United States Energy Association

Norway's Global Leadership in Carbon Capture, Utilization, and Storage (CCUS)

OVERVIEW

As the U.S. looks to revitalize its industrial base and create well-paying jobs, carbon capture, utilization, and storage (CCUS) offers a powerful opportunity. By reducing emissions from heavy industries like cement, steel, and refining, CCUS can keep these sectors competitive while supporting a new wave of infrastructure investment. Europe is building the shared carbon infrastructure, known as CO_2 hubs, that make large-scale industrial decarbonization possible. Examining Europe's approach provides valuable lessons for how the U.S. can strengthen its industry, support workers, and build lasting economic growth through carbon capture.

Norway stands out globally for its long-term commitment to CCUS, pioneering major projects and building infrastructure that's now influencing developments across Europe. This article explores the historical background, current status, and future direction of Norway's CCUS efforts.

LAYING THE FOUNDATION: NORWAY'S EARLY COMMITMENT TO CCS

Norway began its journey into carbon capture and storage (CCS) well ahead of most countries. The landmark Sleipner project, launched in 1996, became the world's first commercial CCS facility. Operated by Equinor in the North Sea, it captures around 1 million tonnes of CO_2 annually from natural gas processing and stores it about 1,000 meters below the seabed. This project was driven largely by Norway's early implementation of a carbon tax on offshore oil and gas production in 1991, which made CCS economically feasible. Another milestone came with the Snøhvit LNG facility in 2008, which captures and stores around 700,000 tonnes of CO_2 per year. Together, these two projects provided proof-of-concept for large-scale CCS and laid the groundwork for Norway's ongoing efforts.

WHAT ARE CO_2 HUBS AND WHY ARE THEY IMPORTANT?

CO_2 hubs are centralized systems that connect multiple industrial facilities, such as cement plants, refineries, steel mills, and chemical manufacturers, to shared infrastructure for transporting and permanently storing captured carbon dioxide. Rather than requiring each facility to build and operate its own standalone capture and storage solution, hubs allow for the aggregation of CO_2 from multiple sources. The captured gas is then compressed, transported via common pipelines or ships, and injected into secure underground geological formations.

For regions in the United States with high concentrations of heavy industry, such as the petrochemical corridor along the Gulf Coast, the Midwest steel belt, or cement-producing zones in California and Texas, CO_2 hubs offer a streamlined, cost-effective path to deep decarbonization. These hubs can allow the U.S. to continue to use its vast coal reserves, improving energy security and enabling economic development in parts of the country with coal reserves and coal fueled power plants. Just as importantly, they help preserve and create good-paying, skilled jobs in energy, construction, and manufacturing.

BUILDING A FULL-SCALE VALUE CHAIN: THE LONGSHIP PROJECT

In 2020, the Norwegian government unveiled Longship, one of the most ambitious full-scale CCS projects in the world. Designed to be a complete value chain, Longship encompasses CO_2 capture, transportation by ship, and permanent storage beneath the seabed.

CO_2 CAPTURE SITES

HEIDELBERG MATERIALS BREVIK CEMENT PLANT

Heidelberg Materials' Brevik cement plant is the first in the world to incorporate CCS in full-scale cement production. It began operations in 2024 and captures around 400,000 tonnes of CO_2 annually.

