HORIZON RESULTS BOOSTER

Better Carbon Capture for Industrial Emissions

Enhancing CCUS in Europe in support of the Paris Agreement

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Executive Summary

CO_2 Capture, Utilisation and/or Storage (CCUS) technologies are essential for the decarbonisation of industry. However, the deployment of full-chain CCUS, which must also include CO_2 transport, is influenced by international, national and regional legal and regulatory frameworks. These affect the costs of CCUS so policy must be appropriately designed to financially incentivise large-scale deployment.

This policy brief therefore argues that national climate strategic targets of all countries should be aligned to the goals of the Paris Agreement, and CCUS technology should be included in the list of technological priorities together with renewables and other decarbonisation options in the national regulation of each country. Additional CCUS regulations and political incentives, as well as national, industrial and EU financial support, are needed to initiate and support large-scale CCUS projects.

Educational and public awareness activities are needed in all European countries, supported by academic and research institutions and media outlets to explain the benefits of climate change mitigation options.

Geological storage sites in Southern Europe must be further characterised to assess their capacity to accept large quantities of CO_2 and their ability to effectively and safely store it on a long timescale, thereby demonstrating project economic feasibility and ability to meet demand.

This brief is geared towards policymakers at national and European Commission level, involved with designing national and international policies related to CCUS, as well as research funding organisations.

Four key recommendations are identified in this brief:

- The political framework: Raise awareness among relevant government ministries of the importance of global CCUS deployment where national implementation and ratification of the London Protocol amendment must be made a near-term priority. The European Commission should encourage national policymakers to implement these recommendations.
- Clear definitions: Characterise geological storage sites in all Member States and in particular in Southern Europe.
- A practical roadmap to realise CCUS ambitions: Make provisions for practical implementation of CCUS.
- Fair competition and access: EU Member States should be required to adopt technology neutral support, i.e. broaden the support to all technologies that reduce emissions.

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1 Background

Energy intensive industries are major greenhouse gas emitters, with cement, steel and refineries together accounting for almost 20% of anthropogenic CO_2 emissions worldwide. CCUS technologies are scientifically recognised as essential tools for abatement of CO_2 emissions, that work by separating CO_2 from industrial point sources, then transporting it by pipeline, road tanker, rail or ship, to appropriate geological sites for long-term storage or, alternatively, utilising it as a feedstock for different industrial processes. Notably, the current demand for CO_2 utilisation is relatively small (~37 $MtCO_2$/yr in Europe) and is expected to remain so in the short term,[1] so developing geological storage sites for CO_2 is essential. Numerous credible studies and reports, including those of the Intergovernmental Panel on Climate Change, have demonstrated the essential role of CCUS for providing the lowest cost decarbonisation pathway.

While several CO_2 capture technologies have reached market maturity and various projects are aiming to decrease CO_2 capture costs, further developments are needed in the characterisation and evaluation of the geological subsurface, especially in the south of Europe, and regulations and agreements at international level are required to enable operation across the whole CCUS chain and facilitate cross-border CO_2 transportation. The commitment from both political institutions and industry must be shared.

At the international level, major regulations and their impact on CCUS are discussed below.

1 www.iea.org/reports/putting-co2-to-use

1.1 Transportation across Member States

International conventions dealing with transboundary shipments of CO_2 include:

- The London Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, which provides the precautionary framework needed for parties to effectively prevent pollution of the sea caused by dumping of waste and other matter, incineration, and new activities such as marine geoengineering or uncontrolled carbon capture and storage.
- The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention, 1992), which is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the North-East Atlantic Policy challenges.
- The Trans-European Networks for Energy (TEN-E), which is a central EU regulation that focuses on the development of cross-border European energy infrastructure and provides guidelines for the selection of Projects of Common Interest (PCIs).

The London Protocol was amended in 2009 to enable cross-border CCS projects, however the amendment must be ratified by two-thirds of contracting parties to enter into force. Given the required number of ratifications and difficulties associated with the ratification process, not enough contracting parties have ratified the amendment. This resulted in a deadlock until October 2019 when a formal agreement was reached to allow provisional application of the 2009 amendment of the protocol, thereby enabling transboundary movement of CO_2 for offshore geological storage. Countries who would like to export or receive CO_2 for geological storage[2] must provide a declaration of provisional application and notification of any agreements or arrangements to the International Maritime Organization (IMO).

1.2 Storage

Potential CO_2 storage capacity in Europe is large, with a total conservative estimate of 134 Gt,[3] after taking into account restrictions in place in some Member States. The large majority of potential storage sites have been identified in offshore saline aquifer formations and depleted oil and gas fields which are often inherently suitable for CO_2 storage, including several locations in Southern Europe (see Figure 1). This potential, if fully used, would be more than sufficient to meet the annual targets of 300 Mt of CO_2 captured and stored by 2050, identified by the European Commission in the 1.5 TECH Scenario. Currently only a small portion of CO_2 storage sites are being made available, and they are located in the North Sea, with a total capacity of about 1.25 Gt of CO_2.

