GSEU
GEOLOGICAL SERVICE FOR EUROPE

GeoEnergy Resources

Factsheet: Carbon Capture and Storage (CCS)

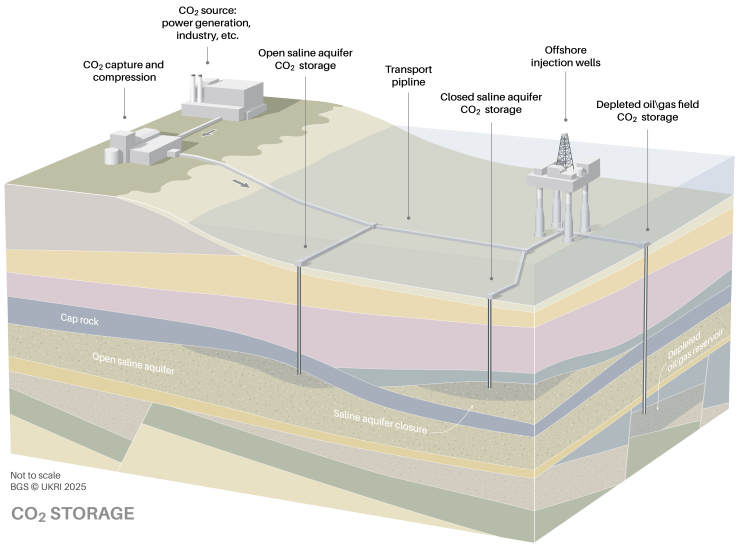
What is CCS?

Carbon capture and storage (CCS) reduces emissions by capture of carbon dioxide (CO_2), either from industry and power generation or directly from the air, and permanent storage deep underground. CO_2 is injected into suitable geological formations at depths greater than 800 metres. The CO_2 is stored in rocks that are porous and permeable, sealed by impermeable cap rocks. Storage rocks typically comprise sandstone or limestone[1]. Basaltic rocks can also be used for storage at smaller scale.

Captured CO_2 can contribute to a circular economy when it is reused, this is termed Carbon Capture Utilisation and Storage (CCUS). Some of the captured CO_2 is used as feedstock by various industries, and the remainder is stored.

Prospective geological storage sites are extensively studied to ensure secure storage of CO_2 for thousands of years. Geological storage requires sites with suitable rock properties, sufficient capacity, low risks, and a viable business case. Potential sites are extensively assessed to identify and mitigate leakage and migration risks, then monitored over time within national regulatory frameworks.

There are numerous monitoring techniques[2] many of which have already been proven effective at existing CO_2 storage sites. Monitoring techniques include reflection seismic surveys at surface or seismic surveys in the wells to confirm the location of the CO_2 plume. The pressure and temperature in the wells are also monitored to ensure these parameters remain within expected limits. Modelling is used to show the site is responding as expected. The model is adjusted over time as understanding of fluid flow within the store improves, to ensure a good match between the observed data and the model. Monitoring at surface can be used to provide assurance that CO_2 is not leaking to the atmosphere.



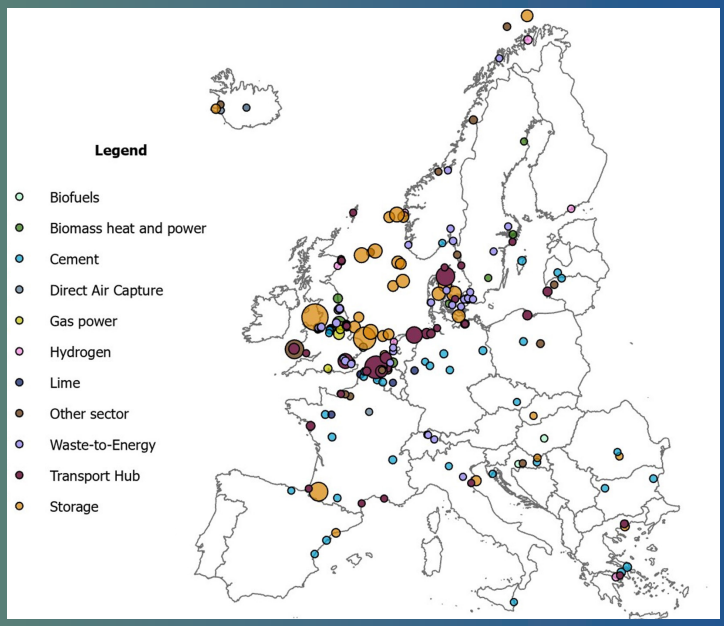
CO_2 capture and storage (CCS). Please note this is for illustration purposes and not to scale. Source: BGS © UKRI 2025 (reproduced with permission).

