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POLICY

European CCS Makes Progress, But Major Challenges Remain

Carbon capture and storage (CCS) has struggled to reach a widespread commercial footing in Europe, even as policymakers continue to view it as an essential component to decarbonizing industry. The European Commission believes CCS has an '"indispensable" role to play on the road to climate neutrality, but the harsh reality is that Europe has limited operational capacity and is struggling with high costs. Nonetheless, a series of final investment decisions (FIDs) in recent months demonstrate some momentum.

- **The EU is likely to miss its ambitious 2030 and 2040 targets for operational CO2 capture and storage capacity.**

With under 1 million metric tons per year of CO2 storage capacity currently operational, the EU faces an enormous challenge if it wants to meet its carbon storage goal of 50 million tons/yr by 2030 or a more aspirational 2040 target of 280 million tons/yr. "At the moment, too few projects are reaching FID," said Bergur Rasmussen, a former Danish member of European Parliament who since April has been director of Brussels-based lobby group CCS Europe. This is a symptom of companies' concern that the levels of investment required remain too risky, he argues, and "without a steady pipeline of new FIDs each year, the 2040 numbers simply cannot be achieved."

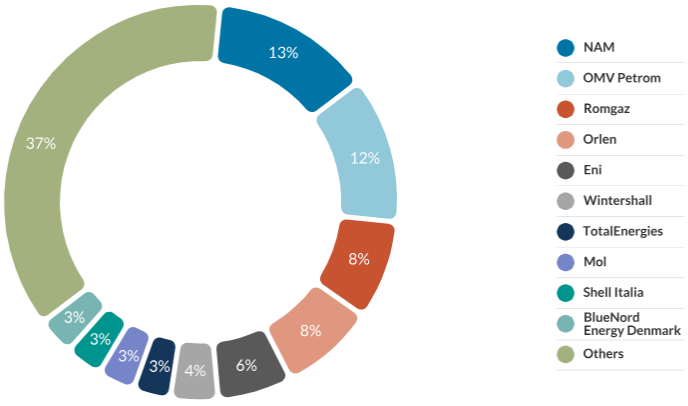
Storage is key for CCS and, last year, the EU's legacy oil and gas producers were tasked with developing 50 million tons/yr of storage capacity within the bloc by 2030, via a provision in the EU's 2024 Net Zero Industry Act (NZIA). Brussels said it was fair that the firms responsible for 95% of the oil and gas produced over 2020-23 should be responsible for developing this storage capacity, and 44 individual producers were tasked with securing a fixed portion of that capacity via a formula that prorated their production over that reference period (see graphic).

The 2040 aspirational target is viewed as a much greater stretch. "The scale-up is extremely demanding," said Rasmussen. "If you take a project like Greensand" — a planned Danish project that, in its first commercial phase, will capture and store around 400,000 tons/yr of CO2 —"Europe would need something close to one project of that size every single week for the next 15 years. That gives a very clear sense of the challenge."

- **In broader Europe, Norwegian projects add some heft.**

There are 12 operational CCS projects in Europe, with 14 under construction and 77 in an "advanced development" stage, according to the latest annual report from the Global CCS Institute, a think tank. Some of these operational projects are outside the EU in Iceland and Norway — the latter, in particular, is home to a mix of legacy CCS projects, including Sleipner, Snohvit and Technology Center Mongstad, alongside new CCS projects such as the opera-

OIL AND GAS COMPANY COMMITMENTS UNDER NZIA
Percent of Their Share of 50 Million tons/yr CO2 Storage Capacity by 2030



Source: Energy Intelligence, Global CCS Institute

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tional Northern Lights transport and storage project and under construction projects at Brevik and Oslo.

"There are only a few small capture sites running today, and we do not yet have a fully commercial storage site operating in EU territory," conceded Rasmussen.

Project ramp-ups will not be easy. Greensand, which will be the EU's first major storage site, was due to open for business this year or in early 2026, but the timeline has recently slipped. "We expect commercial storage to commence by mid-2026," Mads Gade, CEO of Ineos Energy Europe, told Energy Intelligence. Gade's firm is a member of the Greensand consortium, alongside the UK's Harbour Energy and Denmark's Nordsofonden.

Rasmussen believes a number of recent FIDs in Europe means CCS is "finally starting to look like a real industrial system instead of one-off pilots." However, despite projects receiving funds from Brussels and member states, there still aren't enough projects taking FID to keep the 2030 or 2040 targets in sight.

- **European CCS developers face commercial risks and high costs.**

While the EU's legacy oil and gas firms must build out their allotted CO2 storage capacity, the primary commercial driver for EU heavy industry to invest in CCS is the cost of its carbon emissions.

