Evaluating Offshore Carbon Capture and Storage (CCS)

Disclaimer: This factsheet is a guide only and is designed to give readers a plain English overview of the law. It does not replace the need for professional legal advice in individual cases. To request free initial legal advice on a public interest environmental or planning law issue, please visit our website.

While every effort has been made to ensure the information is accurate, the EDO does not accept any responsibility for any loss or damage resulting from any error in this factsheet or use of this work.

This factsheet was last updated on 26 June 2026

What is this factsheet about?

This factsheet provides a guide to evaluate offshore carbon capture and storage (**CCS**). The stages of the CCS process are described, and a number of the potential risks and impacts to the environment and human health are summarised.

Outline
(Click subheadings to skip to that section)

What is CCS?

CCS is a process that takes relatively pure carbon dioxide (**CO_2**) from different sources to a storage location for long-term isolation from the atmosphere. The process of storing CO_2 (**CO2** throughout) offshore involves capturing a stream of CO2 from industrial and energy-related sources. The CO2 is separated, conditioned, and compressed for transport by pipelines and injected at a site offshore, deep underground (Geological storage or geosequestration) (1) (2).

CCS as a climate mitigation tool

CCS is a type of carbon management technology (**CMT**) that has been proposed as a way of capturing CO2 emissions from industrial processes and power plants to avoid their release into the atmosphere (3), thereby mitigating anthropogenic climate change.

A schematic of the different types of CMT is shown in Figure 1:

Carbon dioxide *removal* (**CDR**) takes *existing* CO2 out of the air, CCS and the related processes of carbon capture and utilisation (**CCU**) and carbon capture utilisation and storage (**CCUS**) capture CO2 – either in processing, or pre- or post-combustion of fossil fuels - *before it's released into the atmosphere*.

A subcategory of CCUS is called enhanced oil recovery (**EOR**). During EOR operations, also known as CCUS-EOR, CO2 is pumped into depleted oil and gas reservoirs where it 'sweeps' the reservoir, allowing more oil to be extracted. Some of the CO2 injected is returned with the oil, but a proportion remains stored in the subsurface to be stored (4).

The International Energy Agency (IEA) initially stipulated that CCS was essential in the array of methods to bring global CO2 emissions down (5), but they have subsequently tempered their support for CCS[1]. The IEA analysis of global CCUS projects indicates that it is not on track: "the pipeline of current projects is around 40% of the Net Zero Scenario requirement in 2030" (6), with current operating CCS almost stalled at 50 Mt CO2 (50 million tonnes) annually. This is orders of magnitude below the 'large-scale' Gigatonnes (billion tonnes) of CO2 required to be sequestered each year to 2050 (6). The Institute for Energy Economics and Financial Analysis (IEEFA) in reviewing the latest IEA information can only see a "minimal role" for CCUS in reducing emissions by 2050 (7).

The Global CCS Institute defines 'large-scale' storage as 400,000 tonnes of CO2 per annum, or 800,000 tonnes per annum for a coal plant (8). Currently, about 1 MtCO2/yr can be injected into a sequestration well, if everything goes well, and an estimated 7 – 8Gt CO_2/yr needs to be stored by 2050 to keep global temperatures below 1.5°C . Therefore, at least 7000 wells would be needed to keep global warming to 1.5°C – that is an average of 300-400 wells per year (9). While there are many "successful" demonstration projects for CCS

---

[1] For example – https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-c-goal-in-reach/a-renewed-pathway-to-net-zero-emissions [2023 update]; https://www.iea.org/reports/world-energy-outlook-2025/net-zero-emissions-by-2050 [2025]

technologies, few large-scale projects have performed as planned due to technical difficulties.

Capacity for climate mitigation

CCS projects have a history of under-performing. A 2022 IEEFA report analysed the performance of 13 operational large-scale CCS projects worldwide, which together represent 55% of captured CO2, using figures published by the companies. The report concluded that 10 out of the 13 projects have captured far less CO2 than expected (10).

For example:

- The Gorgon project operated by Chevron in Western Australia promised to reduce scope 1 CO2 from LNG production by around 40% over the life of the system (11) (12). Chevron initially claimed that as much as 80% of the total separated CO2 would be stored (10) (9). Instead, the project was delayed by 3.5 years and missed its target by more than 50% due to unforeseen engineering challenges (10) (12). At this rate, less than 3% of the project's total GHGs (including scope 3 emissions) are being currently stored. Over the life of the project, CO2 storage will be less than 6% of total emissions, even with perfect implementation[2].
- In the U.S., ExxonMobil's Shute Creek facility near the LaBarge field in Wyoming has underperformed by roughly 36% (10).
- Petra Nova in Texas missed its carbon capture targets by about 17% upon starting its operations (13), and ultimately captured just 7% of its total carbon dioxide emissions before being shut down in 2020 (14), at a cost of US$65/tonne of sequestered CO2 (15).
- The Kemper "clean coal" project in Mississippi was long delayed, and construction was eventually abandoned in 2017 (10).
- The world's only operating power plant with CCS – Boundary Dam in Canada – has captured about 50% fewer emissions than planned (10), at a cost of US$110/tonne of sequestered CO2 (15).
- The In Salah project in Algeria was a CCS project that failed after a decision was made to suspend injection due to concerns about possible vertical leakage into the caprock (9).

