
From Heat supplier to Provider of Climate Mitigation

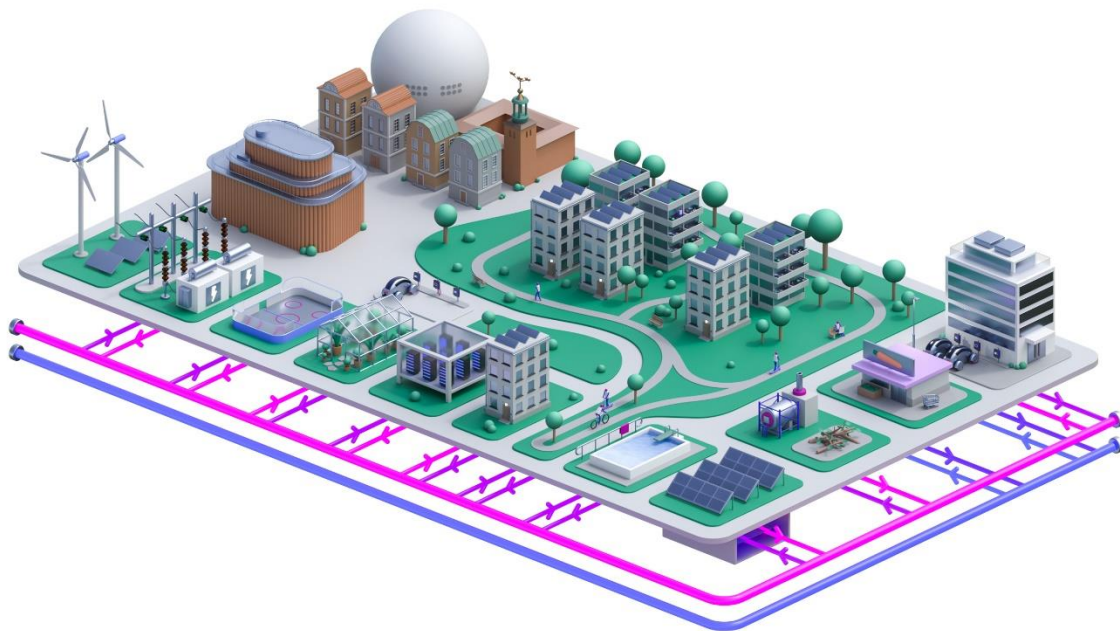
Every city with district heating has an incredibly valuable platform not only for delivering high quality comfort services but also for addressing some of our societies' most pressing needs. This is proven again and again in the evolution of our district heating network in Stockholm.

In its infancy, polluted skies or skyrocketing oil prices made district heating both an appealing and sometimes strategic choice for many cities in Europe. Also in Stockholm.

With higher environmental standards, increased focus on recycling and Stockholm's and other cities' district heating systems allowed politicians to move ahead with a ban on landfill of incinerable and organic waste in 2001. It was clear that energy recovery was a much-preferred alternative in cases where recycling fell short of providing a solution.

For Stockholm Exergi, it became evident that the district heating network was more than a heating system, starting the company's endeavor to leverage this potential to develop new 'Out of the Box' initiatives and services.

A key example of this inventiveness is heat recovery. Starting development work already in 2012, a few years later the world's first open marketplace and business model for heat recovery was launched. Today, Stockholm Exergi purchases excess heat that is fed into the Stockholm district heating network from data centers, food stores, industrial processes, electrical installations and many other sources.



This extensive, open approach to reusing external heat sources in the city, with the objective of reaching up to 10% of the end-customer heating demand, also played an important role in the company's transition away from fossil fuels, culminating in 2019 with the closure of the last coal-fired CHP in Stockholm.

With the urbanization, electrification and digitization of our societies, Stockholm, like many other cities have felt the pain of growth, where peak demand for electrical power can limit the development of the city. Again, the district heating system came to rescue.

