CARBON CAPTURE AND STORAGE

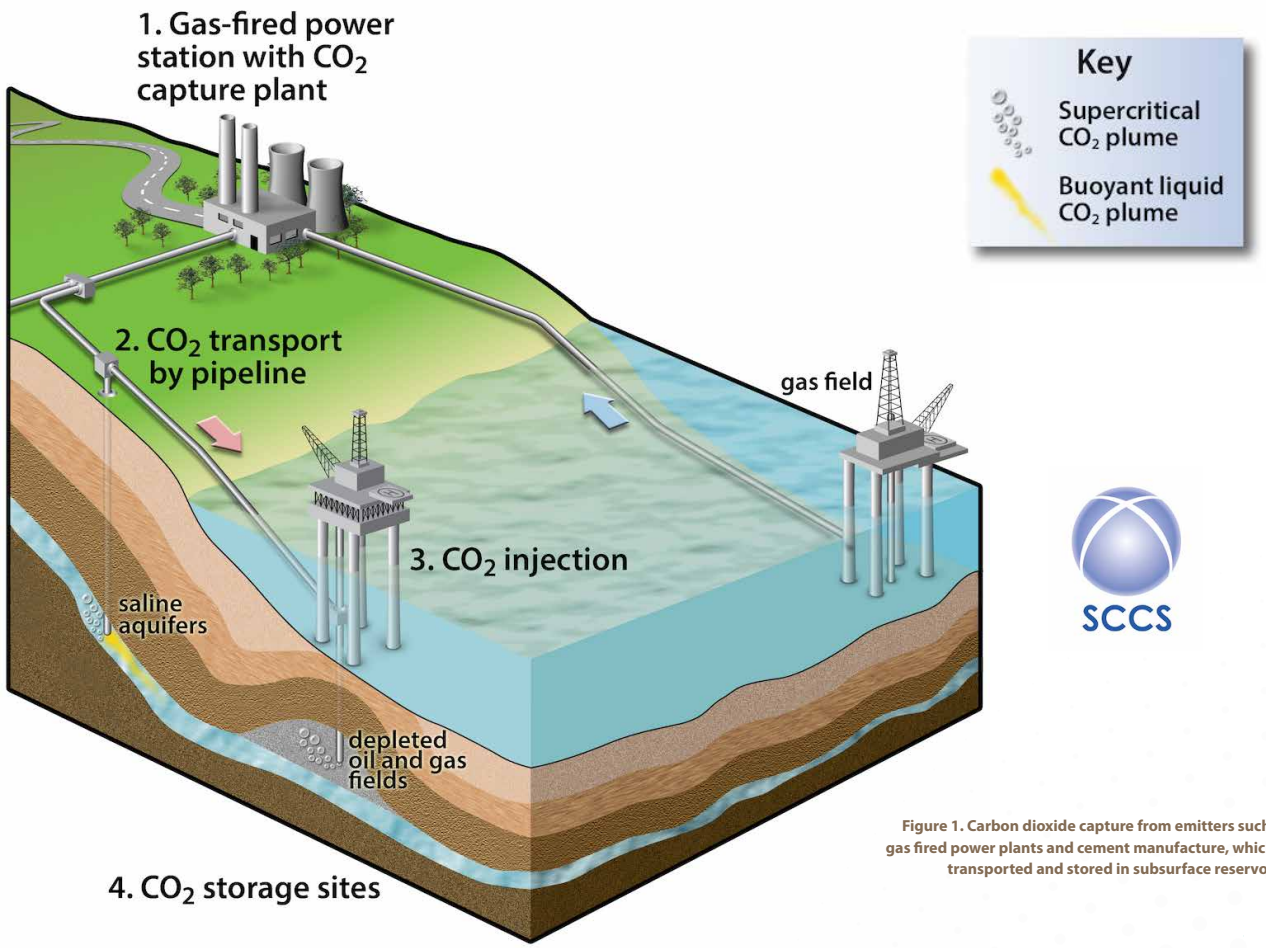


Figure 1. Carbon dioxide capture from emitters such as gas fired power plants and cement manufacture, which is transported and stored in subsurface reservoirs.

Carbon Capture and Storage (CCS) involves capturing and transporting CO_2 from industrial processes and storing it underground where it is trapped for geological time scales (over 10,000 years). It's a proven technology recognised by the Intergovernmental Panel on Climate Change (IPCC) as one of the mitigation options for reducing carbon dioxide (CO_2) concentrations and achieving the net-zero emissions target of the Paris Agreement.