Although the Sleipner and Snøhvit subsea fields in Norway have been cited as success stories, they cannot be used as definitive models for the future of CCS due to the unpredictability of the subsurface conditions, which began deviating from design plans 18 months into CO2 injections, necessitating major interventions (16). While the Sleipner CCS project sequesters 1 MTCO2/year from an offshore gas treatment facility "the process of flow between adjacent sedimentary layers, separated by mudstone layers, remains unclear" despite years of detailed, expensive seismic monitoring of the reservoir (9).

---

[2] Perfect implementation would be 3.4 MTCO2e sequestered out of 59.2MTCO2e per year. Chevron, 'Gorgon Gas Treatment Plant Greenhouse Gas Management Plan' (August 2022) 14 https://australia.chevron.com/-/media/australia/our-businesses/documents/gorgon-gas-treatment-plant-greenhouse-gas-management-plan.pdf

Although CO2 is the primary GHG emitted during combustion of fossil fuels, they are not the only GHGs emitted during the fossil fuel production life cycle and these other GHGs are not removed from the emissions by CCS facilities. Therefore, approval of new fossil fuel production projects has the potential to increase emissions despite CCS facilities.

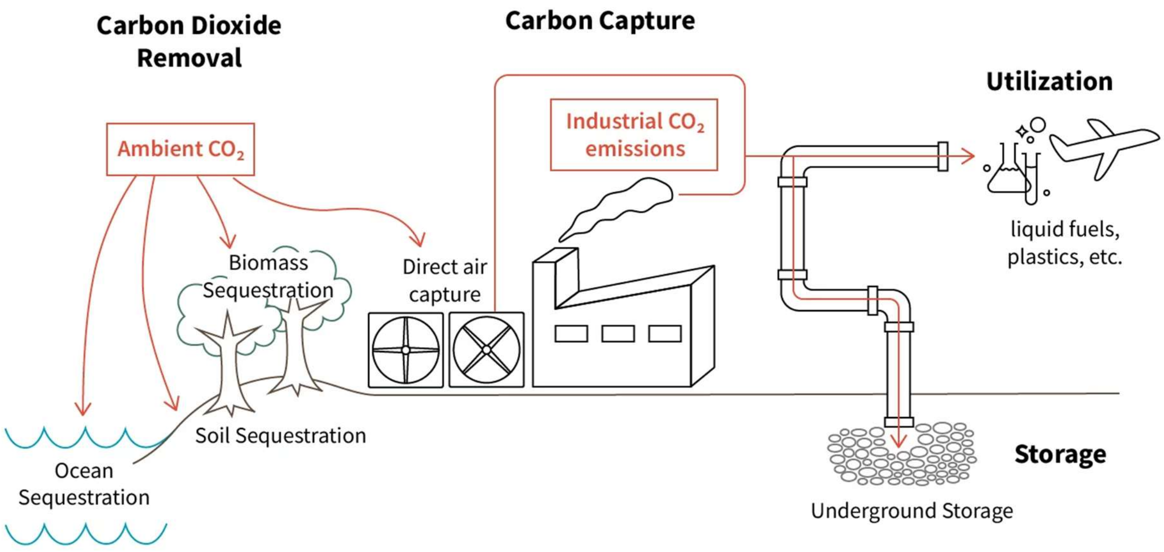


Figure 1. Types of carbon management technologies. Image source: Carbon Management | Understand Energy Learning Hub.

Lifecycle emissions and net climate change impacts

For each tonne of CO2 sequestered, a minimum volume of CO2-e is emitted over the lifecycle of the storage. All stages of the process require energy, or fuel, to operate and therefore produce greenhouse gas emissions additional to those being stored. The Australian Clean Energy Regulator (NGER) includes in its determination of CCS emissions; the operations required to capture greenhouse gases, processing or compressing of the gases, transportation and injection of the gases to the storage, and fugitive emissions from pipeline and storage leaks (17).

This fuel requirement is called the CCS "energy penalty". For example, the energy penalty for CCS to abate the CO2 generated by the 1493 coal-fired power plants in the US would be an additional ~400–600 million tonnes of coal per year or building an additional ~100 GW of CO2-free baseload power (i.e., to compensate for the reduced efficiency of the plants due to CCS) (18). Most CCS projects address emissions only for one stage of the energy production life cycle. For example, the CCS facility at Gorgon was designed to remove only the amount equivalent to reservoir CO2, while an almost equal amount of CO2 was associated with the production facility.

