



INNOVATION FUND

Driving clean innovative technologies towards the market

K6 PROGRAM

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



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Project summary

The K6 Program will transform one of the oldest and strategic cement plants in Europe (located in the Hauts de France region in France) and will make it the first cement plant in Europe to take a large step towards carbon neutrality. The K6 Program aims to produce the first carbon neutral cement in Europe, becoming a representative project for the cement industry worldwide and supporting the green transition of a hard-to-abate sector. The plant has a capacity of more than 800 000 tonnes of cement and uses 145 000 tonnes of local waste per year. It also provides nearly 400 direct and indirect jobs, and supplies construction materials to an extensive regional market that ranges from Dunkirk to Paris.

The project will deploy a first-of-a-kind industrial-scale combination of an airtight kiln and cryogenic carbon capture technology. The captured CO₂, otherwise emitted to the atmosphere, will be finally stored in a permanent storage site in the North Sea (this part of the technology chain falls outside the Innovation Fund project boundary). The project will result in the avoidance of 8.1 Mt CO₂eq emissions over its first ten years of operation. The integration of the K6 Program with the nearby Port of Dunkirk will foster the development of the port as a future European CO₂ hub.

COORDINATOR

EQIOM (FR)

BENEFICIARIES

AIR LIQUIDE (FR), AIR LIQUIDE GLOBAL
E&C SOLUTIONS FRANCE (FR)

LOCATION

Lumbres, Hauts de France, France

SECTOR

Cement and lime

AMOUNT OF INNOVATION FUND GRANT

EUR 153 386 598

RELEVANT COSTS

EUR 255 644 331

GHG EMISSIONS AVOIDANCE

8.1 MtCO₂eq

STARTING DATE

April 2022

PLANNED DATE OF ENTRY INTO OPERATION

Q1 2028

A first-of-a-kind carbon neutral cement

The K6 Program plans to modernize a current cement production site. The project will integrate the rotary kiln system – the central unit of the cement clinker production process – with a very efficient CO₂ capture system to produce the first carbon neutral cement in Europe. It will also put in place a complete chain of carbon capture, liquefaction, transport and storage at full industrial scale.

The main innovation of the project is the installation of the most energy efficient Oxyfuel technology in a cement plant at full scale, in combination with the cryogenic capture and membrane separation technology developed by Air Liquide (Cryocap™). The Oxyfuel technology uses pure oxygen instead air for the combustion in the cement kiln. The airtightness of the system enables a high concentration of the CO₂ from both the combustion and limestone decarbonation in the flue gas and therefore allows direct and efficient capture.

This innovative process has been applied twice at a pilot scale (<100 TPD) in the coal power plant industry and is expected to achieve a CO₂ capture rate of 95 – 98%.

The K6 Program is going to implement technologies to enhance the energy efficiency of the standard cement production subprocesses (going beyond the state of the art).

The plant traditionally uses waste-derived fuels with varying percentage shares of biomass in its clinker manufacturing process. Thus, the overall CO₂ emissions balance per ton of clinker will be slightly negative, i.e. the fraction coming from the biological fuel will balance the remaining actual emissions and lead to net carbon removal.

The captured CO₂ will then be transported to the Dunkirk port and onwards to a permanent underground storage site in the North Sea¹.

A solution for the green transition and carbon neutrality of a hard-to-abate sector

The project will result in an avoidance of 8.1 Mt CO₂e emissions over the first ten years of operation. The absolute emissions avoidance includes around 14% of net carbon removal based on the capture, transport and storage of CO₂ from biogenic fuels (such as waste woods and

impregnated sawdust). Net carbon removal is necessary to achieve the EU objective of EU-wide climate neutrality by 2050².

The K6 Program solution will be a flagship project for the cement industry worldwide and is consistent with the “modernisation and decarbonisation process” of the New Industrial Strategy for Europe. The project also supports the development of the Carbon Capture Utilisation and Storage sector, one of the main priority objectives of the European Strategic Technology Plan (SET Plan).

The K6 Program is in line with the new Circular Economy Action Plan in Europe, as it will reduce the water use. The K6 process will reduce water consumption by 250 000 to 400 000 m³ per year in the area, which that corresponds to the volume of fresh water consumed by 3 000 households in one year³.

A solution to support a Carbon Capture & Storage (CCS) cross-border value chain in Northern Europe

At sector level, the technology of the novel kiln combined with CO₂ capture has the potential to be implemented in both existing and new cement plants. The transfer of the technology to other sectors of the economy will allow for additional avoidance of CO₂ emissions, for example in the steel, ceramics, glass and chemical fertiliser industries.

The project will be key in supporting the development of a strategically important CO₂ export hub in the port of Dunkirk located 54 kilometres away from the Lumbres cement plant. The CO₂ hub in Dunkirk will be developed in the frame of the so-called D’artagnan Project of Common Interest (PCI). The K6 project is the CO₂ capture building block of a full CCS value chain relying on the Northern Lights and D’Artagnan (PCI): being located in such a strategic industrial area, the project could help to develop and expand a value chain and logistic solution for a large number of existing industries. Several existing factories in France & Belgium emitting more than 100 000 tCO₂eq per year could be connected to the CO₂ hub by train or pipeline. In total, 71 cement plants (out of 213) in Europe, UK and Norway, are located close to the coast, and could also be connected by ship. Finally, the project could support the generation and reinforcement of downstream supply chains for the capture, transportation and storage of large amounts of CO₂ in Europe.

¹ This part of the technology chain falls outside the Innovation Fund project boundary.

² Communication from the Commission to the European Parliament and the Council on Sustainable Carbon Cycles: https://ec.europa.eu/clima/system/files/2021-12/com_2021_800_en_0.pdf

³ Considering 144 litres per person per day supplied in Europe and average household’s size of 2.36 people.