



INNOVATION FUND

Driving clean innovative technologies towards the market

Beccs Stockholm: Bio Energy Carbon Capture and Storage by Stockholm Exergi

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



Project summary

The Beccs Stockholm project will create a world-class, full-scale Bio-Energy Carbon Capture and Storage (BECCS) facility at its existing heat and power biomass plant in Stockholm. The project will combine CO₂ capture with heat recovery, making the process much more energy-efficient than the process in a conventional Carbon Capture Storage (CCS) plant. It will capture and permanently store large quantities of biogenic CO₂, leading to carbon removals from the atmosphere, also called negative emissions. The Beccs Stockholm project has a potential to remove around 7.0 Mt CO₂eq over the first ten years of operation. Net carbon removals are seen as an increasingly important technology-based solution to climate mitigation, indispensable to reach climate neutrality in 2050. The project will also be a catalyst for paving the way for a new market of net carbon removals. Besides the actual negative emissions achieved, Beccs Stockholm will also have a positive impact on the balance for renewable heat and electricity, resulting in additional reduction of around 0,8 Mt CO₂eq over the same period.

COORDINATOR

Stockholm Exergi

LOCATION

Stockholm, Sweden

SECTOR

Bio-electricity

AMOUNT OF INNOVATION FUND GRANT

EUR 180 000 000

RELEVANT COSTS

EUR 608 863 394

CAPEX

EUR 455 661 141

TOTAL PROJECT COSTS

EUR 2 707 453 271

GHG EMISSION AVOIDANCE

7.8 Mt CO₂eq

STARTING DATE

01 July 2021

PLANNED DATE OF ENTRY INTO OPERATION

Q3 2026

A world-class, full-scale Bio-Energy Carbon Capture and Storage (BECCS) plant

Beccs Stockholm will make use of a novel combination of existing technologies (Hot Potassium Carbonate for CCS and bio-fueled CHP) on a new scale, to develop the first, large commercial BECCS plant in Europe. The HPC-technology is well proven with multiple installations over the years. Its application with flue-gases from a bio-fueled CHP-plant is, however, not tested in full scale. Therefore, Stockholm Exergi has designed, constructed and now operates a smaller-scale R&D facility at the plant site with support from the Swedish Energy Agency with the objective to gain practical experience and results before designing the full scale plant. The Beccs Stockholm implementation will represent the first-of-a-kind global integration of CO₂ capture in an existing combined heat and power (CHP) plant that uses biomass-based fuels. By using the excess heat of the CO₂ capture facility to supply Stockholm's district heating network, the extra energy required for the CCS process (i.e. the energy penalty) will be greatly reduced. This energy penalty is normally in the range of 15-29%, of the energy produced, while Beccs Stockholm will reduce it to a mere 2%. Importantly, 90% of the CO₂ in the flue gas will be captured by use of the HPC technology. Stockholm Exergi selected this CO₂ absorption technology based on several advantages, such as its non-toxicity, the high selectivity for CO₂ and as a result high purity of captured CO₂, its low regeneration heat; and, the compact lay out of the technology in comparison to other CO₂ absorption solutions. After liquefaction and buffering, the CO₂ will be transported by ship to an underground storage site in the North Sea (although being part of relevant cost-calculation, this part of the technology chain is not part of the project).

Beccs Stockholm actively supports the climate neutrality goal and multiple European strategies

The scaling up of carbon removal solutions that capture CO₂ from the atmosphere and store it for the long term is vital to achieve the EU objective of economy-wide Climate Neutrality by 2050¹. Beccs Stockholm will support the achievement of this climate goal by capturing and storing almost 800 000 tonnes of biogenic CO₂ per year, with the aim to further improve the technology in the future. CCS, as well as bioenergy – the building blocks of the project – are among the ten main priority actions of the European Strategic Energy Technology Plan (SET Plan) to accelerate the energy system's transformation. In particular, the SET Plan highlights

that CCS needs to become a cost-competitive technology and gain public acceptance, to be eventually commercially deployed.

Beccs Stockholm will remove/avoid the emissions of 7.8 Mt CO₂eq of absolute GHG emissions during its first ten years of operation. This is the equivalent to more than the 2018 GHG emissions from public electricity and heat production in Sweden². From the overall emissions removed/avoided, 90% will come from CO₂ capture and storage (removal), and 10% will be associated with renewable electricity and heat generation from a renewable source.

At site-level, the project will implement solutions in line with the Circular Economy Action Plan, using locally-sourced biomass waste, as a feedstock in the electricity and heat generating plant, reusing process water to eliminate or diminish the use of fresh water, and with the opportunity to supply sustainably managed forests with fly ash coming from the co-incineration of the current biomass waste with phosphorous-rich sludge, with the potential to increase Swedish forest sequestration of carbon by 0.45 Mt CO₂eq per year. In line with the EU recovery ambition, the project will also create direct jobs locally and outside Sweden, acting as a springboard for many more highly-skilled engineering, construction and operation-related jobs throughout the CCS value chain.

Measures taken during the preparation phase increased the support of the project among citizens, living as close as 140 metres from the facility. For Stockholm Exergi, nurturing a strong and transparent relation with citizens, is and has always been a priority. One example of this, was the launch of a public acceptance survey at an early stage in the project's planning. This is an essential prerequisite for successful implementation within the boundaries of a populated city. Stockholm Exergi, which is already active in the field, will continue its efforts to establish a market for net CO₂ removals as a novel product. This will make the net carbon removals at Beccs Stockholm profitable for a CHP plant, paving the way for other actors to join.

Strategic location to support scalability and technology transfer

The Beccs Stockholm technology can be replicated in other sites. For example, two locations have already been identified in the region where the solution could be implemented by 2030. These two sites have the potential to avoid 1.1 Mt CO₂eq per year, of which 0.8 Mt from biogenic sources, thereby contributing to the necessary net carbon removals foreseen by relevant scenarios reaching climate neutrality.

The solution also has the potential to be scaled up across the economy, by replicating the technology in other industries, such as the pulp and paper industry, waste incinerators and heat plants.

The project overall will help to establish a new European market for net carbon removals. By contributing to the establishment of all necessary links in the CCS value chain in Northern Europe, including transport by ship of the CO₂ for storage in saline aquifers or depleted gas-/oil-fields in the North Sea basin, Beccs Stockholm is one of the important early adopters that will lead many other CCS projects to follow suit, both in the region and further afield.

1 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

2 The public electricity and heat production sector in Sweden produced 7.08 Mt CO₂eq in 2018. <https://climate-energy.eea.europa.eu/topics/climate-change-mitigation/greenhouse-gas-emissions-inventory/intro>