Update on CCS in the Netherlands

An update on carbon capture projects in the Netherlands, including Porthos, Aramis and Twence, government strategy and research projects, were presented at the CATO (CO2 capture, transport and storage) community gathering in Rijswijk, Netherlands on Sept 26. By Karl Jeffery.

The Dutch Porthos project, expected to be the first full scale CCS project in the Netherlands, has now overcome the final permitting barriers to its final investment decision (FID) we heard at the CATO (CO2 capture, transport and storage) community gathering in Rijswijk, Netherlands on Sept 26.

The final barrier to FID was the need for a positive ruling from the Netherlands Council of State against an appeal against Porthos made by an environmental organisation in Nov 2021. The grounds of that appeal were that Porthos should not be allowed to proceed due to nitrogen emissions from road vehicles in constructing the project. The Council made its positive ruling in August 2023.

The project team has proved that it is possible to safely decommission an offshore gas well, a step which was required before government approval was granted.

In the Netherlands, carbon capture is calculated to be more cost effective than all other CO2 mitigation schemes, in terms of emissions avoided per euro of subsidy, said Sytze Ferwerda, public affairs advisor with Porthos. This includes investing in wind, heat pumps and solar.

Aramis

The work of Porthos will be continued with the next expected Dutch project, Aramis, which will carry CO2 from emitters across Northwest Europe.

It aims to connect Northwest Germany, France, and Belgium into the Netherlands, and perhaps connections further afield if CO2 can be transported by train. There will also be an import terminal for CO2 by tanker.

It will have a pipeline with capacity of 22 mtpa, and connect to three different offshore storage sites, explained Karel Kersten, public advisor with Aramis.

Operations are expected to start in 2028, or 2029 if there are some environmental appeals, Mr Kersten said. Initial capacity will be minimum 7.5 mtpa. This means Aramis and Porthos will be storing a minimum of 10 mtpa, so nearly reaching the Dutch national target of 11.5 mtpa of CCS by 2030 (see next section).

Aramis will shortly begin its Front-end Engineering and Design (FEED) phase.

While Porthos and Aramis are separate projects, Aramis builds on Porthos, seeking to meet growing demand. "If you saw how fast Porthos sold out its 2.5 mtpa, the lesson is, 'do it ten times bigger, and do it twice,'" Mr Kersten said.

Dutch government

The Netherlands has a goal of reducing emissions by twenty-three million tonnes a year (mtpa) by 2030, and using CCS to achieve half of that goal, said Pim van Loon, CCS Programme Manager with the Dutch Ministry of Economic Affairs and Climate. "I think that is a realistic and ambitious target and we will make it."

The Netherlands has made Euro 45m available for pre-FEED studies of future projects.

Work has begun to plan a CO2 and decarbonised hydrogen pipeline between Ludwigshafen and Cologne in Germany to Rotterdam, known as the "Delta Rhine Corridor," so the CO2 project can spread across Northern Europe, he said.

The Dutch government is not setting any restrictions on what CO2 sources can be used in publicly funded CCS projects. So it is still possible to use it on power generation and blue hydrogen (fossil fuel gas) projects, he said.

The Netherlands sector of the North Sea is thought to have capacity for 1600m tonnes of CO2. The Netherlands has recently signed a MOU with the Belgian government to reconfirm both countries are happy for CO2 to be transported between the two countries.

One audience member asked whether the Netherlands public was prepared to accept some of its storage space being used to store CO2 from other countries. "In every Dutch person there hides a business man," said Mr Kersten from Aramis. "If you say, 'it's Dutch storage but Germans will pay for it,' it relieves a bit of pressure."

However, most of the CO2 sources being planned are currently Dutch. "We are not flooded by foreign CO2," said Mr van Loon.

Twence

The second full scale carbon capture and utilisation project in the Netherlands, at the Twence waste to energy plant in the East of the country, is scheduled to be operational by the end of 2023.

It follows the first full scale CCU project, AVR, which has been capturing 60,000 tonnes per year for use by greenhouses since 2019.

Twence will capture 100k tonnes a year of CO2. The CO2 will not be stored, but piped to industrial greenhouses, where it becomes a fertiliser, and replaces CO2 generated specifically for that purpose by burning gas.

Construction started in May 2022, and the carbon capture system was installed in early 2023. The largest components are three columns: the CO2 absorber system, the desorber for separating the solvent from CO2, and a cooler, said Ronald de Vries, projects manager at Twence. These columns were delivered to the site by road and canal.

The cooler is there to cool flue gas after flowing through the capture process. It is heated in the capture process and needs to be cooled to the same temperature as the rest of the flue gas, before venting. Only a third of the flue gas emitted by the site is processed by the facility, due to limitations in how much CO2 can be utilised.

The CO2 is also used to make 'dry ice,' frozen

CO2 used for cooling and theatre smoke machines. The project team seek to further reduce the level of impurities in the CO2 to bring it to 'food grade quality' so it could be used for soft drinks. "We are almost near it," Mr de Vries said.

