, the Northern Lights project aims to pioneer and accelerate the decarbonization of European industry, by providing available storage capacity of up to 0.7 MtCO2eq/year for emitters, in addition to the capacity already reserved by the Norwegian government (0.8 MtCO2eq/year for Norcem and Fortum). The funding from the Norwegian government was approved by the European authorities on July 17, 2020 and ratified by the Norwegian Parliament on December 14, 2020. The establishment of the joint venture that will operate and own the Northern Lights project was approved by various national competition authorities in mid-January 2021. The project is expected to be operational by 2024. **Context** In the carbon management cycle, CCS is deployed following the reduction of emissions through various actions, such as energy efficiency initiatives or the improvement of the energy mix of industrial companies: the switch from coal to natural gas (which can reduce GHG emissions by half), and the development of low carbon electricity, etc. CCS is the process of capturing residual CO2 emissions in flue-gas, separating them from the other components (nitrogen, water, etc.) and liquefying the CO2 to ensure optimal transport to the storage site by pipeline, ship or other logistical means. The CO2 is then injected into underground porous rock where it can be stored permanently. This project represents a major step forward in the decarbonization of European industry and will enable

the development of large-scale, low-carbon hydrogen production. This project also offers potential opportunities for the integration of CCU: the recycling of CO_2.
It is also possible to generate negative emissions with this technology when CO_2 is captured directly from the atmosphere (DAC = Direct Air Capture) or when it is derived from biomass or waste (BECCS).

Technical description of the project

Phase 1

- Phase 1 concerns the development of shipping transportation and the permanent storage of CO_2. This first phase will provide the capacity to store up to 1.5 $MtCO_2$/year by 2024, by which time the project is expected to be operational.
- Once the CO_2 from the industrial emitters has been captured, it will be transported by ship in liquid form to the offloading terminal on the west coast of Norway. It will then be pumped from the temporary storage tanks into a subsea pipeline of approximately 100 km long, and injected via a well into the underground geological formation where it will be permanently stored at about 2,500 meters below the seabed of the North Sea.

Field operations

- The facility is expected to be operational by 2024.
- The CO_2 receiving terminal will be located in the Naturgassparken industrial area in Øygarden, in west Norway.
- The site will be operated remotely from the Sture Terminal in Øygarden and from the Oseberg A offshore platform.

Storage and location

- The "Aurora" EL001 exploitation license was issued in January 2019.
- The storage facility is located at a depth of 2,500 meters below the seabed, south of the Troll gas field.
- In March 2020, the Eos confirmation well was drilled, confirming the characteristics of the storage site. It will be used for CO_2 injection and storage.

Main project's drivers for reducing the greenhouse gas emissions

Reduction levers	**Details on the aspects of the project**
☐ Energy and resource efficiency (including behaviour)	
☐ Energy Decarbonisation	
☐ Energy efficiency improvements	
☐ Improving efficiency in non-energy resources	
☒ Emissions absorption: creation of carbon sinks, negative emissions (BECCS, CCU/S, ...)	Transport and storage of CO2 from the two Norwegian industrial sites and any industrial sites in Europe that subscribe to the Northern Lights transport and storage service in the future.
☐ Financing low-carbon producers or disinvestment from carbon assets	
☐ Reduction of other greenhouse gases emission	

Emission scope(s) on which the project has a significant impact and quantification of GHG emission reductions per emission scope

	Aspects of the project contributing to the reduction of emissions by emission category	**Quantification of associated GHG emissions by emission category** **Please follow the quantification methodology used in the Afep guidelines.**
Reduction of the company's carbon dependency		
Scope 1 *Direct emissions generated by the company's activity.*	Potential entitlement to storage capacity for partners' scope 1 emissions	0.7 MtCO2eq/year maximum.
Scope 2 *Indirect emissions associated with the company's electricity and heat consumption.*		
Scope 3 *Emissions induced (upstream or downstream) by the company's activities, products and/or services in its value chain.*	Reduction of CO2 emissions from fossil fuel combustion i.e. Natural Gas	Up to 1.5 MtCO2eq/year
Increase of carbon sinks		
Emissions Absorption *Carbon sinks creation, (BECCS, CCU/S, …)*	Permanent storage of CO2 in deep underground reservoirs located offshore	1.5 MtCO2eq/year 27% of which is CO2 of biogenic origin (Fortum

			waste incinerator) “carbon negative”
GHG emissions avoided by the company at third parties			
Avoided Emissions *Emissions avoided by the activities, products and/or services in charge of the project, or by the financing of emission reduction projects.*		Permanent storage service for large industrial companies that capture their CO_2	1.5 $MtCO_2eq$/year

