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Carbon Capture and Storage - FAQ

POLICY BRIEF
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DISCLAIMER

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Introduction

Carbon Capture and Storage (CCS) has undeniably gained prominence in climate policy discourse in recent years. Thus arises a need for a common understanding of the topic and its implications – an understanding which must be rooted in empirical evidence and science-based assessments. CCS remains a polarising issue in no small part due to misunderstandings and misconceptions surrounding its use, related ownership models, business case, and climate value.

This brief addresses the most frequently asked questions regarding CCS, from the way that the technology operates to its effectiveness in mitigating CO_2 emissions, cost, and environmental risks. It aims to provide clear, transparent answers by building upon existing academic research and civil society expertise.

1/ What is CCS and how does it work?

“Carbon capture and storage” refers to the set of technologies designed to capture CO_2 at the point where it is produced, transport it and store it in suitable geological formations. In practical terms, CO_2 is captured before it can reach the atmosphere, where it would otherwise contribute to global warming. CCS can therefore be used to reduce the CO_2 emissions of specific economic activities.

CCS comprises of a range of technologies across the different parts of its value chain – capture, transport, and storage – each with distinct advantages and limitations. Their deployment is assessed case by case, balancing performance, cost, and technical, and geological and geographical constraints.[1]

The capture phase relies on technologies that separate CO_2 from other compounds, which are typically classified into three main categories.[2] The most common technology is post-combustion: CO_2 is captured from the flue gas stream resulting from fuel combustion or from the chemical processes associated with the treatment of carbon-containing raw materials. The second category is pre-combustion, where CO_2 is removed from the fuel or raw material before it is burned or processed. The third is oxyfuel combustion, in which oxygen is used in the combustion process to create a CO_2-rich gas stream.

All three capture methods create a separate CO_2 stream which can then be transported to a storage location by pipeline, ship, barge, rail, road or any combination of these. The choice of the transport mode depends on several factors, including the volume of CO_2 captured, the location of capture and storage sites, the distance between them. Physical constraints such as terrain and topography also influence the feasibility and the cost of different transport options.

The final step is storing the CO_2 underground by injecting it deep into suitable underground geological formations, typically at depths of around 1-3 km. These can be on- or offshore, with deep saline

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[1] One example would be in the capture stage: post-combustion capture technologies can be retrofitted to existing industrial installations, while oxy-fuel combustion may offer higher capture rates but requires more extensive modifications to the facility.

[2] Hanson, E. et al. (2025). Carbon capture, utilization, and storage (CCUS) technologies: Evaluating the effectiveness of advanced CCUS solutions for reducing CO2 emissions, Results in Surfaces and Interfaces, Volume 18, 100381, ISSN 2666-8459, https://doi.org/10.1016/j.rsurfi.2024.100381

aquifers representing the most widely available storage option. Other suitable structures include depleted oil or gas fields.[3] These formations typically consist of porous rock reservoirs where CO_2 can be stored, covered by impermeable caprock that acts as a seal and prevents upward migration of the gas. Properly selected and managed, these formations can securely store CO_2 indefinitely. Over time, the injected CO_2 becomes increasingly immobilised through a combination of trapping mechanisms, including residual trapping, dissolution into formation fluids, and, in some cases, mineralisation into solid carbonates.

