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Söderenergi's progressive BECCS plan

During 2025, Swedish municipal energy utility Söderenergi AB reached a major milestone by reserving the very first negative emissions from its planned bioenergy with carbon capture and storage (BECCS) plant for neighbouring global pharmaceutical major and heat client AstraZeneca. For Söderenergi, the carbon dioxide removal (CDR) reservation complements a CDR Letter of Intent (LoI) also signed during 2025 with urban developer and real estate major Fabege, as it secures financing ahead of a final investment decision expected at the end of 2026.

INDEED, WHEN IT COMES TO LARGE-SCALE BECCS

projects, few would seem to have as advantageous circumstances already in place as Söderenergi has – a large point source of biogenic carbon dioxide (bioCO₂), ample space within the existing property including Baltic Sea waterfront, ability to integrate utilities and share operations and maintenance (O&M) staff, no residential or other neighbours in proximity, to mention a few.

Nonetheless, designing, building, and operating a 500,000 tonnes of carbon dioxide (CO₂) per annum capacity BECCS plant is one thing, funding the sizeable capital investment project, without negatively impacting its existing heat and power clients or its owners, is another. Like other such projects, for Söderenergi's BECCS project to fly, a sustainable financing and business model is needed, and, as Douglas Heilborn, BECCS Project Director at Söderenergi, explains, it is to be found through a combination of government support, EU support, and carbon dioxide removal (CDR) credit revenues.

While the two former sources are welcome, it is the latter that will ultimately provide the lion's share in making the project bankable, and this is why the AstraZeneca announcement in particular, is a major milestone for the project.

– We are happy and proud that the first negative emissions from our plant will end up with AstraZeneca, a company with roots in

Södertälje. The agreement shows confidence in our BECCS project and contributes to building the industry for negative emissions, commented Robert Tingvall, CEO of Söderenergi, at the time of the announcement.

Well advanced planning

First initiated in 2019 and officially started with a pre-feasibility study in 2020, Söderenergi's BECCS project is currently in the fourth phase of planning, targeting a BECCS plant commissioning in 2030 – assuming a positive final investment decision in between. The Swedish Energy Agency has provided grant support through the phases, totalling SEK 87.5 million (~ EUR 8 million) thus far, from its 'Industry Step' (Industriklivet) funding programme.

– The overall focus of the project right now is to create the conditions for a final investment decision by the end of 2026. This means that the entire value chain for BECCS needs to be in place – from carbon capture, intermediate storage, transport, and geological storage, to a certified product for customers with ambitious climate goals, explained Douglas Heilborn when Bioenergy International visited Södertälje for an update.

A major bioenergy player

To understand why Söderenergi has so much go-

ing for it as a BECCS location, some background is in order. Formed in 1990, Söderenergi is a major district heating producer, currently the fourth largest in Sweden. On a normal annual basis, the company supplies around 2.5 TWh of district heat to the Southern Greater Stockholm area – its owner-municipalities Södertälje, Huddinge, and Botkyrka, as well as the municipalities of Nykvarn and Salem. In addition to district heat, Söderenergi generates around 500 GWh of electricity annually, as well as provides process steam and hot water to industrial clients in Södertälje, including its neighbour AstraZeneca.

The company currently operates four bioenergy plants located at three sites in Fittja, Skogås, and Igelsta, respectively, the latter location where the BECCS plant is planned to be built. The fuel mix across the entire fleet comprises 99.4 percent recycled or biomass fuels, of which recycled wood waste accounts for just over half. The remaining 0.6 percent is fossil oil, used in start-up and at two emergency back-up heat boiler units in Södertälje and Huddinge General Hospital, respectively. This remaining fossil oil is something the company is working on to phase out completely.

The Fittja plant in Botkyrka municipality is a heat-only facility, and comprises two wood-powder-fired units with a total output of 380 MW of

Hannah Edgren, Communication Specialist, Douglas Heilborn, BECCS Project Director and Michael Bartlett, BECCS Project Manager at Söderenergi



A view of Söderenergi's Igelsta bioenergy site with the Igelsta heat plant (left), shipunloading and fuel reception, and Igelsta CHP plant.

"The overall focus of the project right now is to create the conditions for a final investment decision by the end of 2026"

DOUGLAS HEILBORN, BECCS PROJECT DIRECTOR, SÖDERENERGI

heat. Typically operational during the winter season only, the plant uses wood pellets that are milled on site into powder. The Skogås plant in Huddinge municipality is a heat-only plant comprising four small biooil-fired units supplying around 20 GWh of heat annually. The facility is also hydraulically interconnected with Stockholm Exergi's district heating network.