Clarification on the calculation or other remarks:

Carbon impact of the project

In phase one, the project will develop the capacity to store up to 1.5 $MtCO_2eq$/year.

0.8 $MtCO_2eq$/year will be reserved by the Norwegian authorities
0.7 $MtCO_2eq$/year can be sold to third-party customers

In phase two, the project has the potential to reach 5 $MtCO_2e$/year of storage

capacity. However, implementing the project will also generate CO_2 emissions:

the transport and temporary storage of CO_2 (before it is permanently stored in offshore reservoirs): 0.03 tCO_2/tCO_2 stored, total direct emissions (on-site construction for onshore + offshore + rig + emissions throughout the field operation period) + indirect emissions (CO_2 content of construction materials for ships, onshore, offshore)

i.e. storage of 1.5 $MtCO_2eq$/year will generate emissions of 50 kt tCO_2/year.

Impact on the two capture sites
The two capture sites (Fortum and Norcem) will each reduce their direct emissions by 0.4 $MtCO_2eq$/year.

Modality of verification of the quantification.

Calculation standard used (ADEME base, GHG protocol, etc.): European ETS and CCUS Directives

Verification of the calculation (internal or external): Verifications are subject to national and European regulations (CCS Directive among others).

Other environmental and social benefits of the project

TotalEnergies is committed to working towards the Sustainable Development Goals (SDGs), to ensure a brighter and more sustainable future for all. For this reason, the Group is constructing a sustainable development approach based on four pillars: integrating climate change into its business strategy, preserving the environment, respecting and mobilizing employees and suppliers, and contributing to the economic development of the regions where it operates.

To this end, the Northern Lights project, because of its co-benefits, will help to achieve 3 of the SDGs and to meet specific targets:

- SDG 7: Ensure access to affordable, reliable, sustainable and modern energy
  - The project ensures the generation of reliable, sustainable and modern energy by transporting and storing the emissions from power plants.
- SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
  - The project’s CO_2 transport and storage service provides a solution to the CO_2 captured by industrial companies and will therefore enable the development of a sustainable, low-carbon industry in Europe.
- SDG 13: Take urgent action to combat climate change and its impacts
  - The aim of the project is to develop geological storage capacity, which is essential for fighting climate change.

Project maturity level

☐ Prototype laboratory test (TRL 7)
☐ Real life testing (TRL 7-8)
☐ Pre-commercial prototype (TRL 9)
☐ Small-scale implementation
☒ Medium to large scale implementation

Remarks: **click here to enter the level of maturity of the project**

Capacity and conditions of the project reproducibility, with associated climate impact mitigation potential

The Northern Lights solution can be replicated for all emitters (waste-to-energy, hydrogen, cement and steel producers and other CO_2 emitters) as well as for all communities who would like to be involved in the decarbonization effort.

To date, 15 projects are being examined in Europe. No such project is currently under consideration in France.

Climate-related issues
The Intergovernmental Panel on Climate Change (IPCC) has described CCS technology as essential in