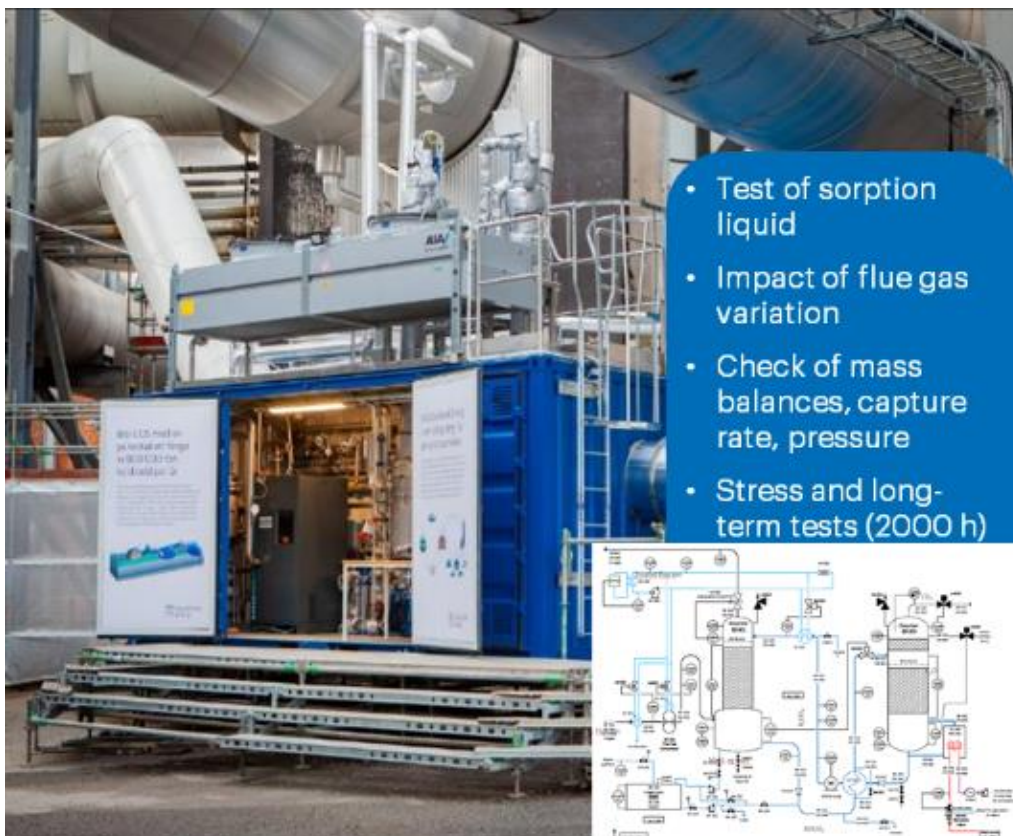
Thinking out of the box, Stockholm Exergi together with the regional DSO (Ellevio) and the national TSO (Svenska kraftnät) devised a solution where Stockholm Exergi would guarantee the injection of up to 20% extra power during hours where demand would exceed the network capacity of the DSO. Of course, using sustainable fuels.

In the same spirit, the company also deployed what may well be the largest distributed capacity control system of a district heating network ensuring a fair distribution of heat in a situation of extreme cold or system failure. Today, close to 7 000 multi-tenant buildings are connected. Relying on the same implementation, customers can now follow their heat demand in real-time and subscribe for premium comfort services.

The IPCC Special Report Global Warming of 1.5 °C from 2018 (SR1.5) once again triggered the company to think out of the box. The report stated: “All pathways that limit global warming to 1.5 °C with limited or no overshoot project the use of carbon dioxide removal (CDR) on the order of 100–1 000 GtCO₂ over the 21st century.”

With this daunting challenge outlined, IPCC goes on to conclude that most of the CDR will have to happen with bio-based Carbon Capture and Storage, i.e. BECCS. Having recently launched Europe’s largest biomass CHP, named KVV8, the opportunity to leverage the CDR-potential of the plant was identified.

Very quickly, the company set up a test facility, to lay the groundwork of what may become the world’s largest production unit of negative emissions. In late 2019, the test plant was launched to work out the most efficient way of capturing biogenic CO₂ from KVV8’s flue gases.