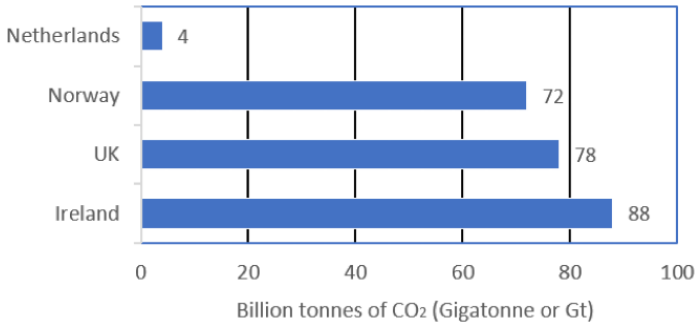
CO_2 is released as a by-product of the combustion of fossil fuels and biofuels. CCS involves the separation and capture of CO_2emissions, typically from industrial and electricity generation point-sources, such as coal and natural gas-fired power plants, blue hydrogen gas producers and heavy industry like cement, steel and aluminium. CCS, in combination with direct air capture technologies and biofuels, can provide negative emissions overall, where more CO_2 is stored than being produced, therefore lowering atmospheric concentrations. Negative emissions can also offset hard-to-capture emissions from industries such as aviation and agriculture. Transport of CO_2 via trucks, ships or pipelines moves the CO_2 to permanent underground storage sites (Figure 1). CO_2 is typically stored at depths greater than 800 metres underground (about the length of eight football pitches). Sites are monitored to ensure safe storage over decades, no less than 20 years.

How much CO_2 can be stored?

The storage capacity of CO_2 is measured in metric tonnes. One tonne of CO_2 is roughly equivalent to emissions from driving 6,000km in a diesel car. Annual greenhouse gas emissions worldwide are estimated to be over 50 billion tonnes (50 gigatonnes, or 50 Gt) of CO_2 equivalent.

Global subsurface storage capacity is substantial. The IPCC (Intergovernmental Panel of Climate Change) estimates that the global storage capacity for CCS is greater than the total requirements to limit global warming to 1.5°C to the year 2100[1].

Examples of CO_2 Storage Capacity of Selected Countries:[2,3,4,5]



Norway has already injected more than 0.16 Gt of CO_2 into their offshore subsurface Sleipner site since 1996, and the UK hosted their first CCS licencing round in 2022 with a goal of capturing and storing between 0.075 - 0.18 Gt by 2050[3].

Where can CO_2 be stored?

Storage options for CO_2 include subsurface geological storage, mineral sequestration where CO_2 is incorporated into carbonate minerals, and utilisation in industrial processes. Ocean storage (direct release onto the deep seafloor or into the ocean water column) is also possible but is not favoured due to potential negative environmental consequences.

Subsurface geological storage can occur in:

- Deep porous saline aquifers
- Depleted oil and gas fields
- Enhanced oil recovery or enhanced gas recovery projects where the CO_2 is injected into partially depleted oil or gas fields to increase the recovery factor
- Coal beds
- Igneous rocks such as basalt where mineral reactions trap the CO_2 in a solid form (e.g. Carbfix in Iceland)

CCS in Ireland

CCS can offset emissions from gas-powered electricity, reduce emissions from industries like cement and agriculture, and support the deployment of negative emissions technologies (like direct air and bioenergy with carbon capture) in Ireland. Ireland has significant potential to store CO_2 in geological formations in offshore deep saline aquifers and depleted gas fields including Kinsale Head and Corrib (Figure 2). Potential for CO_2 storage in saline aquifers offshore Ireland is estimated up to 88 Gt[5]. CO_2 storage capacity of Ireland's depleted gas fields are estimated at 0.321 Gt (Kinsale) and 0.044 Gt (Corrib)[6]. The depleted Kinsale Head gas field alone could have sufficient storage capacity to take the equivalent of up to 40 years of CO_2 emissions from the top 10 point-source emitters, such as power plants in Ireland[6].

While CCS is listed in Ireland's national Climate Action Plan, Ireland has not yet transposed the EU Directive to allow for the storage of CO_2 in the subsurface. Further work is needed to assess its potential and implement necessary directives.

Ireland is part of the European Union Emissions Trading Scheme (EU-ETS) which sets an absolute limit on the total annual emissions of certain greenhouse gases by any significant enterprise within the EU. The absolute limit of allowable emissions is reduced over time and financial penalties are incurred when targets are not achieved. Revenue for the scheme is generated by the purchasing and trading of carbon credits, which funds green-energy initiatives and creates financial incentives to reduce CO_2.

CCS and Geoscientists

Geoscientists play a vital role in supporting low-emission energy technologies by locating and characterising suitable reservoirs for CO_2 storage.

Geoscientists interpret seismic and well data, analyse stratigraphic formations and faults for their storage, trapping and flow potential, and are essential in site development, infrastructure, and management. Existing historical datasets, such as borehole data and seismic surveys, combined with experience from Ireland's historical hydrocarbon exploration, and ongoing international CCS developments, have already provided an insight into the potential for development of CO_2 storage, with much still to be learned.