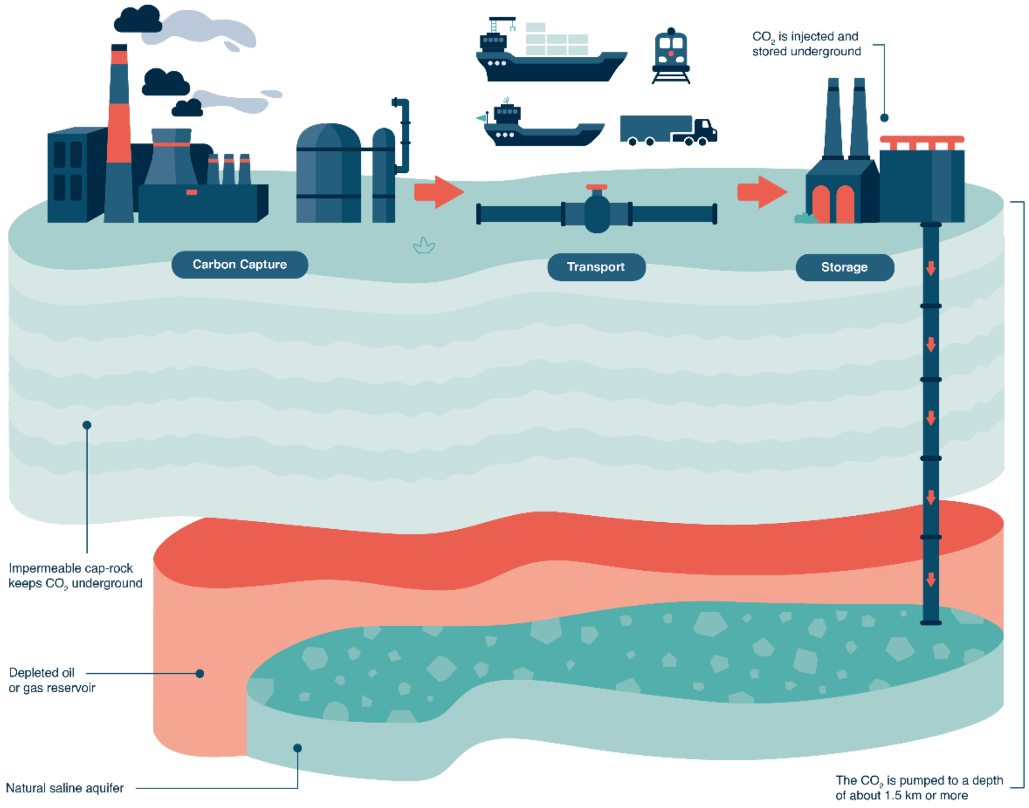

Figure 1: CO_2 capture, transport and storage value chain. Source: Bellona (2024)

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[3] White, C. M., Strazisar, B. R., Granite, E. J., Hoffman, J. S., & Pennline, H. W. (2003). Separation and Capture of CO2 from Large Stationary Sources and Sequestration in Geological Formations—Coalbeds and Deep Saline Aquifers. Journal of the Air & Waste Management Association, 53(6), 645–715. https://doi.org/10.1080/10473289.2003.10466206

2/ Is CCS an effective climate mitigation tool?

CCS can be an effective tool for reducing CO_2 emissions, particularly in sectors such as cement, steel and chemical production, and to a lesser extent waste incineration[4] where alternative mitigation options are limited. Current CO_2 capture technologies can achieve significant emission reductions of around 20-65% for steel, 60-75% for pulp and paper, and 50-90% for cement.[5]

However, CCS faces several constraints that affect its performance and deployment. The process requires significant infrastructure development across its value chain, particularly for transport and storage.[6] It is also energy-intensive, with CO_2 capture alone resulting in 10-40% higher energy consumption.[7] This "energy penalty" highlights the importance of powering CCS with renewable energy sources, so that the additional energy demand does not significantly reduce the net emissions reductions achieved.

To maximise the climate mitigation potential of CCS, these challenges must be addressed through careful system design and policy choices. This includes prioritising public support of its application in sectors with limited to no decarbonisation alternatives, ensuring access to low-carbon energy to minimise the energy penalty, and developing shared transport and storage infrastructure to improve efficiency and reduce associated costs. Robust site selection, regulatory oversight, and long-term monitoring are also essential to ensure the integrity of CO_2 storage. When these conditions are met, CCS can be an effective climate mitigation tool by delivering substantial and permanent CO_2 reductions.

Overall, CCS's deployment is constrained not by a lack of effectiveness, but by an uncertain business case: the cost of emitting CO_2 is not sufficiently internalised in the price of goods, leading to a situation where investing in capture and storage is often less economically attractive than continuing to emit.[8]

3/ Which decarbonisation alternatives other than CCS should be prioritised?

Decarbonisation pathways should prioritise solutions that deliver the largest emissions reductions at the lowest cost and highest energy efficiency. While CCS plays an important role, it is complementary to, rather than a substitute for, other decarbonisation tools.

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[4] A large share of municipal waste incinerated is recyclable, and many countries/regions already set clear targets to reduce reliance on incineration, e.g. specific targets for minimising the amount of waste incinerated. There are important distinctions between hazardous waste incineration, non-hazardous municipal waste incineration, and co-incineration. While hazardous waste streams may have more limited alternatives, non-hazardous waste incineration already faces structural overcapacity at EU level, and viable pathways exist to further reduce volumes through prevention, reuse, and recycling. (see more here: CCS-Ladder-2.0-report.pdf)

[5] D. Leeson, N. Mac Dowell, N. Shah, C. Petit, P.S. Fennell (2017). A Techno-economic analysis and systematic review of carbon capture and storage (CCS) applied to the iron and steel, cement, oil refining and pulp and paper industries, as well as other high purity sources, **International Journal of Greenhouse Gas Control**, Volume 61, Pages 71-84, ISSN 1750-5836, https://doi.org/10.1016/j.ijggc.2017.03.020

[6] Kim, T.W. et al. (2024). Review on carbon capture and storage (CCS) from source to sink; part 1: Essential aspects for CO2 pipeline transportation, **International Journal of Greenhouse Gas Control**, Volume 137, 104208, ISSN 1750-5836, https://doi.org/10.1016/j.ijggc.2024.104208

[7] Garcia, J.A. et al. (2022). Technical analysis of CO2 capture pathways and technologies, **Journal of Environmental Chemical Engineering**, Volume 10, Issue 5, 108470, ISSN 2213-3437, https://doi.org/10.1016/j.jece.2022.108470

[8] Dávila, J.G., Aagesen, M. (2024). How to accelerate CCS deployment in the Cement Industry? Assessing impacts of uncertainties on the business case, **International Journal of Greenhouse Gas Control**, Volume 137, 104197, ISSN 1750-5836, https://doi.org/10.1016/j.ijggc.2024.104197

A large share of emissions can be reduced through measures such as phasing out fossil fuels, increasing renewable energy deployment, electrification, improving energy and material efficiency, reducing demand for industrial goods, fuel switching and more. Many of these options are available at relatively low cost: all are under \$100/tCO_2, some even below \$20/tCO_2.[9]

Priority should be given to avoiding emissions altogether, then reducing energy and material demand, and deploying direct electrification and renewable energy solutions wherever possible. In many cases, these approaches are more efficient and cost-effective than CCS, as they eliminate emissions at the source rather than managing them after they are produced.[10]

CCS is most relevant in addressing emissions that cannot be avoided or reduced through these measures, particularly process emissions in heavy industry (e.g. cement, lime, or waste incineration), where CO_2 is released as a result of chemical processes that are inherent parts of production.[11]

Given the limited time to reach net zero, a coordinated approach is required: avoiding emissions where possible, while maximising emissions reductions through a combination of tools, while deploying CCS strategically where needed.