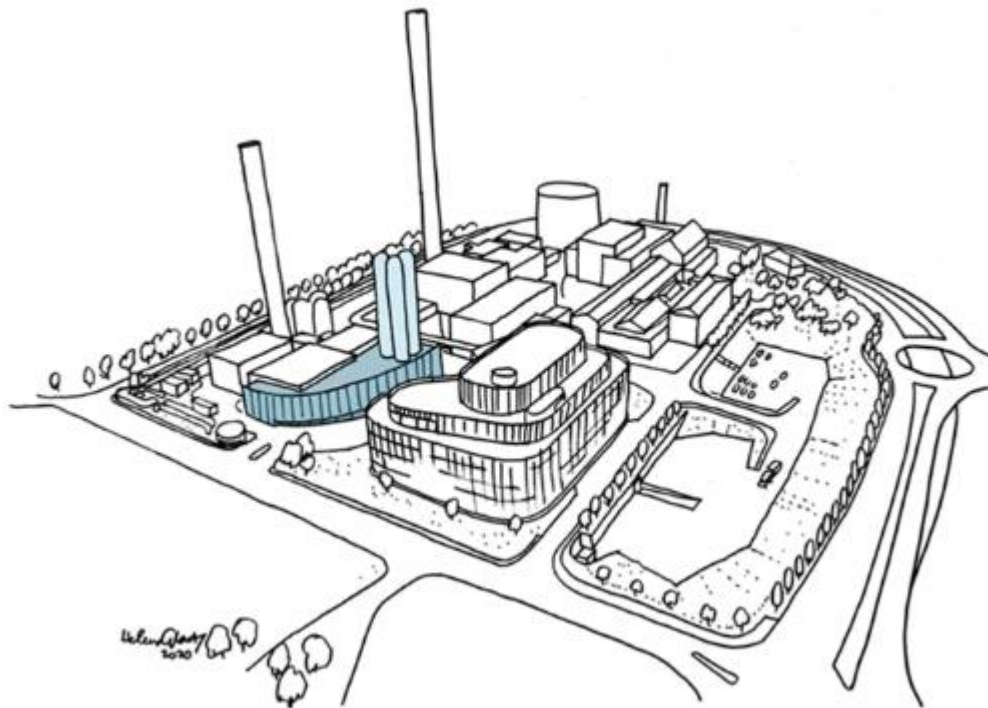
In the pilot facility, the choice of Hot Potassium Carbonate as sorption liquid was confirmed, and it has already been proven that the implementation can have a capture rate of 90% on industrial scale, with close to 20% of CO₂ in the flue gases.

Technically, the concept is ready. The challenge now is funding, business models and the regulatory environment. Again, Stockholm Exergi has set out to define and develop a new market for a service without which we face a dire future with temperatures raising far beyond 2 °C.

Luckily, this development coincides with an exceptional realization among business leaders that the climate is a shared responsibility, and a critical component of a prosperous future. Against this background, there has been a massive growth in companies and organizations stating their intention to become net-zero, i.e. climate-neutral, from 2030 or at the latest by 2050. Collectively, according to the UN initiative Race to Zero, there are currently 2 360 (995) businesses, 708 (449) cities, 163 (38) investors, 24 (21) regions and 624 (505) higher education institutions who have committed to net-zero by 2050 (figures in brackets are from July 2020).

To respond to this need for climate mitigation measures, which demand negative emissions, the entire business framework must be invented. Thus, in Stockholm Exergi's business development dialogues, we seek not only to validate demand for BECCS/negative emissions. We also look to identify customer's preferences, covering questions from contract length to correlation between price and permanence of storage as well as requirements for certification and the need for adaptations of international emission accounting rules.

The company is now set to launch the plant in 2025.