Under the EU's Emissions Trading System (ETS), companies must pay relatively high prices — around €80 per ton ($93/ton) currently — to emit CO2. But there continues to be a mismatch between these prices and the cost of developing CCS; while reports suggest costs for some Chinese coal-fired CCS projects are as low as $30-$40/ton, European projects are estimated at $200-$300/ton.

"The cost difference often quoted between China and Europe is not surprising," said Rasmussen. "Whereas China builds large, standardized units onto plants with lower labor and financing costs with its simpler permitting process and cheaper energy inputs, Europe is dealing with early, customized projects, offshore storage and quite complex governance."

For now, the majority of EU CCS projects are not economic without mandates and subsidies. "So yes, Europe starts at the high end, but we don't expect it to remain that way," said Rasmussen. "The combination of ETS prices, better policy tools and a growing project pipeline thanks to funding support should push European CCS into a competitive space as we move through the 2030s."

Rasmussen notes that some CCS projects have successfully applied for funding from the EU's Innovation Fund, which uses proceeds from the ETS to support energy transition sectors, including CCS. It is "encouraging" that the latest round of Innovation Fund awards will support projects accounting for nearly 40% of the 50 million ton CO2 storage capacity in Europe by 2030, he said.

- **Brussels and EU member states must still address regulatory and infrastructure issues to incentivize widespread deployment.**

Beyond costs, broader regulatory and infrastructure issues also pose significant headwinds. In Germany, multiple CCS projects edging toward FID face both uncertainty around regulations for CO2 transport and storage and a lack of network of CO2 pipelines. For example, cement maker Heidelberg Materials is close to an FID for its CCS project at a plant at Geseke in North Rhine-Westphalia, a project that would capture about 700,000 tons/yr of CO2. But the company told Energy Intelligence this week that "the necessary conditions for FID are not yet in place."

In October, the European Commission said the bloc needs to support CO2 transportation infrastructure and storage, and an open consultation process is open until Jan. 9. Brussels is asking for opinions on better ways to establish an internal market for CO2 and for better ways to develop a CO2 transport network.

The Heidelberg Materials spokesperson said there is movement on a German CO2 Transport and Storage Act, with the draft law taking an "important step forward" last week as it proceeded to the vote in the Bundesrat, Germany's upper house of parliament. This law aims to enable the build-out of high-pressure pipelines to move large volumes of captured CO2 from industrial clusters to coastal areas for storage or export, in part by speeding regulatory reviews by declaring that the pipelines are in the overriding public interest.

Heidelberg has assessed that "there are no existing pipelines that could be repurposed" for CO2 transport for its planned GeZero project at Geseke, said its spokesperson, and it is therefore "planning an interim transport solution by rail towards the North Sea" as it awaits the build-out of a new transport network.

Work on CO2 infrastructure will likely be accompanied by financial support. In a speech this month, European Energy and Housing Commissioner Dan Jorgensen said the EU and member states need to use public money to derisk decarbonization tools. CCS won't "reach scale and reduce prices significantly without subsidies," he said.

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- **Clustering CCS near hard-to-abate industry may be key.**

The most advanced CCS projects are clustered around the North Sea, where countries like Norway, the UK, the Netherlands and Denmark have moved early on storage and transport, noted Rasmussen. Belgium is joining Germany in starting to show support for CCS as both look to connect industrial hubs to CCS pipeline networks. The UK, meanwhile, has taken a cluster approach and has pledged almost £22 billion ($29 billion) over a 25-year period to support CCS.

There are also "encouraging steps" in Italy and Greece, Rasmussen said. In Italy, Eni and Snam have started commercial operations of the small Phase 1 development of the Ravenna CO2 storage project. While it boasts only 25,000 tons/yr of storage capacity, Ravenna's developers are planning a second phase with 4 million tons/yr capacity by 2030. In Greece, the Energean-led Prinos CO2 storage project has received funding from the EU and Greece, and, as a European Project of Common Interest, is eligible to apply to further financing instruments. The 1 million ton/yr first phase could be operational in 2026 or 2027.

Norway's progress reflects the country's early commitment to CCS and prioritization of storage. The Northern Lights consortium built storage capacity first, while the government created a clear regulatory framework and acknowledged the significant technical and commercial risks to private companies by offering financing. This gave the industry the confidence to join later, and today Northern Lights is becoming an anchor point for the whole region, said Rasmussen.

"For the EU, the main lesson is that predictable access to storage unlocks investment in capture — and upfront funding will be key to get there," said Rasmussen. "We do see Brussels starting to recognize this, for example, through the storage capacity obligation in the NZIA, which is a step in the right direction. But we need to see proper implementation of the NZIA obligations, with predictable application of penalties for noncompliance, when appropriate."

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