SOURCE: HEIDELBERGMATERIALS.COM

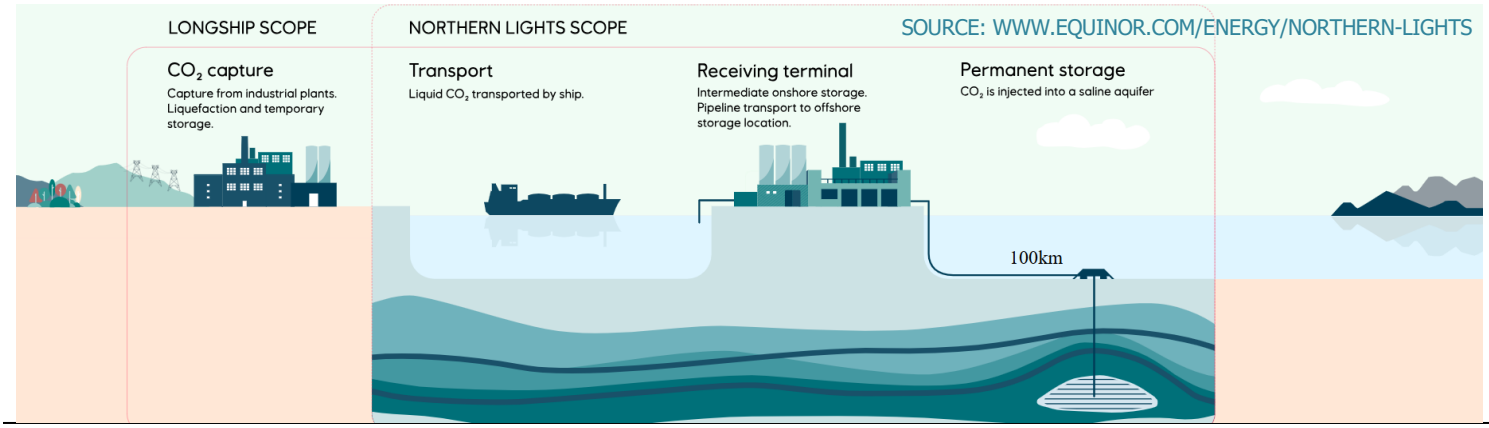
HAFSLUND OSLO CELSIO'S WASTE-TO-ENERGY PLANT

Hafslund Oslo Celsio's waste-to-energy plant will join the Longship Project in 2029, capturing about 350,000 tonnes of CO_2 per year from incinerated municipal waste.

SOURCE: ESGTIMES.IN

NORTHERN LIGHTS TRANSPORT & STORAGE

The Northern Lights JV, a joint venture operated by Equinor, Shell, and TotalEnergies, manages CO_2 transport and storage for Longship. CO_2 captured at industrial sites is liquefied and transported by specially built ships to a terminal in Øygarden on Norway's west coast. From there, it is pumped into offshore geological formations under the North Sea. Phase 1 of Northern Lights can store up to 1.5 million tonnes of CO_2 per year, with Phase 2 aiming to increase that to 5 million tonnes/year by 2028. This expansion will be supported by a €714 million investment from the consortium partners.



GOVERNMENT SUPPORT: DE-RISKING THE MARKET

Longship's total cost is estimated at approximatey $3 billion, with the Norwegian government covering nearly two-thirds or $2 billion. This level of support reflects a long-term view: Norway sees CCS not only as an emissions solution, but as a potential export industry. As countries across Europe face tightening climate targets, Norway aims to become the region's CO_2 storage hub.

The state's role is critical: by shouldering early risk, Norway is helping derisk private investment and accelerate the emergence of a carbon services market.

INNOVATION AND INDUSTRY: CCS TECHNOLOGIES IN DEVELOPMENT

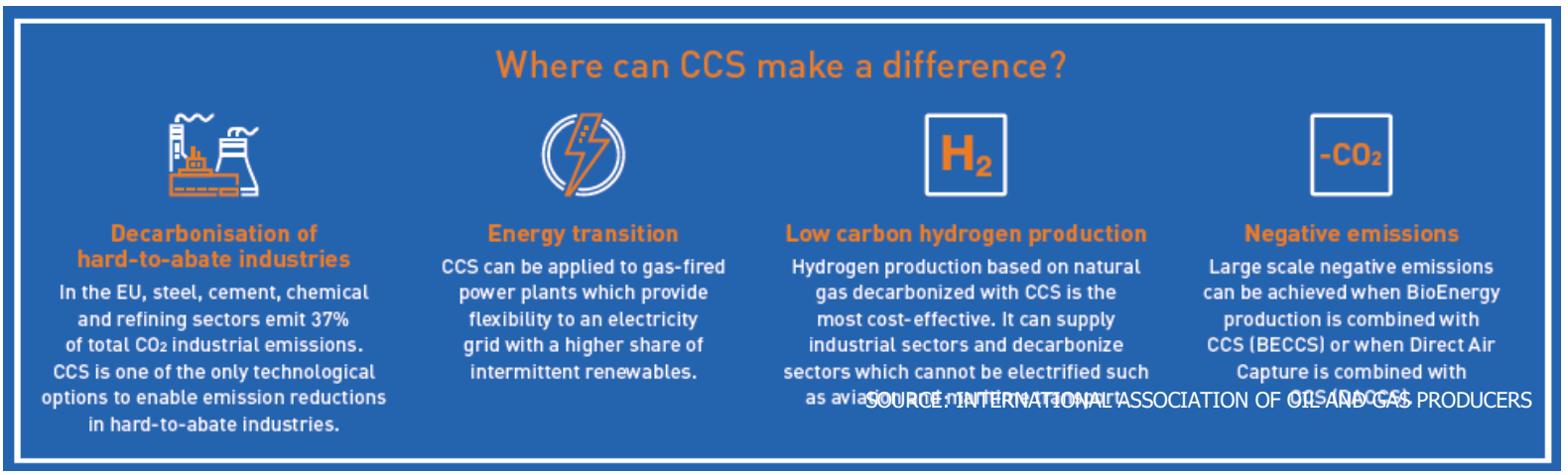
Beyond Longship, Norway is fostering innovation in CCS through a number of startups and R&D initiatives. These are developing modular or low-cost capture technologies for a variety of industrial applications.