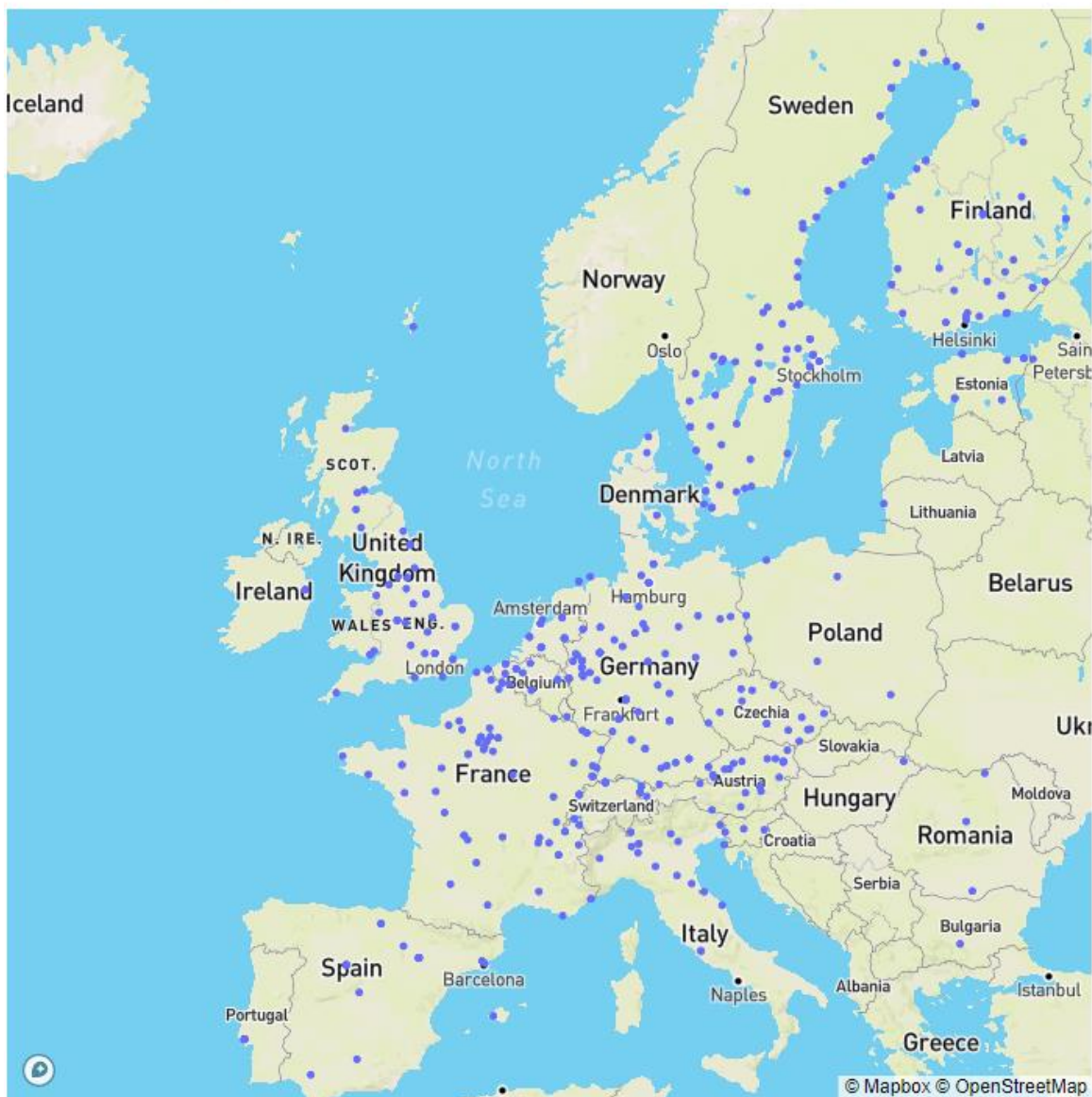
With this initiative, Stockholm Exergi makes a major effort to provide one of the most important climate mitigation instruments of the future, starting with 800 ktonnes of negative emissions per year with the potential to more than double that over the coming decades.

This is not only good news for the climate and Stockholm Exergi. This is an opportunity for existing district heating networks throughout Europe to contribute to the production of the negative emissions that will be required to mitigate climate change.

By relying on data from a recent study of point sources of biogenic CO₂ in Europe (Assessment of carbon dioxide removal potential via BECCS in a carbon-neutral Europe, Lorenzo Rosa, Daniel L. Sanchez and Marco Mazzotti) and the sEnergies project (<https://www.seenergies.eu/>), it is possible to assess this opportunity.

In the map below, the 460 district heating networks in Europe closest to existing point sources of biogenic CO₂ have been mapped.