	order to achieve a worldwide “net-zero” carbon balance by the second half of the 21st century. Today, approximately 40 MT/year of CO_2 is stored geologically. In its 2020 “Sustainable Development” scenario, the International Energy Agency (IEA) estimates that these volumes must be increased to 850 MT/year by 2030 and 5.6 GT/year by 2050 in order to meet the Paris Agreement objective. In France, the National Low-Carbon Strategy (SNBC) has set a target of achieving net-zero emissions by 2050. Its reference scenario, “With Additional Measures” (Avec Mesures Supplémentaires - AMS), forecasts 15 MT/year of CCS (5 MT/year in industry and 10 MT/CO_2 in bioenergy). ADEME has selected 3 industrial centers of interest for CCS deployment (Dunquerke, Le Havre-Rouen, and Lacq), with a combined potential capacity of 24 MT/year. **<u>Conditions for the project’s success:</u>** In the project's later stages of development, it will be possible to increase capacity at the site in accordance with market demand from major CO_2 emitters across Europe. The main conditions for the success of the project and of the CCS industry as a whole, are as follows: • The net-zero emission aims of governments, companies and communities • The conversion of these aims into quantified targets and action plans In addition, value must be created for CO_2 through: • Recognition of the added value of low-carbon products (cement, steel, chemicals, etc.) • Decarbonization incentives based on regulation as well as carbon taxation
Amount of investment made (in €)	An investment decision was made by TotalEnergies and its partners in Norway on May 15, 2020 (NOK 6.9 billion or approximately €800 million for CO_2 transport and storage). The funding from the Norwegian government was approved by the European authorities on July 17, 2020 and ratified by the Norwegian Parliament on December 14, 2020. The establishment of the joint venture that will operate and own the Northern Lights project was approved by various national competition authorities in mid-January 2021.
Economic profitability of the project (ROI)	☐ ST (0-3 years) ☐ MT (4-10 years) ☐ LT (> 10 years) **Remarks:** Economic viability not disclosed. Northern Lights marks the first step towards developing a value chain based on carbon management and decarbonization services. It paves the way for new forms of international logistics. TotalEnergies has drawn on its expertise in carbon capture, transport, underground storage and complex chain management to develop this new decarbonization tool. TotalEnergies is thus offering a solution which meets the scale of the decarbonization challenge by taking the first steps towards commercializing this emerging industry.
Engaged partnerships	**<u>Committed partnerships</u>** TotalEnergies is working in partnership with Equinor and Shell on this project. The Norwegian government is supporting the project through subsidies in return for reserving 0.8 $MtCO_2eq$/year of storage capacity over the first 10 years of operation. **<u>Business development</u>** A non-binding Memorandum of Understanding has already been signed with nine European companies for the development of CO_2 capture and storage value chains. The signatory companies include: Air Liquide, Arcelor Mittal, Ervia, Fortum, Preem, HeidelbergCement, and Stockholm Exergi. The establishment of binding commercial agreements will depend on, among other things, a favorable decision by the Norwegian authorities, the decision to develop CO_2 capture facilities by third-party customers and the conclusion of bilateral agreements between Norway and third-party countries, where these customers are based, for CO_2 transport and storage. This cross-sectoral collaboration provides a unique solution to managing large volumes of CO_2 and preventing their release into the atmosphere. These new value chains and the infrastructure for CCS projects can only be developed through cooperation between governments and the private sector.
Open comments from the project owner	Experts agree that CCS is an essential tool in the fight against climate change and very important long-term objectives have been set for this technology. Even after 2050, it will still be necessary to keep reducing the CO_2 content in our atmosphere, which can be achieved through CCS. This collective awareness and greater societal acceptance because of offshore storage and the resulting public and private commitments made, have given rise to a multitude of projects planned between now and 2030, with CCS activity set to increase fivefold. Furthermore, in May 2020, TotalEnergies announced its aim to achieve net-zero emissions by 2050, in line with the society, for all of its global operations, from production to the use of its energy products by its customers.

	This target is based on three key areas: **1.** A target of net-zero emissions for TotalEnergies' global operations by 2050 or before (scope 1+2) **2.** A commitment to achieving net-zero emissions in Europe for all of its production and energy products used by its customers by 2050 or before (scope 1+2+3) **3.** An aim to reduce the average carbon intensity of Total's energy products used by its customers worldwide by 60% or more by 2050 (below 27.5 gCO_2/MJ) with intermediate targets of 15% by 2030 and 35% by 2040 (scope 1+2+3) The Northern Lights project will therefore help TotalEnergies to expand its range of low-carbon products and services offered to its customers.
More about the project	
Contact the company carrying the project	presse@totalenergies.com
Project URL links	https://northernlightsccs.com/en
Illustrations of the project