The main contributor to GHG emissions from CCS (i.e., Scope 1 & 2 emissions) is the energy generation for the processing stage of the CO2, and fugitive emissions (19):

- Capture. Amine scrubbing is a common and long-used capture method that involves a liquid solvent, amine solution, used to absorb CO2 from flue gases, thereby purifying and capturing up to 90% of CO2. This is an energy-intensive process because heat is required to regenerate the amine solvent and release the CO2.

- Compression. Energy is required to change the CO2 from a gas to a liquid, and that liquid CO2 is further compressed to reach an optimal flow condition for pipeline transport.
- Transport. Fugitive emissions are a risk associated with CO2 pipeline infrastructure, and the risk increases with transport distance. Using the limited available records from the USA PHMSA for release volumes, during the period 2002-2009 the average release volume of natural gas was approximately 782,000 cubic metres per pipeline leak/incident (20). Sub-sea isolation valves can significantly reduce the volume of gas released by isolating the leak within a few minutes. Without sub-sea isolation valves, leaks could be prolonged and release large volumes of gas.

As described above, GHG emissions are possible through all steps of the CCS process. Leaks can also occur during all steps, and even a minor leak can nullify the effects of CCS. As such, it is important to understand the regimes governing the monitoring and remediation of leaks in the near- and long-term.

Uncertainty and risk of CCS processes

The uncertainties and risks of CCS are assessed in sequence: carbon capture; CO2 transport; and CO2 storage (geosequestration):

Carbon capture

Despite significant research efforts[3], carbon capture is locked operationally into a decades-old technology of amine liquid-phase capture (21):

- Amine scrubbing of CO2 is energy intensive and risks escape of air pollutants (e.g., nitrosamines)
- Most operational CCS projects are associated with CO2 capture from raw gas processing (gas or LNG plants) because amine scrubbing is most efficient with gases having high-CO2 content, such as reservoir CO2 in raw gas, but it falls away with CO2 levels in post-combustion exhausts (e.g., fossil-fuelled power stations).
- Amine scrubbers are also the most water intensive method due to the additional cooling water requirements (22). Rosa (2020) (23) found that the “water efficiency” of CCS (the amount of water used per unit of CO2 captured) depends on the type of fossil infrastructure and the corresponding capture technology. The water footprint of CCS ranges from 0.74 to 575 cubic metrics of water per ton of CO2 (24).

---

[3] For example – Cousins, A., Feron, P., Hayward, J., Jiang, K. and Zhai, R., 2019. *Further assessment of emerging CO_2 capture technologies for the power sector and their potential to reduce cost*. CSIRO report EP189975 (for IEAGHG), CSIRO, Australia.

Transport

The preferred transport of CO2 is pipelines, although ships are being actively developed (e.g., Norway's Northern Lights CCS project (25)). Transporting CO2 in a pressurised state comes with risks, and experience to date with CO2 pipeline infrastructure (mostly in the USA) has been primarily for enhanced oil recovery (EOR). Gas composition and recovery methods for CCS will vary due to the range of industries for which CCS aims to capture and sequester CO2 (26). This is likely to result in a range of impurity levels in different CO2 sources, and higher impurity levels than those encountered in EOR.

Pipeline transport risks:

Corrosion of pipeline materials was identified as the leading cause of historical pipeline failure in the Gulf of Mexico (27).

- When the gas is not adequately dehydrated or water enters the pipeline, CO2 and impurities, in particular hydrogen sulfide (H_2S) and nitrogen dioxide (NO_2), can form acid and result in pipeline corrosion (28). Impurities in the gas (non-CO2 compounds) add complexity to pipeline transportation and need to be considered in pipeline design (29).

Offshore pipeline failures:

For offshore pipelines, a unique set of additional risks need to be considered and mitigated.

- Offshore natural gas pipelines have had higher failure rates than onshore pipelines. An analysis of failures recorded in the USA Pipeline and Hazardous Materials Safety Administration (PHMSA) database for offshore natural gas transmission and gathering pipelines between 1990 and 2009 showed that there were 346 significant incidents during this period (29). Of these incidents, 59% were leakage incidents, 17% were ruptures incidents, and the remaining were system-component failures (such as valves, joints, and welds).
- Storms and cyclones can cause physical damage from storm generated waves, debris, seabed scouring caused by strong currents, and turbidity currents caused by cyclones (30). The strong currents induced during storms, particularly cyclones and hurricanes, can scour unconsolidated sand on the seabed from beneath marine pipelines. This can leave sections of pipeline unsupported and result in subsidence and strain on the pipeline joins. Conversely, pipelines can be buried by sediment. Modelling of storm-scour and incorporation of sufficient stabilisation mechanisms into pipeline design can mitigate for these risks but come at increased cost (30).
- Axial walking, caused by thermal expansion and contraction of pipeline infrastructure when transmission is turned on and off, can place stress on joins and connecting parts of the pipeline (31).
- Laying pipelines offshore is inherently more challenging than onshore, and with increasing depth there is increased risk of welded joins being stressed (26).