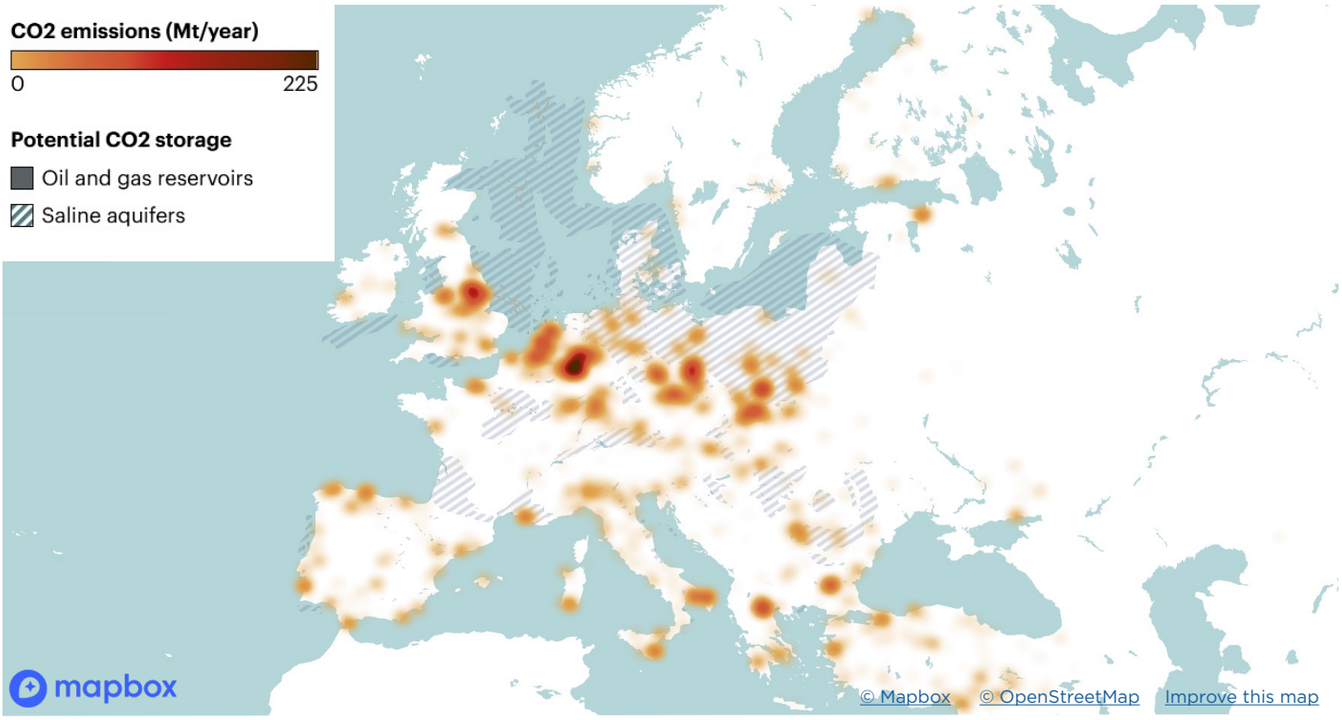
2 www.imo.org/en/MediaCentre/MeetingSummaries/Pages/LC-41-LP-14-.aspx

3 ec.europa.eu/info/sites/default/files/iogp_-_report_-_ccs_ccu.pdf

Strict and comprehensive monitoring procedures must be in place to prevent leakage of CO_2 from geological storage for safety, ecological and economical benefit and to inform the communities and avoid public concern.

The Directive 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide ('CCS Directive') establishes a legal framework for the environmentally safe geological storage of CO_2. The CCS Directive aims to ensure that there is no significant risk of leakage of CO_2 or damage to health or the environment, and to prevent any adverse effects on the security of the transport network or storage sites. The CCS Directive has amended six existing EU Directives in order to protect the environment and human health from the risks connected to geological storage of CO_2. As a result, capture and transport of CO_2 streams are covered by national instruments regulated by the Environmental Impact Assessment (EIA) Directive and Industrial Emission Directive. In addition, there are regulations in place at various federal and state levels, which could enable, but in many cases would complicate or prohibit, pipeline transport and geological storage in certain areas.

Figure 1.
CO_2 emissions sources and potential geological storage in Europe



IEA, Raimund Malischek, Samantha McCulloch (2021) The world has vast capacity to store CO_2: Net zero means we'll need it, https://www.iea.org/commentaries/the-world-has-vast-capacity-to-store-co2-net-zero-means-we-ll-need-it.

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

2 Recommendations

This brief highlights the challenges and barriers to the inclusion of CCUS technology in the list of technological priorities, together with renewables and other decarbonisation options, in the national regulation of each country. The recommendations below provide an overview of the areas for further investments and actions, together with a list of practical steps required from policymakers to implement CCUS technologies and thereby support achieving Paris Agreement targets.