4/ What is the cost of CCS?

The cost of CCS varies widely across sectors and projects, primarily due to differences in capture conditions, infrastructure requirements, and scale. The capture process requires advanced materials and large amounts of energy, while transport and storage rely on extensive infrastructure, such as pipelines and offshore injection platforms. Taken together, these factors contribute to relatively high upfront capital costs (CapEx) compared to conventional industrial processes without CCS.[12]

The cost of CO_2 capture depends on the specific industrial application and technology used, as well as process-specific factors such as the volume of flue gas, CO_2 concentration, and required purity levels (which themselves depend on transport and storage specifications).[13,14]

Capture costs are typically estimated at \$40-120/tCO_2 for industrial processes such as cement and steel, \$20-35 for chemicals like ammonia and methanol and \$50-100 for power generation.[15]

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[9] IPCC (2022). Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926

[10] E3G, Bellona Deutschland, Carbon Capture and Storage Ladder 2.0, available at: https://de.bellona.org/publication/ccs-ladder-2-0/

[11] Ibid.

[12] Hanson, E. et al. (2025). Carbon capture, utilization, and storage (CCUS) technologies: Evaluating the effectiveness of advanced CCUS solutions for reducing CO2 emissions, Results in Surfaces and Interfaces, Volume 18, 100381, ISSN 2666-8459, https://doi.org/10.1016/j.rsurfi.2024.100381

[13] Rochelle, G. T. (2009). Amine scrubbing for CO_2 capture. Science, 325(5948), 1652–1654. https://doi.org/10.1126/science.1176731

[14] IEAGHG. (2017). Techno-economic evaluation of CO_2 capture from industrial sources (Report No. 2017-02). International Energy Agency Greenhouse Gas R&D Programme.

[15] IEA (2021), Is carbon capture too expensive?, IEA, Paris https://www.iea.org/commentaries/is-carbon-capture-too-expensive