Storage

CO_2 storage involves injection of CO_2 into the subsurface, typically to a depth of 1 – 4 km (32). Usually, it is injected into a permeable sedimentary rock that is overlain by a low permeability mudstone or shale that acts as a caprock (**Figure 2**). In Australia, the two most applicable reservoirs for CO_2 storage are depleted oil/gas formations and saline aquifers (33). Based on technical feasibility alone, 225 Gt of CO_2 could be sequestered underground in Australia by 2050, although as of 2021-2022 only an estimated 1.7 Mt per year of actual geosequestration is occurring (33).

Successful long-term storage relies on stable thermodynamic conditions and structural integrity of the reservoir. However, these conditions are not consistent within a formation or among formations. The criterion for choosing a suitable saline aquifer includes the depth of the reservoir, the capacity for the pores in the caprock to hold fluid or let it pass through (permeability), and the integrity of the caprock (34), and whether the brine and rock minerals have the correct chemistry to create the chemical actions required to mineralise the CO_2. Ensuring the safety and stability of the CO_2 storage remains the biggest challenge in this field of research, making site selection critical, as well as the method and rate of injection (9).

Structural failure risks:

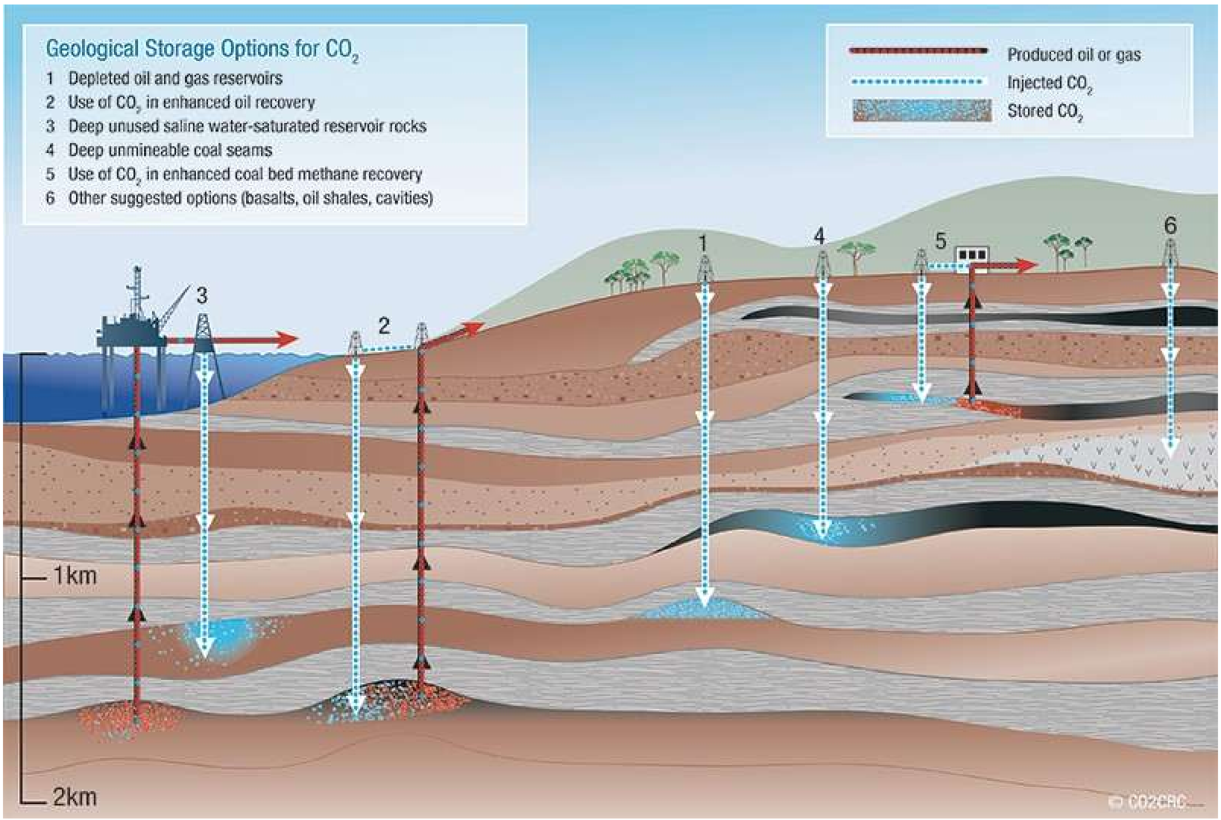
Absolute reliability of long-term (millennia) geosequestration of CO_2 is unverifi-ed/-able. Risks of losing CO_2 from geological storage have been well studied and documented (35) (36) (37) (38) (39). Known hazards include caprock fracturing, migration along fault lines, groundwater contamination, failures in well integrity, and induced seismicity, as well as earthquake rupture of the geological formation.

