The Sustainable Industry Lab

Prospects for Carbon Capture and Storage in the Netherlands

Carbon Capture and Storage (CCS) projects in the Netherlands were abandoned during the last decade because of social resistance and lack of a business case. Yet CCS features prominently in the Dutch Climate Agreement and several new projects emerged in recent years. Will CCS finally take off as a major contributor to climate change mitigation?

This is a short summary of a scientific paper, *Different this time? The prospects of CCS in the Netherlands in the 2020s*, written by researchers affiliated with the Sustainable Industry Lab (SIL) and Utrecht University. It describes the development of technology, business case, legislative framework and social acceptance of CCS over the past twenty years. This gives a perspective from which to judge the prospects in the coming decades.

A companion piece, to be written shortly, will consider what **choices** regarding CCS the Netherlands will be called to make, and what the **consequences** are for the transformation of the Dutch industry portfolio.

In the past decade Carbon Capture and Storage (CCS) was mostly known for project postponements and cancellations. It faded from the agenda. But now CCS is back on the agenda. The Dutch Climate Agreement has given CCS a significant role in reducing CO_2 emissions from industry. At 7 megatonnes (Mton) annual emissions reduction by 2030 out of a total of 50 Mton, it is set to deliver roughly half of the total industry reduction. As a consequence, prospects for the realization of CCS beyond pilot scale in this decade look brighter than before. This potentially makes CCS the largest emissions reduction technology in the Netherlands after wind and solar power. But there are still significant challenges to deploy CCS as we see in the press after each CCS announcement.[1] Here we give a short summary of the technology, its financing and its social acceptance. A more comprehensive treatment can be found in the scientific paper.

Mature technology

CCS technology has been available for decades. The two major projects in Europe, both in depleted Norwegian gas fields, store a total of 1.7 Mton of CO_2 annually, a quarter of the Dutch ambition for 2030. These successful projects prove that CCS is technically mature and ready for large-scale application.

[1] see e.g. Is opslag CO2 in zeebodem wel zo goed? and Subsidie voor CO2 opslag is belonen van vervuiler.

For the upcoming decade, ten other projects are on European drawing boards. The Dutch Porthos project is the most advanced. A CO_2 pipeline connecting industries in the Rotterdam port area is designed to transport 5 Mton per year to a depleted offshore natural gas field. The initiators have been granted a subsidy of 1.2 billion euro and intend to start injecting CO_2 by the end of 2023. Similar shared infrastructure is being planned in the Amsterdam-IJmuiden region (the Athos project, 7.5 Mton per year) and the Den Helder port region in the north-west (Aramis project, 10 Mton per year). In the north, a hydrogen plant with CCS is in an early development stage (Magnum project), planning to store CO_2 in a Norwegian gas field. Together, these projects offer scope for CCS to deliver more than what is agreed in the Dutch Climate Agreement.

Coping with uncertainty

Whereas the technological basis for CCS is secure, its financial basis and its social acceptance look fragile. Even when the first project is approved and executed, CCS will not necessarily be an accepted 'industry' with a pipeline of projects whose decision depends solely on a positive business case. It is here that most uncertainties lie. This became apparent about ten years ago when various CCS projects were abandoned. The plan to store CO_2 in a gas field under residential areas of Barendrecht (close to Rotterdam) ran into social resistance. The tender had already been awarded, but the government cancelled the project because of upcoming elections. Preparations for a larger project with storage under the North Sea were discontinued in 2017, lacking a clear business case. Thus, social and financial factors were the show-stoppers for these projects.

New subsidies have been introduced since. Notably, Industry CCS now qualifies under the Dutch SDE++ subsidy scheme, which is the main financial support mechanism for the Dutch Climate Agreement. In the paper the business case for a typical CCS project is analyzed in different regulatory contexts. We find that policy uncertainty is a significant disincentive for investment in a CCS project. Only a stable, high CO_2 price or a strict future emissions cap makes for a clear business case.

Planning uncertainties may also cause a project to founder. In the development stage a CCS project requires costly exploratory work without any certainty that a permit will be awarded. During and after the project, the carbon store needs to be monitored for leaks. It is also not yet clear how long potential accountability for leaks can last, nor is the legal abandonment procedure fully developed yet. Furthermore, rules for third party access to CO_2 infrastructure are still unclear. These uncertainties were no reason to stop previous projects. But more clarity and less risks do help in doing the math.

Compelling stories

This much is clear: the public has never embraced CCS. Lacking recent data on the Netherlands, it is impossible to know if opinions have shifted. It is no doubt helpful that current projects avoid NIMBYism by taking storage offshore. There is more clarity on attitudes of societal stakeholders. They continue to show significant differences. Opponents say it is an end-of-pipe solution that extends dependence on fossil fuels. Proponents say it gives time to work on a transition. Both agree that CCS should not distract from or delay the transition to renewables. But even for concrete projects reasonable people can disagree whether or not that is the case. The larger CCS becomes, the more pronounced these differences will be.

It remains difficult to tell a compelling story about CCS as an interim solution. That is where an alternative to of CCS, Carbon Capture and Utilization (CCU) comes in. It has a more appealing narrative by bringing carbon back in the (industrial) loop to close the cycle. Horticulture, where CO_2

is used as a growth stimulator, has long been an example of CCU, but volumes are small compared to the Dutch CCS ambition. Another possibility is to turn CO_2 into chemicals or fuels. The conversion requires much renewable energy, mostly renewable (green) hydrogen. As long as there is no surplus of renewable power and green hydrogen, this path hardly prevents any carbon emission. Therefore, carbon utilization is an option that develops only at a late stage of the energy transition, after 2030.

Taking everything together, CCS is a large and uncertain presence in the energy transition – for the Netherlands and for the world. It is a technology that is readily at our disposal; but we wish we could dispose of it. It is at once a transition technology and a technology of last resort. That makes for difficult choices.