Why is CCS important?

Every year, around 40 billion tonnes of CO_2 are emitted by human activities, driving climate change[3]. Emission sources can be attributed to power generation, industry, transport, fuel combustion, agriculture, buildings, and waste[3]. CCS is essential to reduce emissions[4], alongside measures like energy efficiency, renewable energy, and sustainable practices.

Despite its importance, deployment remains limited: as of 2025, only about 64 Mt of CO_2 are captured annually[5]. However, CCS is expanding. In Europe, projects such as Sleipner and Snøhvit (Norway) have operated for decades, while new large-scale developments like Longship (Norway), Ravenna (Italy), and Porthos (the Netherlands) aim to significantly increase storage capacity.

Globally, 108 CCS projects are operational or under construction[5].



CCS projects in all stages of development including capture, transport and storage projects (October 2025). Reproduced with permission from the Clean Air Task Force[6].

CCS and Society

How is CCS relevant to policy?

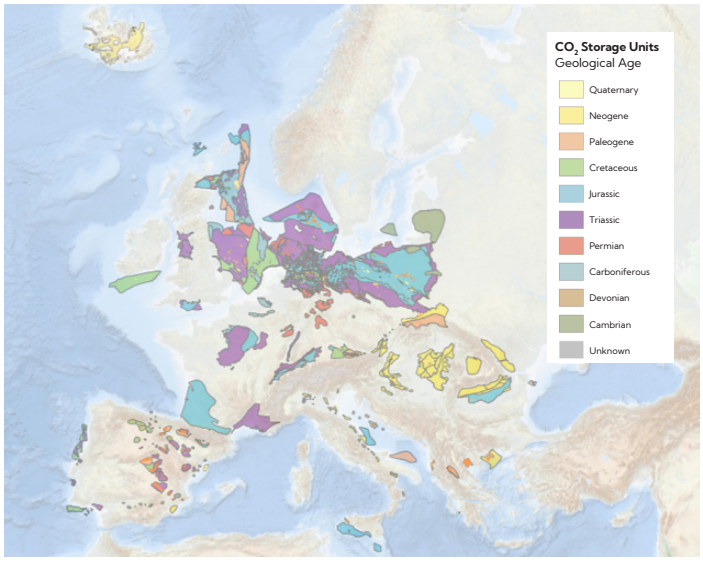
High-level agreements such as the Paris Agreement (2015) aim to limit global temperature rise to within 2°C above pre-industrial levels[7].

In May 2024, the European Union (EU) adopted the Net-Zero Industry Act (NZIA) to scale up clean technologies and reach net-zero CO_2 emissions by 2050[8]. It designates CCS as strategic, supports faster permitting, and targets 50 Mt annual CO_2 injection capacity by 2030, with oil and gas producers responsible for delivery[9]. The NZIA also promotes the release of subsurface data and strengthens the role of geological services in aggregating knowledge[10].

The EU supports CCS through the Innovation Fund[11] and research programmes such as Horizon Europe to improve efficiency and reduce costs. Public engagement and clear permitting procedures are essential, alongside coordinated spatial planning and EU-wide frameworks to manage cross-border and liability challenges.

What is needed to scale-up CO_2 storage?

Our pan-European CO_2 storage atlas displays potential CO_2 storage sites ('traps') using a Storage Readiness Level[12]. The levels indicate maturity of understanding in terms of CO_2 storage, and what is needed to advance each site. For many traps, additional data are needed. Areas with CO_2 storage potential are identified in the Atlas as 'formations' and 'storage units', and require further work to determine traps. In some cases, relevant data already exist, for example, from hydrocarbon exploration, but remain unreleased; in others, new seismic surveys, data acquisition, or well drilling are needed.



Pan-European CO_2 storage atlas developed within the Geological Service for Europe (GSEU) project, showing potential storage units, available on the EGDI Map Viewer[13]. The colours indicate the geologically youngest rocks being considered for CO_2 storage.

The role of EuroGeoSurveys

The EuroGeoSurveys GeoEnergy Expert Group (GEEG) contributes to key European Commission initiatives, including NZIA implementation, updates to CO_2 Storage Directive guidance, and national transposition of the CCS Directive.