Thorough geotechnical site characterisation, a conducive policy environment, stringent regulation, monitoring, and multi-decadal investment commitment are key to geological CCS being conducted safely, achieving the desired injection volume, and minimising risk of CO_2 escaping the reservoir (40).

- At any location and depth within a geological formation, there is a pre-existing stress field. This depends on factors including the depth of the formation (the weight of overlying rocks and sediments creates gravitational stress), and the tectonic setting (plate movement creates stress, depending on the direction of motion) (41).
- The stress field within the reservoir and seal rocks at a CCS site change during CO_2 (or any fluid) injection, because of pressure build up and structural changes to the pores trapping the gas (42). Changes to the stress field can cause existing faults to slip or new fractures to develop, cause movement along the interface between geological layers (bedding-plane slip), create induced seismicity, and even result in uplift, whereby the rocks themselves are moved upwards.

- Chemical reactions between the CO2 and fault material can also decrease the stress threshold required for slip (43). Mechanical failure of the reservoir or seal rock can occur if a fault penetrates the entire seal.

Figure 2. Schematic of the different types of onshore and offshore geological storage options for CO2. Image credit: Orr, F., 2009. Science (44).



CCS as Enhanced Oil Recovery

Many existing CCS projects globally have been designed with the goal of extending the life of fossil fuel extraction sties. These projects facilitate Enhanced oil recovery (EOR; also called Improved Oil Recovery, IOR)[4] (45). During the EOR process, slugs of water and CO2 are alternately injected into a subsurface reservoir, pushing oil in the reservoir toward an oil production well (Figure 1). Thus, while conventional methods of oil production typically only remove 20-40% of the oil from a reservoir, an additional 30-60% can be extracted by EOR (45).

Oil reservoirs and depleted gas fields:

- Storage methods (46): Previous extraction of oil and gas can create extra capacity in the reservoir pressure (pressure headroom) to operate before weakness occurs in

---

[4] This process is equally appropriate for use in producing gas and condensates; therefore, Enhanced Hydrocarbon Recovery (EHR) is perhaps a better term, yet EOR is the most commonly used term in the literature. Thomas, 2008. Enhanced Oil Recovery – An Overview. Oil & Gas Science and Technology, 63(1); 9-19. https://ogst.ifpenergiesnouvelles.fr/articles/ogst/pdf/2008/01/ogst07042.pdf

the structural integrity of the reservoir. This headroom enables some CO2 to be returned to the reservoir in the form of CO2 processed to a compressed liquid form (supercritical).
- Geological suitability (10): These fossil fuel fields have been well-studied, and the infrastructure (e.g., well integrity) is known and used from decades of CO2 extraction. However, monitoring of these sites is critical for the assessment of additional risks associated with aging infrastructure, and they should be evaluated with the same criteria as the saline aquifers.

Marine Ecological Risks and Impacts

Marine impacts relate to potential problems associated with equipment failures, leaks and geological instability of chosen storage sites. These problems can release CO2 and other toxic and hazardous pollutants that are produced during the CO2 processing stage, such as benzene and derivatives, monoethanolamine or other amines, and mercury (47).

Primary risks and impacts include, but are not limited to:
- Catastrophic and rapid loss of containment from pipeline, injection site (blowout), or reservoir- or land-land based infrastructure (48).
    - Asphyxiation risk near population centre or habitat (e.g., shorebirds)
    - Carbonic acid formation lowering pH, impacting coral and skeletal formations.
- Slow CO2 leaks alter the sea's carbonate buffering system, creating changes in microbial communities, aquatic vegetation, and fauna communities (49). These impacts vary with the depth, flow, and temperature of the surrounding seawater.
- Disturbance or destruction of fragile habitat and communities on the seafloor from dredging, trenching, and pipelaying (50).
- Repeat seismic surveys to find and monitor stability of the reservoirs, impact marine mammal and food-chain organisms (51; 52).
- Monitoring of sediment clouds (plumes) from mining activity requires ongoing time lapse (4D) seismic surveys, setting chronic pressure on the marine mammals and food-chain organisms.
- Pollutants that are toxic and hazardous to the environment are produced during CO2 processing and can persist in marine sediments, including but not limited to hydrochloric and hydrofluoric acid, nitrous and nitric acids, sulfurous and sulfuric acids, hexafluoroethane, cadmium, mercury, thallium. The release of these into sediments can occur through infrastructure failure (53).