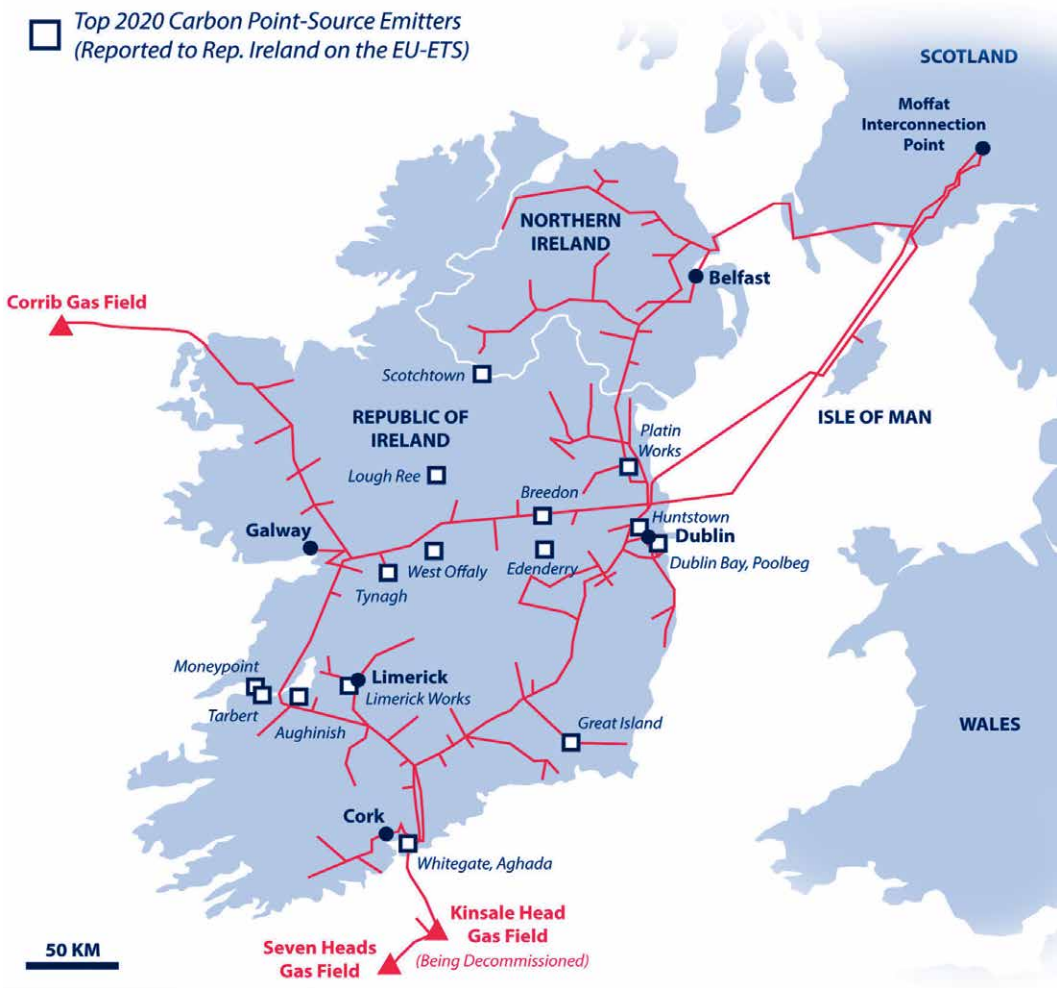


Figure 2. Locations of main point-source emitters on the island of Ireland and the gas transmission network. Offshore gas fields include Kinsale and Corrib, which have the potential to become CO_2 storage sites in the future[6].

Abbreviations

CCS = carbon capture and storage

IPCC = Intergovernmental Panel of Climate Change

CO_2 = carbon dioxide

Gt = gigatonnes, billion of tonnes

EU-ETS = European Union Emissions Trading Scheme

References used in this document and further reading:

- [1]IPCC (2023). Summary for Policymakers. In: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC, Geneva, Switzerland.
- [2]North Sea Transit Authority website (2023). Carbon Capture and Storage.
- [3]NSBTF: North Sea Basin Task Force (2023). Strategic regional plan on CO_2 transport and storage infrastructure: the North Sea Region.
- [4]Wettestad, J., Jackson Inderberg, T.H., and Guldrandsen, L.H. (2023). Exploring paths and Innovation in Norwegian carbon capture and storage policies, Environmental Policy and Governance, 1-12.
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- [6]English, J.M. and English K.L., (2022). Carbon Capture and Storage potential in Ireland – returning carbon whence it came. First Break, 40(5), 35-43.
- [7]English, J.M. and English, K.L. (2022). An Overview of Carbon Capture & Storage (CCS) and its Potential Role in the Energy Transition. First Break, 40(4), 35-40.