EuroGeoSurveys manages the European Geological Data Infrastructure (EGDI) that provides open access to data on geological storage. As new data are released under the NZIA, they can be integrated into future updates, supporting transparent and coordinated management of subsurface knowledge.

EuroGeoSurveys Members play a key role in CCS deployment, providing impartial scientific expertise and contributing to public engagement. They also contribute to major networks, including CO_2GeoNet[14], the European Energy Research Alliance[15], Carbon Management Europe[16], the Industrial Carbon Management Forum[17], and relevant Commission consultations.

Towards long-term impact

Scaling up CCS is essential for climate neutrality, especially in hard-to-abate sectors. While initiatives like the NZIA are accelerating CCS deployment, gaps remain between current capacity and future needs. A permanent Geological Service for Europe, with open access to subsurface data via EGDI, would strengthen coordination and support the efficient roll-out of CO_2 storage.

References:

1. CO_2GeoNet 2026. Explore CCS. Where and how much CO_2 can we store underground? https://co2geonet.com/explore-ccs/where-and-how-much-co2-can-we-store-underground/#10414 [accessed 13/05/26]
2. IEAGHG 2026. Monitoring Selection Tool. Available from https://ieaghg.org/monitoring-selection-tool/ [accessed 18/02/26]
3. IEA-EDGAR CO_2 (v4), a component of the EDGAR (Emissions Database for Global Atmospheric Research) Community GHG database version EDGAR_2025_GHG (2025) including or based on data from IEA (2024) Greenhouse Gas Emissions from Energy, www.iea.org/statistics, as modified by the Joint Research Centre. Available from https://edgar.jrc.ec.europa.eu/report_2025 [accessed 16/02/26]
4. IPCC, 2005: IPCC Special Report on Carbon Dioxide Capture and Storage. Prepared by Working Group III of the Intergovernmental Panel on Climate Change [Metz, B., O. Davidson, H. C. de Coninck, M. Loos, and L. A. Meyer (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 442 pp available from https://www.ipcc.ch/report/carbon-dioxide-capture-and-storage/ [accessed 13/05/26]
5. Global CCS Institute, 2025. Global Status of CCS 2025 Australia. Available from https://www.globalccsinstitute.com/global-status-of-ccs/ [accessed 16/02/26]
6. Clean Air Task Force, 2025. Europe Carbon Capture Activity and project map. Available from https://www.catf.us/ccsmapeurope/ [accessed 16/02/26]
7. United Nations Framework Convention on Climate Change, 2015. The Paris Agreement COP21. Available from https://unfccc.int/process-and-meetings/the-paris-agreement [accessed 16/02/26]
8. European Commission, 2023. The Net-Zero Industry Act. available from https://single-market-economy.ec.europa.eu/publications/net-zero-industry-act_en [accessed 16/02/26]
9. European Commission, 2025. Commission identifies the EU oil and gas producers to provide new CO_2 storage solutions for hard-to-abate emissions in Europe. News article. 22 May 2025. Available from https://climate.ec.europa.eu/news-your-voice/news/commission-identifies-eu-oil-and-gas-producers-provide-new-co2-storage-solutions-hard-abate-2025-05-22_en [accessed 18/02/26]
10. European Commission, 2024. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Towards an ambitious Industrial Carbon Management for the EU. Strasbourg, 6.2.2024. COM(2024) 62 final. Available from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52024DC0062 [accessed 19/02/26]
11. European Commission, 2026. Innovation Fund. https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund_en [accessed 19/02/26]
12. Akhurst, M. Kirk, K, Neele, F, Grimstad, A-A, Bentham, M and Bergmo, P. 2021. Storage Readiness Levels: communicating the maturity of site technical understanding, permitting and planning needed for storage operations using CO_2. International Journal of Greenhouse Gas Control, 110, 103402. https://doi.org/10.1016/j.ijggc.2021.103402
13. European Geological Data Infrastructure (EGDI) https://www.europe-geology.eu/ [accessed 26/05/2026]
14. CO_2GeoNet https://co2geonet.com/home/ [accessed 19/02/26]
15. European Energy Research Alliance – CCS https://eera-ccs.eu/ [accessed 19/02/26]
16. Carbon Management Europe https://zeroemissionsplatform.eu/ [accessed 19/02/26]
17. Industrial Carbon Management Forum https://energy.ec.europa.eu/topics/carbon-management-and-fossil-fuels/industrial-carbon-management/icm-forum-and-working-groups_en [accessed 19/02/26]

Funded by the European Union