Public Health Impacts

The negative health, environmental, and environmental justice impacts from the upstream extraction as well as the burning of (and export of) oil, gas, and coal include, but are not limited to: groundwater contamination, toxic dust production, and methane releases from coal mining; toxic chemical releases to air, water, and from oil and gas drilling operations; methane releases in the fracking and transport of natural gas; particulate matter, sulfur dioxide, volatile organic compounds, and nitrogen oxides emissions from burning coal and gas; groundwater and drinking water contamination from coal ash, the toxic byproduct of coal burning (54).

Air pollution impacts from the proposed buildout of CCS infrastructure is one of the major concerns for environmental justice communities. Environmental justice advocates argue that instead of transitioning away from facilities that emit hazardous air pollutants, CCS will only prolong the life of these facilities without removing the non-CO2 air pollution (55). According to a report by the European Environment Agency (EEA) on the air pollution impacts from CCS, air pollutant emissions (e.g., nitrous oxides, sulfur dioxide, ammonia, non-methane volatile organic compounds, and particulate matter) could increase due to the additional combustion of fossil fuels associated with CCS[5]. At existing facilities with CCS, air pollution reduction has not been demonstrated. Jacobson (2019) found that the CCS-retrofitted coal power plant in the Petra Nova project had a 25% increase in air pollution compared with no CCS (56).

The main source of **water pollution** is from post-combustion CCS facilities that use amine scrubbers. The water pollution arises from amine wastewater from reclaimers (57), and poses a moderate to severe threat to human health and ecological systems. Amine wastewater can increase the toxicity to freshwater ecosystems by ten times (58). Scrubbing chemicals, in particular alkanolamines, are emitted in traces in water vapor into the environment (59). These traces can contaminate and degrade water through precipitation and run-off. Amine wastewater also degrades over time to produce other toxic and hazardous (carcinogenic and mutagenic) compounds (57). Amine risks include: cardiovascular disease, cognitive decline, cancer, and premature death.

---

[5] See pages 21 and 24 in EEA, Air pollution impacts from carbon capture and storage (CCS), (2011), available at: https://data.europa.eu/doi/10.2800/84208.

References

1. What is CCS? | Geoscience Australia (accessed June 2026).
2. Masson-Delmotte, V., et al. *2018: Global Warming of 1.5oC.* IPCC. s.l. : IPCC Special Report, 2018. https://doi:10.107/9781009157940.001
3. Stanford University (2025) Carbon Management: Understand Energy Learning Hub. [Online] Stanford University, May 2025. Carbon Management | Understand Energy Learning Hub (accessed March 2026)
4. *Hanson, E., Nwakile, C., & Hammed, V. O. (2024) Carbon capture, utilization, and storage (CCUS) technologies: Evaluating the effectiveness of advanced CCUS solutions for reducing CO2 emissions. Results in Surfaces and Interfaces, 18, 100381. https://doi.org/10.1016/j.rsurfi.2024.100381.*
5. OECD, International Energy Agency, United Nations Industrial Development Organisation (2011)Technology Roadmap: Carbon Capture and Storage in Industrial Applications. IEA. https://www.iea.org/reports/roadmap-carbon-capture-and-storage-in-industrial-applications
6. International Energy Agency. Carbon Capture Utilsation and Storage (2023) https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage [accessed March 2026].

7Hauber, G. (2026) Minimal role for carbon capture, utilization, and storage, (CCUS) in IEA's World Energy Outlook 2025. https://ieefa.org/resources/minimal-role-carbon-capture-utilization-and-storage-ccus-ieas-world-energy-outlook-2025

8. Global CCS Institute (2017). "Large-scale CCS facilities – definition" Archived. https://web.archive.org/web/20170821184726/http://www.globalccsinstitute.com/projects/large-scale-ccs-projects-definitions.
9. The Royal Society (2022) Locked away – Geological carbon storage policy briefing. < https://royalsociety.org/geological-carbon-storage.
10. Robertson, B., Mousavian, M. (2022)'The Carbon Capture Crux: Lessons Learned', *Institute for Energy Economics and Financial Analysi*s (IEEFA) <https://ieefa.org/resources/carbon-capture-crux-lessons-learned.
11. Drugman, D. (2023) Big Oil's Been Secretly Validating Critics' Concerns about Carbon Capture. *DeSmog.* https://www.desmog.com/2023/02/13/exxon-shell-bp-api-concerns-carbon-capture/.
12. Chevron, 'Gorgon Gas Development and Jansz Feed Gas Pipeline Five-year Environmental Performance Report 2015– 2020' (October 2020) 45, https://australia.chevron.com/-/meida/australia/our-businesses/documents/gorgon-and-jansz-feed-gas-pipeline-5-year-environmental-performance-report-2015-2020.pdf
13. Groom, N. (2020) Problems Plagued U.S. CO2 Capture Project before Shutdown, (7 August, 2020). *Reuters.*https://www.reuters.com/article/us-usa-energy-carbon-capture/problems-plagued-u-s-co2-capture-project-before-shutdown-document-idUSKCN2523K8
14. Smyth, J.(2020) Petra Nova Carbon Capture Project Stalls with Cheap Oil, (6 August 2020) Energy and Policy Institute https://energyandpolicy.org/petra-nova/.
15. Baylin-Stern, A., Berghout, N. (2021) Is Carbon Capture Too Expensive?, (17 February 2021) *IEA* https://www.iea.org/commentaries/is-carbon-capture-too-expensive.