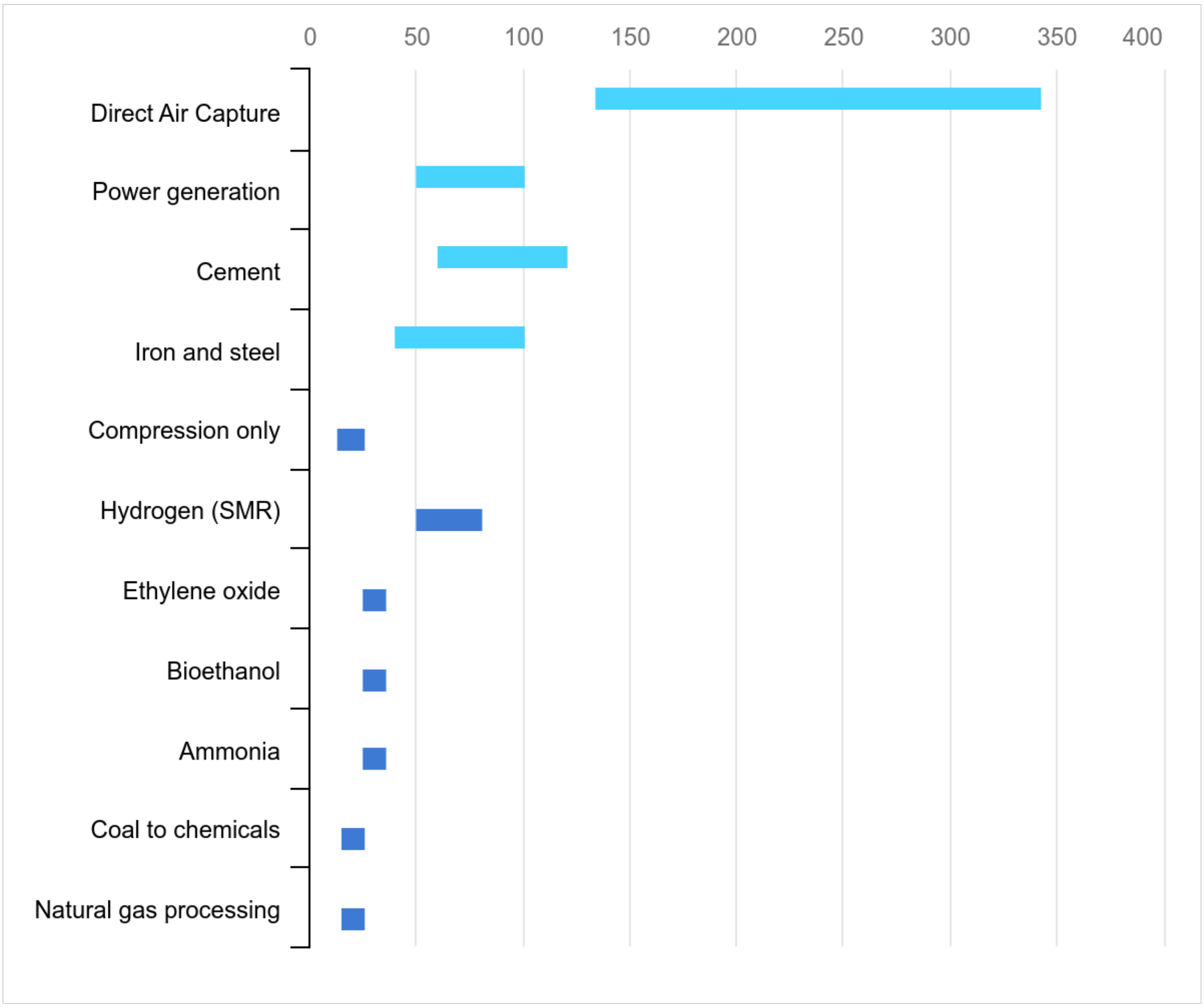

Figure 2: Levelised cost of CO_2 capture by sector and initial CO_2 concentration. Source: IEA (2021)

The costs of CO_2 transport and storage vary based on factors such as the location and characteristics of the storage site, as well as the mode of transport. One study estimates the combined CO_2 transport and storage costs in Europe to range from \$15-35/tCO_2[16] depending on distance, scale, and the selected storage site. Another assessment, which factors in cost overruns of real-world projects exposed to inflation, public policy, and financing issues, estimated a much higher cost range of €80-100/tCO2 (\$94-117) for offshore CO_2 storage.[17] Storage costs alone are often lower, with the Global CCS Institute (GCCSI) having published ranges of \$2–15/tCO_2 for onshore storage and \$5–30/tCO_2 for offshore storage, al-

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[16] Smith, E. et al. (2021). The cost of CO2 transport and storage in global integrated assessment modeling, International Journal of Greenhouse Gas Control, Volume 109, 103367, ISSN 1750-5836, https://doi.org/10.1016/j.ijggc.2021.103367

[17] Agora Industrie (2026), Carbon Capture and Storage (CCS) in der Energiewende zur Klimaneutralität, available at: https://www.agora-industrie.de/fileadmin/Projekte/2023/2023-31_IND_Carbon_Management/394_A-IND_OekoInst_CCS-in-der-Energiewende_WEB.pdf

though higher costs are possible in less favourable conditions.[18] Following injection, storage sites require ongoing monitoring to ensure containment, which is a standard component of CO_2 storage projects and typically represents a relatively small portion of the overall cost.[19]

However, these relatively high costs do not necessarily translate into equally large increases in the price of end products. This is because the cost of raw materials typically represents only a limited share of the final product price, which is often determined more by labour, construction and other value chain costs.[20] One case study found that, while CCS substantially increased the production cost of cement and pulp, it only increased the cost of certain end-products by 1-5% while reducing CO_2 emissions by 30%.[21] Another case study found similar results for cement and steel: only a 1% price increase of the end-product with a 51% reduction in CO_2 emissions.[22]

Overall, while CCS involves relatively high upfront costs, these are highly context-dependent and tend to decrease with scale, infrastructure development, and experience. Importantly, the impact on final product prices is often limited, meaning CCS can deliver substantial emissions reductions without significantly increasing costs for consumers.

5/ Does CCS entail risks for the environment and human health?

As with all industrial activities, CCS will have environmental impacts associated with water usage, air emissions and land-use. The environmental impacts of CCS projects are managed through national Environmental Impact Assessments and environmental permitting procedures. The decision to develop a CCS project will involve a trade-off between localised environmental impacts versus the expected reduction in global warming potential realised through the project.[23] The specific environmental impacts of CCS vary across the specific application and technologies used. [24]

Post-combustion capture technologies, particularly those based on amine solvents, can result in the release of chemical compounds such as amines and their degradation products, some of which may have environmental or health implications. These risks are generally considered manageable with appropriate controls but require monitoring and regulation to ensure they remain within acceptable limits.[25,26]

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[18] GCCSI (2025), Cost of CO_2 storage, Global CCS Institute, available at: https://www.globalccsinstitute.com/wp-content/uploads/2025/12/Cost-of-CO2-Storage-1225.pdf

[19] IEAGHG. (2020). Monitoring and modelling of CO_2 storage: The potential for improving cost efficiency and reducing uncertainty. International Energy Agency Greenhouse Gas R&D Programme. https://ieaghg.org/publications/monitoring-and-modelling-of-co2-storage/

[20] Moya, J.A, Boulamanti, A. (2016). Production costs from energy-intensive industries in the EU and third countries, Joint Research Centre, EUR27729EN, doi:10.2790/056120

[21] Emanuelsson, A. Johnsson, F. (2022). The cost of CCS - a product chain analysis of the cement and pulp industries, Proceedings of the 16th Greenhouse Gas Control Technologies Conference (GHGT-16) http://dx.doi.org/10.2139/ssrn.4280350