From coal conversions...

Finally, the Igelsta site in Södertälje, which consists of two separate plants – Igelsta heat plant and Igelsta combined heat and power (CHP) facility. Furthermore, the site includes a vessel receiving and fuel handling terminal with space to berth two coasters for unloading.

The Igelsta heat plant consists of three heat-only boilers as well as a steam generator for delivering high-quality steam to local industries. The heat plant was originally built with three identical boilers for pulverized coal (PC) combustion, all of which have subsequently been converted to fire on three different recovered biogenic fuels. Boiler one was converted in 1997

from PC to grate combustion of primarily solid recovered fuel (SRF). The 80 MW boiler is one of Söderenergi's baseload units operating over 6,000 hours annually.

Operating as a peak load unit, the 95 MW boiler two is fired on tall pitch oil, a biogenic residue from the pulp industry. Also rated at 95 MW, boiler three at Igelsta heat plant is a bubbling fluidized bed (BFB) boiler with a flue gas condenser that currently uses recycled wood waste (RWW). It currently operates around 3,600 hours annually.

... to carbon removal

Commissioned in 2009, the Igelsta CHP plant is the owner-municipalities' single largest environmental investment (~SEK 2.4 billion or EUR 258 million) to date and currently Sweden's second-largest biomass-fired CHP plant.

Fuelled by chipped logging residues, RWW, and SRF, the 210 MWth / 85 MWe baseload facility utilizes circulating fluidized bed (CFB) boiler technology with flue gas condensing. The plant operates around 6,200 hours per annum,

consuming around 600,000 tonnes of biogenic fuel, supplying approximately 1,400 GWh of heat and 550 GWh of electricity. It is the Igelsta CHP facility that is the intended supplier of biogenic carbon dioxide (bioCO₂) for the planned BECCS plant.

Advanced logistics

On an annual basis, the two Igesta plants consume around 1 million tonnes per annum of solid biogenic fuel, the mix being approximately 60 percent recycled wood waste (RWW), 30 percent logging residues and 10 percent solid recovered fuel (SRF). Roughly half of the total volume of solid fuel is delivered by vessel, primarily from northern Europe, some 150 vessels annually.

On account of the prevailing topography at Igelsta, onsite fuel storage is quite limited – currently, four 10,000 m³ silos service both plants. To resolve this, Söderenergi has developed a biomass fuel terminal in Nykvarn, which receives block train shipments of chipped logging residues from other parts of the country as well as trucks.

The 8-hectare terminal functions as the intermediate fuel storage and central logistics hub for Igelsta. From the terminal, the fuel is trucked the 30 km to Igelsta using Sweden's first commercial 74-tonne shuttle truck (see BioInt no. 103 - 6/2018), with a 98-tonne carrier also trialled. While all terminal wheeled-loaders and shuttle trucks operate on renewable diesel, the first fully electric shuttle truck recently entered into service.



An artist's rendering of Söderenergi's planned BECCS plant (in white) – including intermediate carbon dioxide storage, and quayside shiploading – at its Igelsta site in Södertälje.

Capture technology selected

– The BECCS plant is planned to be built close to the CHP, and capture the CO₂ from the flue gases of the CHP, explained Michael Bartlett, BECCS Project Manager at Söderenergi.

According to the plans, the flue gases from the CHP will be redirected before the stack and piped directly to the carbon capture unit for which a technology pathway has been selected.

– In the previous phase, we conducted in-depth assessments comparing two technical alternatives that were identified as being viable options for us, an amine-based solution and Hot Potassium Carbonate (HPC). We selected the latter, as it is the technology that has the least impact on the host plant and is more cost-effective for us at the system level as more district heat can be recovered at the required temperatures, said Michael Bartlett, without divulging details on the selected supplier.

Bartlett added that the studies included environmental effects and considerations, noting that “the consequences for the two alternatives differ, but are considered to be equivalent and manageable.”

Developing a carbon dioxide hub

Following separation of the CO₂ from the flue gases, the planned plant includes CO₂ cleaning liquefaction, onsite intermediate storage, a new quayside, as well as gas infrastructure such as pumping and shiploading equipment. Perhaps uniquely for Söderenergi, the company is mak-

ing the most of its location by planning an overcapacity in storage.

– It is about keeping future options open when making such large investments in fundamental infrastructure, in this case, a quayside liquefied carbon dioxide handling and intermediate storage with vessel loading or unloading capabilities. For example, CO₂ storage as a service

to other industries in Södertälje or elsewhere, irrespective of whether the CO₂ is for utilization or sequestration, ended Douglas Heilborn.

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View of Södertälje inlet from Igelsta CHP.