16. auber, G., Hauber (2023) Norway's Sleipner and Snøhvit CCS: Industry Models or Cautionary Tales? (14 June 2023) *IEEFA* https://ieefa.org/resources/norways-sleipner-and-snohvit-ccs-industry-models-or-cautionary-tales.

17. Clean Energy Regulator (2024) carbon-capture-and-storage-method-2021-simple-method-guide .

18. House, K.Z., *et al.* (2009) The energy penalty of post-combustion CO2 capture & storage and its implications for retrofitting the U.S. installed base*. Energy Environ*. Sci., 2: 193-205*. http://DOI: 10.1039/B811608C.*

19. Gusca J., Blumberga D. (2011) Simplified dynamic life cycle assessment model of CO2 compression, transportation and injection phase within carbon capture and storage*. Energy Procedia. 4:2526-2532* .

20. U.S. Department of Transportation. (2025) Pipeline and Hazardous Materials Safety Administration. Pipeline and Hazardous Materials Safety Administration.

21. Rochelle, G.T. (2016) Conventional amine scrubbing for CO_2 capture. In *Absorption-based post-combustion capture of carbon dioxide* (pp. 35-67). Woodhead Publishing.

22. *Newmark et al. 2010.*

23. Rosa, L., *et al.* (2020) The water footprint of carbon capture and storage. *Renewable and Sustainable Energy Reviews. Elsevier* 138(C) *DOI: 10.1016/j.rser.2020.110511.*

24. https://norlights.com/news/northern-lights-first-co2-transport-ship-ready-for-delivery/.

25. Duncan, I., Wang, H. (2014) Evaluating the Likelihood of Pipeline Failures for Future Offshore CO_2 Sequestration Projects*. International Journal of Greenhouse Gas Control 24: 124–138. https://doi.org/10.1016/j.ijggc.2014.02.004.*

26. Mandke, J.S. (1990) Corrosion Causes Most Pipeline Failures in Gulf of Mexico*. Oil and Gas Journal*, 88: 44*. https://www.osti.gov/biblio/6087974.*

27. Sim, S,. *et al.* (2013) Investigating the Effect of Water Content in Supercritical CO_2 as Relevant to the Corrosion of Carbon Capture and Storage Pipelines*. Corrosion 70: 185–95. https://doi.org/10.5006/0944.*

28. Seevam, P.N., et al. (2008) Transporting the Next Generation of CO_2 for Carbon, Capture and Storage: The Impact of Impurities on Supercritical CO_2 Pipelines. *Seventh International Pipeline Conference*, 1: 39–51. *https://doi.org/10.1115/IPC2008-64063.*

29. Draper, S., et al. (2015) Stability of Subsea Pipelines during Large Storms. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering* Sciences 373: 20140106 *https://doi.org/10.1098/rsta.2014.0106.*

30. Xintong, H., *et al.* (2021) Finite-Element Analysis of Pipelines with Axial Walking and Lateral Buckling*. Journal of Pipeline Systems Engineering and* Practice 12: 04021013*. https://doi.org/10.1061/(ASCE)PS.1949-1204.0000550.* .

31. Anderson, S.T. (2017). Risk, liability, and economic issues with long-term CO2 storage—A review. *Natural Resources Research,* 26 (89-112). *https://doi.org/10.1007/s11053-016-9303-6* .

32. CSIRO (2022) Australia's carbon sequestration potential. *https://www.csiro.au/en/research/environmental-impacts/emissions/carbon-dioxide-removal/carbon-sequestration-potential.*

33. Luo A., *et al*., (2022) Review of CO_2 sequestration mechanism in saline aquifers*. Natural Gas Industry B 9. 383-39334.*

34. Metz, B., Davidson, O., De Coninck, H.C., Loos, M. and Meyer, L., (2005) IPCC special report on carbon dioxide capture and storage*. Cambridge: Cambridge University Press.*