[22] Subraveti, S.G. et al. (2023). Is Carbon Capture and Storage (CCS) Really So Expensive? An Analysis of Cascading Costs and CO2 Emissions Reduction of Industrial CCS Implementation on the Construction of a Bridge, Environmental Science & Technology 57 (6), 2595-2601 DOI: 10.1021/acs.est.2c05724

[23] Zapp, P., et al. (2012). Overall environmental impacts of CCS technologies—A life cycle approach, International Journal of Greenhouse Gas Control, 8, 12-21. https://doi.org/10.1016/j.ijggc.2012.01.014

[24] Intergovernmental Panel on Climate Change. (2005). IPCC special report on carbon dioxide capture and storage. Cambridge University Press. https://www.ipcc.ch/report/carbon-dioxide-capture-and-storage/

[25] IEAGHG (2012), Gaseous emissions from amine based PCC processes and their deep removal, available at: https://ieaghg.org/publications/gaseous-emissions-from-amine-based-post-combustion-co2-capture-processes-and-their-deep-removal/

[26] Rochelle, G. T., Chen, E., Freeman, S. A., Van Wagener, D. H., Xu, Q., & Voice, A. K. (2024). Air pollution impacts of amine scrubbing for CO_2 capture. Carbon Capture Science & Technology, 10, 100176. https://doi.org/10.1016/j.ccst.2024.100176

The transport phase presents relatively well-understood risks as well. While accidental CO_2 leaks may reduce mitigation effectiveness and pose local safety concerns, particularly at high concentrations, these risks are can be mitigated and managed through appropriate design, routing, and regulation.[27,28,29]

The storage phase involves potential long-term risks, including leakage and pressure-related effects. These risks are highly dependent on site-specific conditions and the quality of project design and oversight. CO_2 injection modifies subsurface conditions, making thorough assessment and long-term monitoring essential to ensure storage integrity. In recent decades a considerable number of pilot, demonstration and industrial scale CO_2 storage projects have resulted in a wealth of experience in CO_2 injection, predictive modelling, pressure control and monitoring.[30] To this date, there have been no indications of catastrophic leakage events at CO_2 storage sites worldwide.

In the event of such a leakage, CO_2 entering groundwater can alter its chemistry, potentially affecting water quality and local ecosystems. However, such impacts are generally site-specific and can be kept low through careful site selection and management, and CO_2 will not necessarily reach shallow groundwater, as upward migration depends on site-specific conditions and the presence of viable pathways.[31,32] CO_2 injection can also increase subsurface pressure and, in some cases, induce seismicity. Such events are typically small in scale when properly managed and monitored

In the EU, the CO_2 Storage Directive establishes a comprehensive regulatory framework for the safe and responsible deployment of geological CO_2 storage. It sets minimum requirements for site selection, operation, and closure to ensure that risks to human health and the environment, including the risk of CO_2 leakage, are minimised. The Directive also establishes a liability mechanism for storage operators.[33] In addition, its extensive guidance documents support project developers in identifying and managing suitable storage sites.[34]

6/ What is the difference between CCS and CDR?

Carbon Dioxide Removal (CDR) and CCS are often misunderstood or conflated, particularly in policy discussions on approaches to climate mitigation. While there is some technical and functional overlap, it is important to clearly distinguish between them in order to accurately assess their respective climate benefits and design appropriate policy frameworks to regulate them.

CCS reduces emissions by capturing CO_2 at the point where it is produced before it enters

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[27] Intergovernmental Panel on Climate Change. (2005). IPCC special report on carbon dioxide capture and storage. Cambridge University Press. https://www.ipcc.ch/report/carbon-dioxide-capture-and-storage/

[28] Texas A&M Energy Institute. (2025). CCS safety and efficacy study. https://energy.tamu.edu

[29] Chrysostomidis, I., & colleagues. (2013). CO_2 pipeline systems: Assessment of risks and health implications. Institution of Chemical Engineers.

[30] Alsubaih, A., Sepehrnoori, K., Mojdeh, D., Alberto Lopez, M. A comprehensive review of CO2 subsurface storage: Integrity, safety, and economic viability, Energy Geoscience, Vol 6 (3). https://doi.org/10.1016/j.engeos.2025.100441

[31] Mortezaei, K. Amirlatifi, A. Ghazanfari, E. Vahedifard, F. (2021), Potential CO2 leakage from geological storage sites: advances and challenges, Environmental Geotechnics, Vol. 8 No. 1 pp. 3–27, doi: https://doi.org/10.1680/jenge.18.00041

[32] Birkholzer, J. T., Nicot, J. P., Oldenburg, C. M., Zhou, Q., Kraemer, S., & Bandilla, K. (2011). Brine flow up a well caused by pressure perturbation from geologic carbon sequestration. Environmental Science & Technology. https://doi.org/10.1016/j.ijggc.2011.01.003

[33] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide, available at: https://eur-lex.europa.eu/eli/dir/2009/31/oj/eng

[34] European Commission: Directorate-General for Climate Action. (2025). Guidance document 1 : CO2 storage life cycle and risk management framework. Publications Office of the European Union. https://data.europa.eu/doi/10.2834/9476302.

the atmosphere, whereas CDR refers to a broader set of technologies and practices that remove CO_2 (indirectly or directly) from the atmosphere and store it durably. This reduces the concentration of CO_2 in the atmosphere, thereby helping to reduce warming and associated climate impacts.

