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INNOVATION FUND

Driving clean innovative technologies towards the market

Kairos@C: Building strong momentum for massive decarbonisation in the EU through a unique end-to-end CCS project

The Innovation Fund is 100% funded by the EU Emissions Trading System

© Kairos@C Port of Antwerp view

Project summary

The main objective of the Kairos@C project is to create the first and largest cross-border carbon capture and storage (CCS) value chain to capture, liquefy, ship and permanently store CO_2. Located in the Port of Antwerp, Kairos@C will establish a regional hub for innovative energy and carbon value chains. Kairos@C will develop a full industrial-scale CCS project that will encompass the CO_2 capture from various industrial sources on the Zandvliet industrial platform, the CO_2 transport by a local pipeline within the port of Antwerp to the liquefaction and export terminal located in the same port, the shipping towards CO_2 subsea storages in the North Sea and the permanent sequestration of the CO_2 in these storages. The infrastructures in the Port of Antwerp will be built in a phased approach and will be operated on an open access basis. Kairos@C will be the kick-starter of these shared infrastructures.

Kairos@C will enable the deployment of several pioneering technologies that together have the potential to avoid the emission into the atmosphere of 14 Mt CO_2eq over its first ten years of operation. Among the project innovations are: a cryogenic CO_2 capture process at industrial scale; an energy efficient CO_2 liquefaction plant, with ten times the capacity of the largest CO_2 liquefaction unit in operation today; and the development of a major functioning cross-border shipping and storage CCS chain.

COORDINATOR
Air Liquide Large Industry SA (AL)

BENEFICIARIES
BASF Antwerpen NV (BASF)

LOCATION
Antwerpen, Belgium

SECTOR
CO_2 transport and storage

AMOUNT OF INNOVATION FUND GRANT
EUR 356 900 000

GHG EMISSION AVOIDANCE
13.96 Mt CO_2eq

STARTING DATE
November 2020

PLANNED DATE OF ENTRY INTO OPERATION
Q3 2025

Climate Action

Three first-of-its-kind innovations embedded across the project

The first major innovation is the deployment of CryocapTM, a cryogenic CO_2 capture process, at industrial scale. This process enables the transition to a zero-carbon energy system as it consumes mainly electricity and it can use renewable electricity. The integrated multi-feed capture scheme will integrate CO_2 capture and purification from five different sources located on the Zandvliet industrial complex: two hydrogen (H2) plants, two ethylene oxide (EO) plants, and one ammonia (NH3) plant. The project will focus first on the more concentrated CO_2 emissions in the process streams, i.e. those generated as a by-product in a chemical process (ammonia and ethylene oxide) for which no alternative or cost-effective low-carbon technology is available. This is a very cost-effective phased approach (vs full capture upfront investment), starting with the more concentrated emissions in the process streams and allowing integration of future expansions at a later stage.

The second innovative element of the project is the use of an energy efficient liquefaction plant at a scale not realized before (ten times the capacity of the largest CO_2 liquefaction unit in operation today) and tailored to the needs of the Antwerp port.

The third innovative element is the development of liquid CO_2 vessels on a hitherto unavailable scale, whereby the main innovation lies in an appropriate design and steel grade able to withstand both the pressure and weight of liquefied CO_2.

Developing a regional CCS hub to support decarbonisation and industrial competitiveness

Kairos@C is a prominent example of Sustainable Energy Technology (SET) Plan strategy implementation, which looks for clusters and hubs linking a range of carbon and energy intensive industries to increase synergies. The project will support the Port of Antwerp in becoming a regional hub for innovative energy and carbon value chains. The project will also contribute to maintaining and reinforcing European industry's global competitiveness, in line with the EU Industrial Strategy.

Kairos@C will be the first and largest reference for a cross-border liquid CO_2 value chain in a multi-user environment due to a series of factors. First, Antwerp is the second largest European port (after Rotterdam) and fourth largest European industrial cluster. In addition, the BASF site located in the Port of Antwerp is the largest integrated chemical production complex in Belgium, where Air Liquide owns and operates two world scale hydrogen production units on which capture units will be added. Kairos@C will benefit from the synergies with the Antwerp@C initiative, such as the use of shared CO_2 infrastructure within the port of Antwerp.

Kairos@C is also a flagship project in terms of supporting decarbonisation of hard-to-abate sectors to help achieve the goal of making Europe climate neutral by 2050. Overall, the project will result in an avoidance of 14 Mt CO_2eq emissions over the first ten years of operation. This represents more than the 2019 GHG emissions of the entire chemical industry in Belgium. As such, CCS deployment in the Port of Antwerp, with Kairos@C as an anchor project, will become the cornerstone of the decarbonisation roadmap of Flanders and Belgium.

Strategic location to support scalability and technology transfer

The infrastructure in the Port of Antwerp will be built in a phased approach and will create cost effective scalability towards new industrial customers.

Kairos@C will be a key milestone for Air Liquide and BASF to accelerate the deployment of CCS at their other sites, since many of them are ideally located in industrial clusters within close proximity to carbon storage infrastructure.

The CryocapTM technology can also be applied in other energy-intensive sectors for CO_2 streams with a CO_2 concentration range between 15% and 95%, such as in oxy-combustion in the power sector or in cement manufacturing, with strong replication potential throughout the industry.