Meanwhile, the CLIMIT program, a partnership between Gassnova and the Research Council of Norway, continues to fund research on capture efficiency, monitoring technologies, and next-generation storage solutions.

Other ongoing initiatives include:

- NORCE's TherMoCool project: Optimizing CO_2 injection strategies in complex reservoirs through research at Ullandhaug, serving as a research hub aimed at de-risking next-generation CCS deployment.
- SINTEF and the Norwegian CCS Research Centre (NCCS): Leading global research on both CCS and carbon utilization technologies.

Together, these efforts are building out the innovation pipeline that will sustain Norway's leadership in CCS for decades to come and provide valuable technical insights for countries that are ramping up their own deployment efforts.



UTILIZATION: CARBON AS A RESOURCE

Although storage has dominated Norway's early efforts, carbon utilization, the "U" in CCUS, is gaining ground. Norwegian researchers and companies are piloting technologies that convert CO_2 into useful products, including synthetic fuels, chemicals, and construction materials.

One example is the Oslo waste-to-energy project's collaboration with the Frontier carbon removal coalition, a consortium of U.S. companies, including Stripe, Meta, and Alphabet. Frontier has committed to purchasing carbon removal credits from Oslo's CO_2 capture, helping create a price signal for negative emissions. These types of transatlantic partnerships could provide a playbook for U.S. cities exploring how to monetize CO_2 while reducing local pollution and supporting innovation. Several key milestones have taken place in the past year:

- Brevik cement plant's "EvoZero" product sold out for 2025, demonstrating market demand for low-carbon materials.
- First CO_2 shipments successfully transported and injected into the North Sea as part of Longship.
- Northern Lights Phase 2 approved, with expanded capacity to 5 million tonnes/year.
- Frontier coalition commits to purchasing carbon removal credits from the Klemetsrud waste-to-energy plant in Oslo.

CHALLENGES AND OPPORTUNITIES

Despite the progress, there are challenges ahead:

- High upfront costs: Most CCS projects still require significant subsidies to be viable.
- Cross-border regulatory hurdles: Transporting CO_2 between countries, critical for global scaling, requires clearer frameworks.
- Public skepticism: Many still view CCS as a "get out of jail free card" for polluters, rather than a needed complement to clean energy.

However, the opportunities are immense:

- Norway's geological storage potential far exceeds its own emissions, allowing it to serve Europe—and possibly, in the future, global markets.
- Carbon pricing and trading systems are evolving rapidly and improving CCS economics.
- Emerging carbon removal markets, especially in the U.S. private sector, could transform CO_2 from waste into revenue.

CONCLUSION: NORWAY'S GLOBAL LEADERSHIP IN CCS

Norway's three-decade journey from the Sleipner project to the Longship value chain shows that long-term policy commitment, public support, and private-sector involvement can drive significant climate innovation. While carbon capture alone is not a stand-alone solution, it offers a critical tool for decarbonizing sectors that have limited alternatives.

As CCS technologies scale and international cooperation deepens, Norway is well positioned to become a leading exporter of carbon storage services—not just an energy nation, but a climate technology leader for the 21st century.

SOURCE LIST

Technology Developers, Consortiums & Companies

Equinor Northern Lights
https://www.equinor.com/energy/northern-lights

Heidelberg Materials
https://www.heidelbergmaterials.com/en/pr-2025-06-18

Hafslund Oslo Celsio, Norway Carbon Capture and Storage Project (CEWEP)
https://www.cewep.eu/hafslund-oslo-celsio-norway-ccs-project/

Aker Carbon Capture
https://www.akercarboncapture.com

Capsol Technologies
https://www.capsoltechnologies.com

Hydrogen Mem-Tech
https://www.hydrogenmem-tech.com

Frontier Climate
https://frontierclimate.com/

Research & Innovation Programs

CLIMIT – CCS R&D Program (Gassnova + Research Council of Norway)
https://www.climit.no

Gassnova (Norway's state CCS agency)
https://www.gassnova.no

The Research Council of Norway (Forskningsrådet)
https://www.forskningsradet.no/en

Research Projects and Institutions

NORCE – TherMoCool Project
https://www.norceresearch.no/en/projects/thermocool

SINTEF – CCS Research
https://www.sintef.no/en/expertise/co2-capture-and-storage

Norwegian CCS Research Centre (NCCS)
https://www.sintef.no/en/projects/nccs

gigaCCS – Next-gen Norwegian CCS Centre
https://www.sintef.no/en/latest-news/2024/gigaccs--new-national-ccs-research-centre/