The project could be developed further if it had a connection with a CO2 sequestration system, but this would need further government funding, he said. "it is really a challenge to make a project bankable."

Where the waste is of biogenic origin, such as paper, storing the CO2 from its combustion can be classified as a CO2 'removal', since the whole process including growing the paper to make the tree removes CO2 from the atmosphere. This can increase the value of the project, because companies seeking to make their own emissions net zero through offsets may buy carbon credits in it.

The energy requirement is 1 MW of thermal energy per tonne captured, he said.

Mr de Vries says he is happy Twence chose to be a 'first mover' in CCS, because contracts and pricing could be agreed before the breakout of war in Ukraine and subsequent inflation.

The capture and process equipment was provided by Aker Carbon Capture, as a standardised, modularised system, so one design can be used an unlimited number of times,

"We are a Scandinavian company. Scandinavian companies are known for building little boxes, [such as] Lego. That is in essence what we are doing with modularisation, said Pim van Keep, sales director Netherlands with Aker Carbon Capture.

Aker is currently making the third generation of its standard "Just Catch 100" unit, which processes 100,000 tonnes a year. Each generation has a smaller footprint and uses less energy, he said.

There are five similar installations going to projects in Denmark, including one for a negative emissions project, he said.

Government subsidies

The Netherlands has several funding opportunities for carbon capture projects, explained Martijn van de Sande, CCS co-ordinator with Dutch enterprise funding agency Rijksdienst voor Ondernemend Nederland (RVO).

There is up to Euro 2m available for feasibility studies, desk study work done prior to pilot or demonstration projects. These desk study projects can last maximum 1 year, and grants are available up to April 2024.

Then, up to Euro 500k is available for research and development projects, which can run up to 4 years. The next opening is in Spring 2024.

Up to Euro 15m is available for pilots and demonstration plants, under a scheme called Demonstrating Energy Innovation (DEI+). Projects can run for 4 years. Another scheme is MOOI (English translation - Mission-driven Research, Development and Innovation), for research among a larger group of companies, set to open in Spring 2024.

The set-up is still being discussed, but previously such schemes had a maximum budget of Euro 4m.

Further information about Dutch subsidies is online (Dutch language) at rvo.nl/tse and rvo.nl/subsidies-financiering.

Research projects

The C4U project (www.c4u-project.eu) is developing a high temperature solvent for capture, which could be used for example in steel making.

The idea is that if the whole process takes place at high temperatures, then high temperature steam could be used to displace CO2 from the solvent, explained Jurriaan Boon, process technology scientist at Dutch research centre TNO.

The Initiate Project (www.initiate-project.eu) seeks to make ammonia from blast furnace gas, using a Sorption Enhanced Water Gas Shift (SWGS) process. The aim is to build a plant producing 50ktpa of urea, a fertilizer normally made from ammonia.

The project runs from November 2020 to November 2025, and has Euro 21.3m EU funding.

There are seventy people at TNO working on a project to improve processes for CO2 capture, explained Peter van Os, senior project manager at TNO. Areas of research include managing and monitoring emissions, finding ways to better manage solvents, developing shipboard carbon capture systems, developing mobile carbon capture systems, and developing capture clusters.

Experimentation is being done with different levels of capture (such as 90, 95, and 98 per cent), and using solvents of different ages (500 hours, 5000 hours and >10,000 hours), and understanding different types of emissions, such as aerosols (liquid droplets).

In one facility, the emissions were found to suddenly jump to 750mg per cubic metre of gas, after a systems change, which is too high to be permissible, he said.

The project team have a mobile CO2 capture plant, which can handle 3 to 5 m3 per hour of flue gas, with 25 kg per hour solvent flow. This can be used to try out new solvents.

TNO is involved in two shipboard carbon capture projects. One is EverLoNG, (https://everlongccus.eu/) testing out a mid-sized capture system with a prototype installed on an LNG fuelled gas tanker chartered to TotalEnergies.

The other project is "REMARCCABLE," with a 25m high CCS system installed on the Stena Impero tanker. Project partners include the Global Centre for Maritime Decarbonisation, the Oil and Gas Climate Initiative (OGCI), Stena Bulk, Alfa Laval, ABS, Deltamarin Ltd, TNO, Lloyd's Register and Seatrium. It is claimed to be "the world's first project aimed to demonstrate end-to-end shipboard carbon capture at scale."

In the area of CO2 transport and storage, studies are taking place to better understand the challenges, such as possible large pressure drops, and a corresponding drop in temperature, as gas expands into a storage facility, said Filip Neele, senior scientist CCS at TNO.

A research project aims to build digital models of the reservoir, geomechanics, geophysics, wellbore, and facility networks, to better understand the impact of this. The project starts in 2023 and runs for 3 years.

A further project, RETURN (www.return-act.eu) seeks to better understand the process that happens in a reservoir or bottom of the well, if cold CO2 enters a reservoir and starts warming up. There could be a risk of hydrates forming close to the well.

More information

co2-cato.org