Certain CDR approaches use some of the same technologies as those used in CCS projects for CO_2 capture, transport and storage. This is the case for Biomass conversion with Carbon Capture and Storage (BioCCS) and Direct Air Carbon Capture and Storage (DACCS), for example.[35] Both methods require CO_2 transport and storage infrastructure to move CO_2 to permanent storage sites, and their deployment is expected to increase after 2050 according to IPCC scenarios.[36] This highlights that deploying CO_2 transport and storage infrastructure will be important in the medium term for enabling emissions reductions through CCS, and in the longer term for supporting carbon dioxide removals.

Before net zero is reached, CDR can complement emission reductions and help accelerate climate mitigation. Given current emission trends and the likelihood of overshooting global temperature targets, the IPCC estimates that CDR may actually play a substantial role in reaching net-zero by balancing out residual CO_2 and non-CO_2 GHG emissions.[37] Once net-zero has been achieved, CDR should be used to bring annual GHG emissions to a "net negative" to draw down global temperatures and reach the Paris Agreement goals, according to the IPCC integrated assessment models.[38]

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[35] Oh, S., Greene, J., Honegger, M. et al. (2025). Review of Economics and Policies of Carbon Dioxide Removal. Curr Sustainable Renewable Energy Rep 12, 6. https://doi.org/10.1007/s40518-025-00252-1

[36] IPCC (2022). Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926

[37] Ibid.

[38] IPCC (2021) Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3–32, doi:10.1017/9781009157896.001

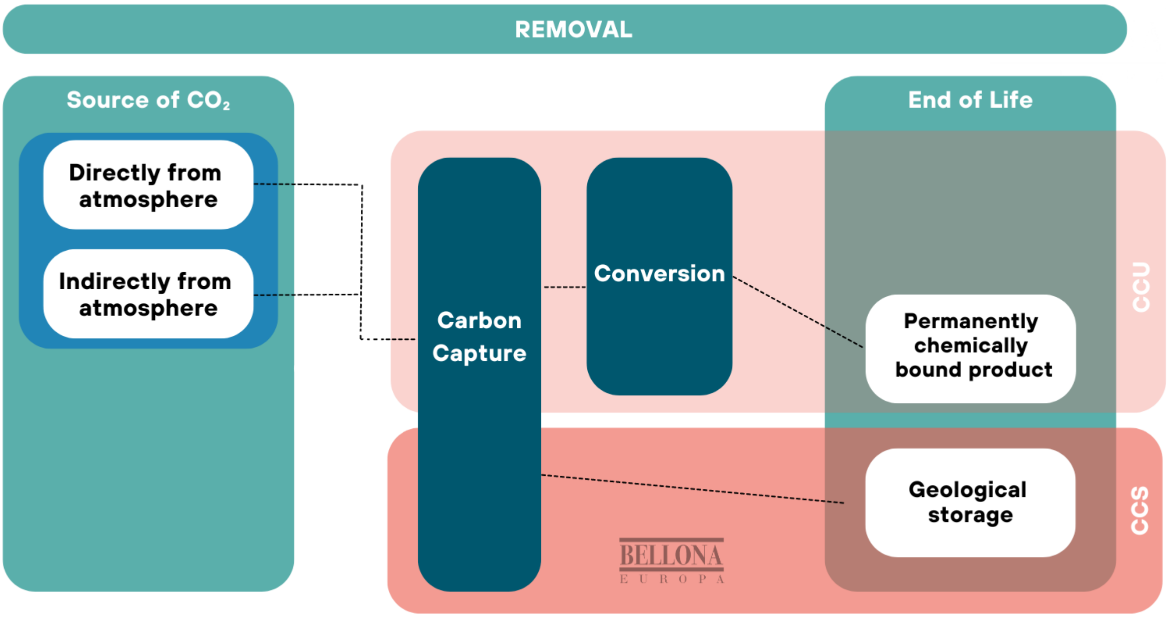

Figure 3: CO_2 pathways that result in its removal from the atmosphere. Source: Bellona (2024)

7/ Is CCS technology developed by oil & gas companies?

CCS is not developed by a single type of actor or sector. Rather, each element of its value chain – capture, transport and storage – relies on distinct technologies, tools and processes developed and operated by a range of players. While oil and gas companies are particularly active in transport and storage, many other actors, including industrial companies, technology providers, and Transmission System Operators (TSOs), develop and deploy CCS technologies across the value chain.

CCS is often associated with the oil and gas sector, not only because of the sector's role in CO_2 transport and storage today, but also due to the historical use of CCS in enhanced oil recovery (EOR). Its first commercial application, in 1972 in Texas (USA), involved injecting CO_2 into oil reservoirs to boost oil extraction.[39] CCS was therefore not originally developed as a climate mitigation tool.