35. Alcalde, J., *et al.,* (2018) Estimating geological CO_2 storage security to deliver on climate mitigation. *Nature Communications*, 9(1), 2201.
36. Daniels, S., *et al. (2023*) Deep Geological Storage of CO2 on the UK Continental Shelf: Containment Certainty. Supplementary Note A: Breakdown of combined well and geological storage risks for typical storage sites*, OGL.*
37. Bashir, A.*, et al.* (2024) Comprehensive review of CO_2 geological storage: Exploring principles, mechanisms, and prospects*. Earth-Science Reviews,* 249, 104672*.*
38. Teng, Y., *et al.* (2025) An overview of the full-chain key technical features in offshore geological carbon sequestration*. Energy Reviews*, Romasheva, N., Ilinova, A. (2019) CCS Projects: How Regulatory Framework Influences Their Deployment. *Resources* 8. https://doi.org/10.3390/resources8040181.
40. Fossen, H. (2010) *Structural Geology*. Cambridge University Press. 481 p..
41. Lu, S. *et al. (2025)* Research Progress on CO_2 Geological Storage Reservoir and Caprock Mechanics: Methods and Status*. Greenhouse Gases: Science and Technology* 15: 264–*276. https://doi.org/10.1002/ghg.2328.*
42. White, J.A., Foxall, W. (2016) Assessing Induced Seismicity Risk at CO_2 Storage Projects: Recent Progress and Remaining Challenges*. International Journal of Greenhouse Gas Control* 49: 413–24. *https://doi.org/10.1016/j.ijggc.2016.03.021.*
43. Franklin M. Orr. (2009) Onshore Geologic Storage of CO_2 *JR.Science* 325 (5948): 1656-1658
44. Thomas, S. (2008) Enhanced Oil Recovery – An Overview*. Oil & Gas Science and Technology,* 63(1); 9-19*. http://DOI: 10.2516/ogst:2007060.*
https://ogst.ifpenergiesnouvelles.fr/articles/ogst/pdf/2008/01/ogst07042.pd
45. Shah, M.S.*, et al.* (2026) Geological and Technical Foundations of Offshore Cos Storage in Depleted Reservoirs*. ACS Omega*. 11: 17033-17078. *https://doi.org/10.1021/acsomega.5c10510*
46. Sathre, R., et al.(2011) The role of Life Cycle Assessment in identifying and reducing environmental impacts of CCS. *Lawrence Berkeley National Laboratory Report*. Lawrence Berkely National Laboratory.
47. Turley, C.M. *et al*.(2004) Literature review: environmental impacts of a gradual or catastrophic release of CO2 into the marien environment following carbon dioxide capture and storage. *Plymouth Marine Laboratory*.
48. Basallote, M.D., *et al.* (2012) Lethal effects on differnent marine organisms, associated wtih sedimetn-seawater acidification deriving from CO2 leakage*. Environmental Science and Pollution Research* 19: 2550-2551.
49. Todd. V.L.G., *et al.*(2015) A review of impacts of marine dredging activities on marine mammals. *ICES Journal Marine Sceince,*72: 328-340.
50. McCauley, R.D., *et al.* (2000) Marine Seismic Surveys - A study of environmental implications. *The APPEA Journal* 40:692-708.
51. McCauley, R., *et al.* (2017) Widely used marine seismic survey air gun operations negatively impact zooplankton. *Nature Ecology and Evolution*, 1.
52. DCCEEW (2024), Interim National Action List for offshore carbon dioxide sequestration*, Department of Climate Change, Energy, the Environment and Water, Canberra. CC BY 4.0. https://www.dcceew.gov.au/environment/marine/sea-dumping/dispose-co2.*
53. Beagley, J. (2022) Cradle to grave: the health harms of fossil fuel dependence and the case for a just phase-out.

https://climateandhealthalliance.org/wp-content/uploads/2022/07/Cradle-To-Grave-Fossil-Fuels-Brief.pdf. (accessed June 2026).
54. Chemnick,J. (2022) EJ communities are wary as CCS racks up policy wins, Climatewire (Sep. 7, 2022) *https://subscriber.politicopro.com/article/eenews/2022/09/07/ej-communities-are-wary-as-ccs-racks-up-policy-wins-00050896*.
55. Jacobson, M. Z. (2019) The health and climate impacts of carbon capture and direct air capture, 12. *Energy Environ. Sci. 3567 https://web.stanford.edu/group/efmh/jacobson/Articles/Others/19-CCS-DAC.pdf*.
56. Hillebrand, M., Pflugmacher, S., Hahn, A. (2016) Toxicological risk assessment in CO2 capture and storage technology, *International Journal of Greenhouse Gas Control* 55:118–143. .
57. Matthias, K., et al. (2011) Worst case scenario study to assess the environmental impact of amine emissions from a CO2 capture plant*, International Journal of Greenhouse Gas Control* 439–447.
58. Physicians for Social Responsibility (2022) Examining Carbon Capture Through A Public Health and Environmental Justice Lens (Apr. 8, 2022*) https://psr.org/resources/examining-carbon-capture-through-a-public-health-environmental-justice-lens/*.

Evaluate this resource

EDO welcomes feedback on this factsheet. Your feedback will help us ensure we are providing useful information.

If you have any concerns or suggestions regarding this factsheet, please fill out the EDO Science Resource Evaluation form by clicking here or scanning the QR code below: