RÉPUBLIQUE FRANÇAISE
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DKarbonation

ADEME AGENCE DE LA TRANSITION ÉCOLOGIQUE

EXPERTISES

CO2 terminalling in Dunkerque: studies supported by ZIBAC

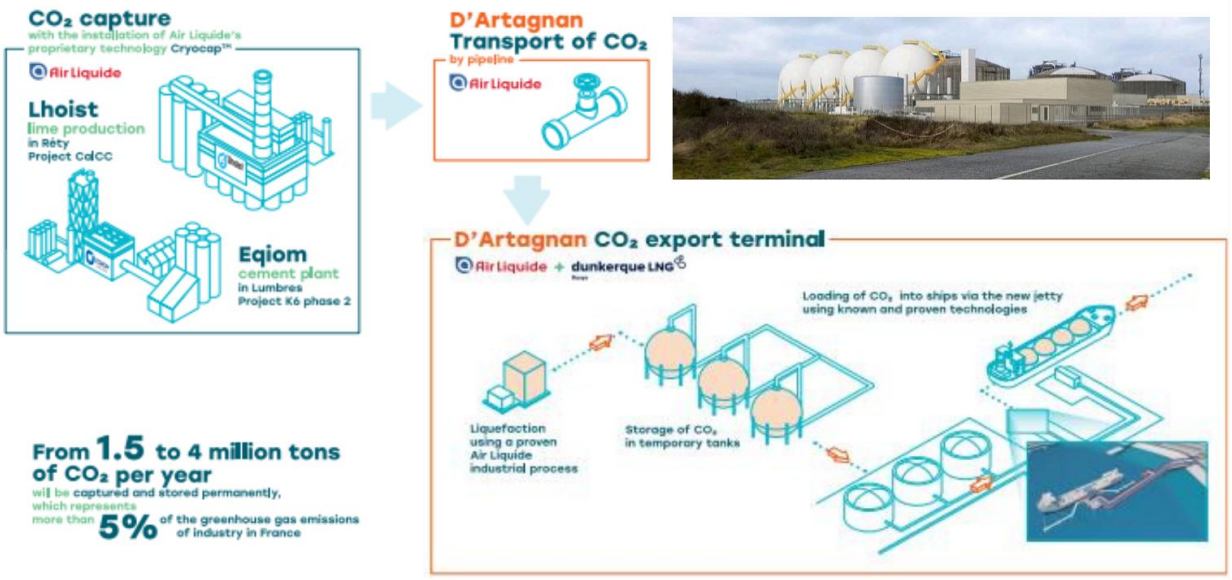
Déc. 2025

FRANCE 2030

CFP ZIBAC – Towards an industrial and maritime CO2 hub serving European decarbonization

Introduction

The production of cement and lime, while essential, inevitably generates carbon dioxide (CO_2) emissions due to the chemical process of limestone decarbonation. While energy efficiency measures can reduce part of these emissions, around two-thirds are inherent to the process. For these hard-to-abate industries, Carbon Capture and Storage (CCS) is therefore indispensable. This technology not only enables a significant reduction in emissions but also paves the way toward a more sustainable and climate-responsible future.



The Cap Décarbonation initiative, led by industrial players EQIOM, Lhoist, Air Liquide France Industrie, Dunkerque LNG, and RTE, addresses this challenge through three complementary projects: CO_2 capture at the Lumbres (cement) and Réty (lime) sites, pipeline transport to Dunkirk, and maritime export via the D'Artagnan project. Dunkerque LNG plays a pivotal role thanks to its long-standing expertise in operating cryogenic terminals for the maritime transport of gases and liquids. This unique know-how is directly transferable to liquefied CO_2, a sector still in its infancy

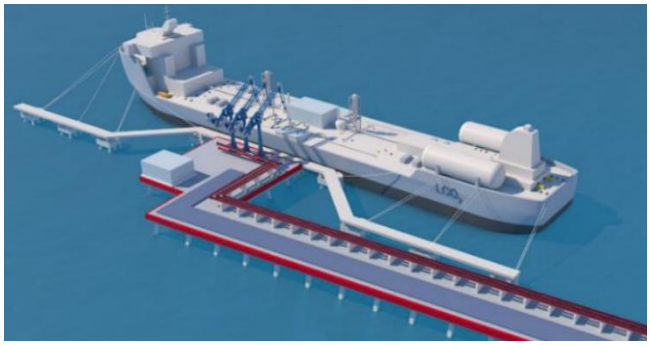
Several studies were launched to test the technical, logistical, and economic feasibility of such a terminal. These were made possible through significant public support, notably from the ZIBaC and CEF (Connecting Europe Facility) programs. With a CO_2 transport market that is still virtually non-existent, this funding is vital to de-risk early development (DEVEX) and prepare for the emergence of a European CO_2 value chain. The project's ambition is to establish a robust, reliable infrastructure for CO_2 capture, transport, and storage, thereby enabling a substantial reduction in greenhouse gas emissions and supporting the energy transition

