Offshore carbon storage deployment and research needs to scale up for UK to deliver net zero pledge

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The U.K. will need to step up research and deployment of new offshore carbon storage wells if it is to achieve the capacity required to deliver its

net zero emissions plans, a briefing by the Royal Society has said.

Published on October 19 by the U.K.'s national science academy, Locked Away—Geological Carbon Storage explores the latest evidence and technical considerations for permanently storing CO_2 by pumping it into deep saline aquifers or depleted oil and gas fields offshore.

Alongside sustained reductions in carbon emissions, international bodies and the U.K.'s Committee on Climate Change identify carbon capture and storage (CCS) as a critical technology in most possible routes to achieving "net zero."

However, the levels of CCS deployment globally have been slow and, globally, are "well below those anticipated to be needed to limit global warming to 1.5°C, or 2°C," the Royal Society report warns.

"Geological carbon storage will be an essential part of our long-term energy transition, both in storing emissions from hard-to-decarbonize industries, and for longer term removal of CO_2 through direct air capture," said Professor Andy Woods FRS, University of Cambridge, chair of the report's working group.

"The U.K.'s access to potential storage sites in its offshore waters, along with a strong industrial base and regulatory and assurance environment, mean this could be an important industry.

"But thousands of wells are likely to be needed globally, and each new subsurface reservoir can take years to develop to ensure its suitability."

Scaling up

The policy briefing considers the latest geoscience evidence and lessons from current and planned CCS projects that could inform policymakers

if they pursue geological carbon storage.

It also looks at the challenges of scaling up CCS, including outstanding research and policy questions relating to transport, storage, monitoring, sustainable business models and incentives.

The IPCC special report on global warming of 1.5°C and research by the International Energy Agency suggest that 7–8 gigatons of CO_2 will need to be stored globally each year by 2050 to keep warming below 1.5°C: this represents over 20% of present global annual fossil fuel and industrial emissions (roughly 34 GtCO2/yr).

By 2100, a cumulative storage of between about 350–1200 Gt of CO_2 is likely to be needed to avoid the worst effects of climate change.

For the U.K. to deliver on its net-zero carbon emissions pledge, it needs to develop new wells—and the associated injection, transport and storage infrastructure—capable of storing about 75–175 MtCO2 every year by 2050, according to the U.K. North Sea Transition Authority.

With CO_2 injection rates currently constrained by pressurization limits, and a 5–7 year timeframe to deploy a new reservoir, the report's expert working group estimates this will require the equivalent of around one new carbon storage system, capable of injecting 4–5 MtCO2/year, being added each year to 2050.

Sustained investment

To date, the upfront capital costs, lack of sufficient and predictable incentives to support operating costs, and concerns over the social acceptability in many jurisdictions have contributed to a global under deployment of CSS.

The Global CCS Institute's 2021 survey lists 27 CCS projects as being operational, capturing 36.6 MtCO2/yr, with a further 62 projects listed as being either in construction or in advanced development. If successfully deployed, the combined capture potential would be 86.4 MtCO2/yr.

A U.K. target of delivering CCS in four industrial clusters, set under the previous government, aims to capture and store around 20–30 $MtCO_2$ each year. With Phase 1 sites, in the East Coast Cluster (Teesside plus Humber) and HyNet in the Northwest, targeting delivery in the middle of this decade.

Scaling up required capacity, the report says, demands an enormous and continued global investment each year to 2050 to build the injection wells, transport networks, monitoring technologies, and a skilled workforce, to install hundreds of new wells each year.

"We have technology to store and monitor carbon in this way," said Professor Woods.

"But as deployment of these technologies rolls out, there will likely be many new challenges, especially since each storage reservoir has its own unique geological structure and setting.

"So we need to continue to invest in research, and the policy and regulatory frameworks that are required to scale up safely and at pace."

In particular, the report highlights the need to understand the storage capacity and properties of different geological formations; the critical pressures which might cause seal rocks to fail and leak; different monitoring strategies for detecting CO_2 leaks, new understanding of some of the geochemical processes; and the potential to increase capacity in old wells.

There is also a need for ongoing effective public dialogue to highlight the importance of carbon storage in mitigating climate change, and to understand and address the concerns of communities and citizens.

Provided by Royal Society

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