Since the mid-1990s, CCS has increasingly been deployed with the explicit aim of reducing CO_2 emissions, starting with projects such as the Sleipner CO_2 storage project in Norway, which captures and stores emissions from gas processing.[40] CCS projects in Europe today

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[39] Donaldson, E. C., Chilingarian, G. V., & Yen, T. F. (Eds.). (1989). Enhanced oil recovery, II: Processes and operations. Elsevier.

[40] Evar, B., Armeni, C., & Scott, V. (2012). An introduction to key developments and concepts in CCS: history, technology, economics and law. In The Social Dynamics of Carbon Capture and Storage (pp. 18-30). Routledge.

share this climate mitigation goal but have broadened their focus to include other industries like cement and waste processing where the technology plays a key role in reducing emissions that are otherwise difficult to abate.

This helps explain why many of the companies with experience in deploying CCS (e.g. Equinor, ENI, Shell, Air Liquide) have historically originated from the oil and gas sector.[41,42] This is also due to the significant technological overlap between CCS and existing oil and gas activities, particularly in CO_2 transport and storage where these industries have extensive experience and expertise in subsurface operations. This expertise is one of the reasons why the Net Zero Industry Act obliges oil and gas producers in particular to contribute to the deployment of CO_2 injection capacity in the EU.[43] However, many oil and gas producers have expressed opposition to this obligation and are actively contesting it in court.[44]

Although the share of oil and gas companies in the CCS ecosystem is decreasing, they remain involved in a large proportion of both historical and current CCS projects, including in Europe where they are active mainly in the CO_2 transport and storage part of the value chain.[45] Some notable projects are Northern Lights in Norway,[46] Ravenna in Italy[47] and Porthos in the Netherlands.[48]

Capture projects, on the other hand, are typically operated by specialised technology providers on behalf of CO_2 emitters or, less frequently, by the emitters themselves.

In recent years, a growing number of startups specialising in specific parts of the CCS value chain, often focusing on capture technologies, have emerged. Many are backed by venture capital or private equity, while some have also received investment from, or been acquired by oil, gas and chemical companies seeking to integrate new technologies into their CCS activities.[49]

8/ How much CO_2 can be stored in Europe?

CO_2 storage potential is typically classified according to its level of operability. The first and broadest category is the theoretical storage resource, which refers to the total volume of CO_2 that could potentially be stored in suitable geological formations. The second and more rep-

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[41] GCCSI (2025), State of the art: CCS technologies 2025, Global CCS Institute, available at: https://www.globalccsinstitute.com/wp-content/uploads/2025/08/State-of-the-Art-CCS-Technologies-2025-Global-CCS-Institute.pdf

[42] Some of the largest players are: Exxon Mobil, Shell, Chevron, Schlumberger, Baker Hughes, Mitsubishi Heavy Industries, Linde, Air Liquide represent the seasoned players. Emerging Startups: Carbon Engineering, Climeworks, Carbon Clean, Global Thermostat, and Carbon Capture Inc. (source)

[43] Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem, available at: https://eur-lex.europa.eu/eli/reg/2024/1735/oj/eng

[44] Carbon Balance Initiative, Fossil giants fight to avoid accountability, leaving Europe's industry to face the consequences, available at: https://www.carbon-balance.earth/blogs-updates/press-release-big-oil-lawsuits

[45] Clean Air Task Force, Europe Carbon Capture Activity and Project Map, available at: https://www.catf.us/ccsmapeurope/

[46] Northern Lights, Who we are, available at: https://norlights.com/who-we-are/

[47] Ravenna CCS, Our activities in Ravenna, available at: https://ravennaccs.com/en-IT/project/ravenna-hub

[48] Porthos, CO_2 reduction through storage under the North Sea, available at: https://www.porthosco2.nl/en/

[49] It should be noted that most of these startups operate outside of Europe. Based on our research, around a third of them have received at least partial investments from oil and gas companies. On the other hand, a small number of European projects are supported by the Horizon Europe fund for research or other public entities.
Examples:
- CarbonOrO: CarbonOrO closes € 4.1 Million Series A Round
- Cool Planet Technologies Secures €23.7M To Expand Carbon Capture Tech

resentative category is Technically Accessible Storage Resource (TASR), which represents the share of this potential that can be accessed using current technologies, regardless of cost potential.[50]

Using this second framework, geological surveys conducted in 2014 under the CO2StoP project across the EU, United Kingdom (UK) and Norway, estimated a total storage capacity around 1000 $GtCO_2$, of which a significant share (250 $GtCO_2$) is located in the UK and Norway.[51] This corresponds to over 300 years of the current total EU CO_2 emissions, for which only a fraction is proposed to be captured via CCS.[52] However, only a portion of this storage potential is expected to be technically and economically accessible.