What studies were conducted and why

Within the ZIBaC framework, three major studies were carried out to confirm the overall feasibility of the D'Artagnan project:

Logistics study for maritime CO_2 export (Lot G): This study assessed the robustness of a complete CO_2 export chain, from capture to geological storage. Using advanced simulation tools derived from LNG expertise, more than 200 scenarios were modeled, taking into account weather conditions, production shutdowns, and vessel availability. The study identified key parameters such as storage tank size, vessel fleet size and speed, and berth scheduling. The analysis confirmed that industrial-scale operations are not only feasible but also highly efficient, with minimal losses.

Pre-FEED study for a dedicated CO_2 jetty (Lot F) : This study evaluated the feasibility of building a dedicated CO_2 jetty in the dock of the existing LNG terminal. Advanced simulations of currents, swell, navigation, and mooring conducted by navigability experts confirmed that operations would be technically feasible and safe, even under extreme weather conditions. Several layout options were assessed, and the selected configuration optimizes port space, minimizes dredging needs, and ensures full compatibility with ongoing LNG operations



Feasibility study on expanding the CO_2 hub (Lot E) : This innovative study explored potential synergies with the LNG terminal, particularly the use of LNG "waste cold" to reduce CO_2 liquefaction costs by around 25%. It also assessed options for future hub expansion, with capacity rising to 4–6 million tonnes per year (Mt/year), and considered possible integration with an offshore export pipeline. The results confirmed that these synergies not only reduce costs but also strengthen the technical and economic viability of the project, laying the groundwork for large-scale decarbonization infrastructure

Conclusions

The studies collectively demonstrate that maritime export of CO_2 from Dunkirk is both technically safe and scalable. This new logistics chain could limit CO_2 losses to below 0.5%, fully aligned with climate targets. A dedicated CO_2 jetty can be built, able to accommodate specialized ships with wide compatibility in terms of size and design pressure (low and medium pressure).

Synergies with the LNG terminal provide a significant competitive advantage compared to standalone solutions. The findings show that the project can progress toward a more ambitious Phase II while remaining compatible with other infrastructure developments, such as a CO_2 pipeline network and offshore export routes. Depending on how the market evolves, the terminal could either expand for larger export volumes or be repurposed as an import hub feeding into a pipeline. Shared infrastructure will lower costs for emitters and society, while positioning Dunkirk as a central CO_2 transport hub for Northwest Europe and strengthening its strategic role in the energy transition.

Next steps

On the strength of these results, Dunkerque LNG and Air Liquide France Industrie (ALFI) have initiated a Front-End Engineering Design (FEED) phase. This critical step will define the detailed technical specifications of the terminal, jetty, and process systems, refine cost estimates and the business model, and prepare the necessary regulatory and environmental approvals.

The ambition is to reach a Final Investment Decision (FID) in 2026, with operations starting in 2030. The terminal will begin with a capacity of 1.5 Mt/year, expandable to 4 Mt/year, making Dunkirk France's first CO_2 hub and a key player in European industrial decarbonization. Through this initiative, Dunkerque LNG and Air Liquide France Industrie are demonstrating their commitment to developing innovative, sustainable solutions to cut greenhouse gas emissions, while strengthening the region's industrial attractiveness. This project will offer emitters a practical path to decarbonization, positioning Dunkirk as a preferred destination for companies committed to reducing their carbon footprint and environmental impact.

RÉSUMÉ

The ZIBAC studies carried out as part of the development of the Dunkerque CO2 terminal have confirmed the technical, logistical, and economic feasibility of a complete CO2 capture, transport, and maritime export chain. Building on synergies with the existing LNG terminal, the D'Artagnan project offers a scalable and competitive solution for decarbonizing the cement and lime industries. It positions Dunkerque as a future strategic CO2 hub in north-western Europe, capable of supporting the energy transition on a large scale.

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