2.1 Cross-border CO_2 transport: provisional application and ratification of the London Protocol amendment

For nations with ambitions of deploying CCUS projects with a transboundary element, a focus on national implementation of the London Protocol is needed. National policymakers and regulators must support CCUS projects by arranging the necessary agreements and notifying the IMO. This is particularly important for advanced stage European projects so the European Commission should urge Member States to ratify the London Protocol amendment and expedite its provisional application as a near-term priority. Additionally, all modes of transport for CO_2 should be acknowledged in the CCUS policy framework enabling all industries across Europe to connect to the CCUS infrastructure. To do this, the TEN-E regulation and the EU ETS Directive should be revised to enable the use of shipping and road transport to achieve a multimodal approach for CO_2 transport across countries and allow all emitters to access storage sites.

2.2 Clear definitions and characterisation of storage sites

The recommendations for CO_2 storage listed below should not be evaluated as a standalone topic, but have to be considered together with CO_2 capture and transport as a holistic system under ecological, economical, safety, and political aspects. Positive and negative experiences with other successfully running or abandoned comparable CCUS projects have to be consulted. The importance of CO_2 storage as part of the CO_2 infrastructure for funding of CCUS projects should also be acknowledged.

The CCS Directive should be integrated with simple and clear technical authorisation steps, uniform at the EU level, which define at least the preliminary steps to be taken to start the authorisation process for CO_2 storage combined with CO_2 capture and transport.

There is a need for site specific characterisation of storage sites in particular in Southern Europe.[4] Here, the regions of interest range from the direct vicinity of potential injection wells to the whole reservoir complex, including all relevant reservoir and caprock layers. Given regional characteristics, such as tectonic and volcanic settings, have to be taken into account together with constraints by the legislation applicable in the region of interest.

Developing and implementing site specific monitoring programmes for relevant parameters on different scales in time and space is key for a better understanding of the dynamic system, to control the storage performance, to ensure safety and enhance public acceptance.[5] Establishing reliable baselines and performing an adequate uncertainty analysis should be part of each programme. The CO_2 storage liability should be shared with authorities because it cannot be fully carried by the private sector.

Computational modelling should be employed through the whole life-cycle of the project to confirm usability of a specific storage site, assess storage capacity, test injection strategies and mitigation approaches, compare with operational data, provide data for the discussions with stakeholders, and provide understandable information to the public.

2.3 Take steps for the practical implementation of CCUS

Realising the implementation of CCUS and its integration in clusters is vital. To enable a more coherent and sound policy landscape for CCUS, awareness should be raised among relevant government ministries and other political stakeholders about the importance of global CCS deployment. This includes improving the understanding of the essential role of CCUS in reaching national decarbonisation targets and its application in each country and globally, as well as obtaining governmental support for the technology.

4 www.globalccsinstitute.com/wp-content/uploads/2020/01/Consoli_Global-CCS-Institue_2015_Global-Storage-Portfolio-1.pdf

5 IEA GHGH Technical Report 2020-01. Monitoring and modelling of CO_2 storage: The Potential for Improving the Cost-Benefit Ratio of Reducing Risk. IEA GHG R&D Programme, February 2020.

Furthermore, the policy framework should ensure adequate carbon pricing, alongside suitable business models, including operational subsidies, to incentivise CCUS and ensure sufficient investments and stakeholder buy-in. Stakeholder buy-in further extends to ensuring public acceptance of CCUS technologies and clusters. There is also a need for adapting public procurement mechanisms to overcome the lack of demand for low-carbon products. As such, policymakers need to jointly work towards societal acceptance, ensured through a coherent policy landscape.

There are a few key steps that can be followed to ensure a successful roadmap towards implementing CCUS:

- Develop a clear view on the need for CCUS (i.e. system modelling studies, economic benefits, jobs retention, avoidance of 'carbon leakage' etc.).
- Implement business models and associated policies to support CCUS in consultation with industry.
- Define a common clean industrial products certification system that tracks and charges CO_2 emissions calculated over the life cycle of products and energy sources.
- Provide funding for demonstration and deployment of full-chain CCUS projects.
- Work on societal readiness to engage public communities and make them feel part of the CCUS strategy.

2.4 Fair competition and access

Member States should be required to adopt technology neutral supports, i.e. broaden the support to all technologies that reduce emissions. This is the approach currently in place in the Netherlands and UK.

This could be achieved by providing support for CCUS clusters in identified high industrial emissions zones to enable them to accelerate decarbonisation. Support for CCUS clusters would be ensured by adopting a multiplier for initial funding in areas where subsequent projects could avail of the infrastructure in the future. The UK is progressing this approach to good effect.

This could be tied to the provision of the infrastructure for permanent storage of CO_2 to enable the future capture and storage of CO_2 that would lead to negative emissions (i.e. through application of bio-energy or direct air capture combined with CCS) which needs to be done at scale according to IEA.

Non-discriminatory and fair market rules would also be covered by such an approach, especially when linked to requirement for a full economic assessment of technologies particularly in the power industry, e.g. Enhanced Levelised Cost of Electricity assessment, where it is used, presents a fairer comparative cost of renewable electricity production.

Project Group

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