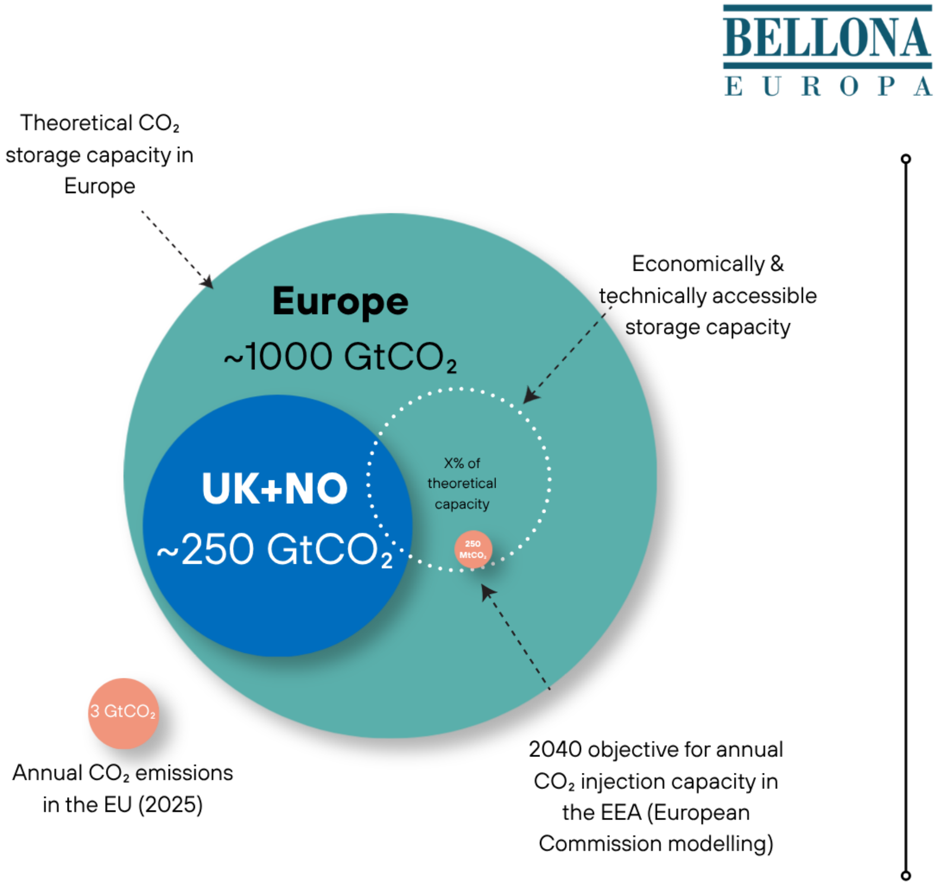

Figure ': CO_2 storage potential in Europe. Source Bellona Europa 2026

A more detailed technical assessment is then required to determine whether a geological formation can be developed for CO_2 storage, and to what extent. This process is reflected in a site's Storage Readiness Level (SRL), which indicates how close a storage site to becoming operational: higher SRL levels correspond to more advanced stages of development.[53] However, progressing through these stages – from site characterisation and permitting to

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[50] Burruss, R. C., Brennan, S. T., Freeman, P. A., Merrill, M. D., Ruppert, L. F., Becker, M. F., ... & Schenk, C. J. (2009). Development of a probabilistic assessment methodology for evaluation of carbon dioxide storage. US Geological Survey Open-File Report, 1035(2009), 81

[51] Poulsen, N., Holloway, S., Neele, F., Smith, N. A., & Kirk, K. (2014). CO2StoP Final Report. Assessment of CO2 storage potential in Europe. European Commission Contract No ENER/C1/154-2011-SI2.611598. GEUS. Danmarks og Grønlands Geologiske Undersøgelse Rapport Vol. 2014 No. 56 https://doi.org/10.22008/gpub/30624

[52] EEA (2025). Total net greenhouse gas emission trends and projections in Europe, European Environmental Agency, available at: https://www.eea.europa.eu/en/analysis/indicators/total-greenhouse-gas-emission-trends

[53] Akhurst, M., Kirk, K., Neele, F., Grimstad, A. A., Bentham, M., & Bergmo, P. (2021). Storage Readiness Levels: communicating the maturity of site technical understanding, permitting and planning needed for storage operations using CO2. International Journal of Greenhouse Gas Control, 110, 103402

construction and operation – is a lengthy process that can take years to decades.

As of 2021, no storage project in the EU or UK had yet reached full readiness (SRL 9) [54] Since this 2021 assessment, the Ravenna CCS Hub has begun storing CO_2 in 2024.[55] Based on current project announcements, total injection capacity in Europe could reach close to 120 $MtCO_2$/year by 2030, although the realisation of this capacity remains uncertain and will depend on project development and the speed of permitting.[56]

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[54] Online Pan-European Atlas of Sustainable Geo-Energy Capacities, available at: https://maps.europe-geology.eu/#baslay=baseMapGEUS&extent=144266.63376999553,806125.1013003206,7831038.9015283715,4536943.440463382&layers=gseu_co2_atlas_tr_v3&filter_0=srl.multi%3D%26period_min_res.multi%3D%26country.multi%3D

[55] Ravenna CCS, Our activities in Ravenna, available at: https://ravennaccs.com/en-IT/project/ravenna-hub

[56] Clean Air Task Force, Tracking CO_2 storage project capacity in Europe, available at: https://www.catf.us/carbon-capture/storage-project-capacity-europe/

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Bellona Europa is an independent, non-profit organisation that meets environmental and climate challenges head-on. We are result-oriented and have a comprehensive and cross-sectoral approach to assess the economics, climate impacts and technical feasibility of necessary climate solutions. To do this, we work with civil society, academia, governments and polluting industries.