District heating networks in the vicinity of biogenic CO₂ point sources

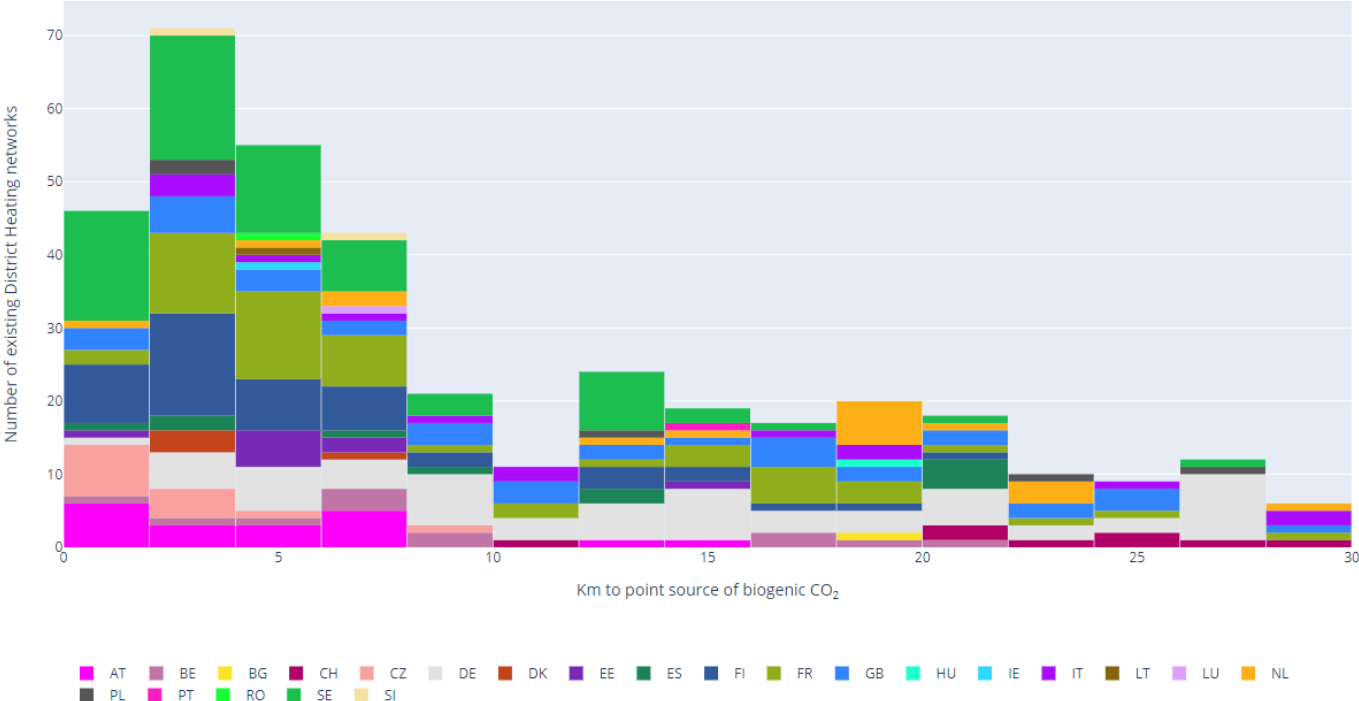


The 460 district heating networks in Europe closest to the existing point sources.

Not all of these 460 district heating networks will be sufficiently close to allow for combining the production of negative emissions with heat recovery and reuse towards a district heating network, which is the key for an efficient production of this climate mitigation tool.

Setting a range limit of 30 km, it is possible to assess the potential of such sector coupling throughout Europe. The result finds that 382 district heating networks are within a range of 30 km from a point source of biogenic/fossil CO₂.

Existing District Heating networks' distance from CO₂ point source (in total 382)



Histogram of distance between district heating networks and point sources, per EU country, within 30 km.

The histogram adds to the significance of the Stockholm Exergi’s BECCS project and company’s willingness to share experiences from the project. The majority of these 382 networks are clearly within the distance to be considered for realizing the coupling between, on the one side, the district heating and, on the other, production of negative emissions (biogenic CO₂) or avoidance of emissions (fossil CO₂). In some cases, these district heating networks are already connected to the point sources, or are point sources themselves, further lowering the bar for benefitting from a BECCS implementation.

Finally, it must be mentioned that the sEEnergies project identified in total over 45 000 areas within Europe where the heat demand could motivate the establishment of a district heating network. Sometimes, such new heating infrastructure, which could have a significant positive impact on Europe’s climate objectives, are not realized due to a lack of profitability compared to the alternative. By leveraging the experiences and models developed by Stockholm Exergi’s BECCS project, more such networks could become a reality.