



16th International Conference on Greenhouse Gas Control Technologies **GHGT-16**

23-27th October 2022, Lyon, France

Legal and Regulatory gaps for carbon dioxide capture, transport, and storage deployment

Linda Frattini^a, Viola Becattini^a, Marian Krüger^b, Oliver Akeret^b Marco Mazzotti^{a*}

^a*Institute of Energy and Process Engineering, ETH Zurich, 8092 Zurich, Switzerland*

^b*Group for Sustainability and Technology, Department of Management, Technology and Economics, ETH Zurich, 8092 Zurich, Switzerland*

Abstract

Carbon capture and storage (CCS) is an emerging technology in Europe. Several industries and European Member States are collaborating to enhance CCS pathways, connecting carbon dioxide (CO₂) sources mostly from inland Europe to storage hubs, which are currently being developed in areas such as the North Sea, e.g., in Norway and Iceland. International and European legislation and regulations have already engaged in clearing the path for CCS deployment, but there are still some aspects to be addressed. This contribution aims at providing the CCS community with an overview of the international and European legal and regulatory landscape relevant to the large-scale deployment of CCS.

Keywords: Carbon capture; carbon storage; legal analysis; regulatory gaps.

Introduction

The scientific community recognises the key role that CCS systems will play as part of the efforts to either mitigate emissions today (from industrial plants, power plants, waste treatment plants) or to enable negative emissions in the future [1].

Several initiatives are being developed by companies in Europe with a certain degree of institutional support, such as the CO₂ transport infrastructure in Germany by Open Grid Europe (OGE) [2], the Coda Terminal, a large-scale CO₂ transport and storage hub in Iceland that will be built by Carbfix (which was selected for a grant award from the European Innovation Fund) [3], and a transport and storage infrastructure in Norway that is being developed by Northern Lights [4]. Furthermore, there are also research and innovation initiatives, among which is the ACCSESS project, that is executed by a broad consortium of 18 industry partners and research organisations, funded by the

*Marco Mazzotti. Tel.: +41-44-632-2456, E-mail address: marco.mazzotti@ipe.mavt.ethz.ch

European Union's Horizon 2020 programme, and dedicated to contributing to the European Green Deal strategy by developing replicable carbon capture utilisation and storage (CCUS) pathways toward a Climate Neutral Europe in 2050. [5]

Among other objectives, the ACCSESS project focuses on developing, designing, and evaluating four optimal pioneering CCS chains linking four CO₂ emitters that have expressed the willingness to implement CCS as early movers to a storage site. As shown in Figure 1, these are one inland waste-to-energy plant (in Switzerland), two inland cement plants (in Germany and Poland) and one pulp and paper mill plant (in Sweden). For these four emitters, optimal CCUS supply chains from sources to sink, i.e., to the CO₂ storage site Northern Lights (in Norway), will be designed.

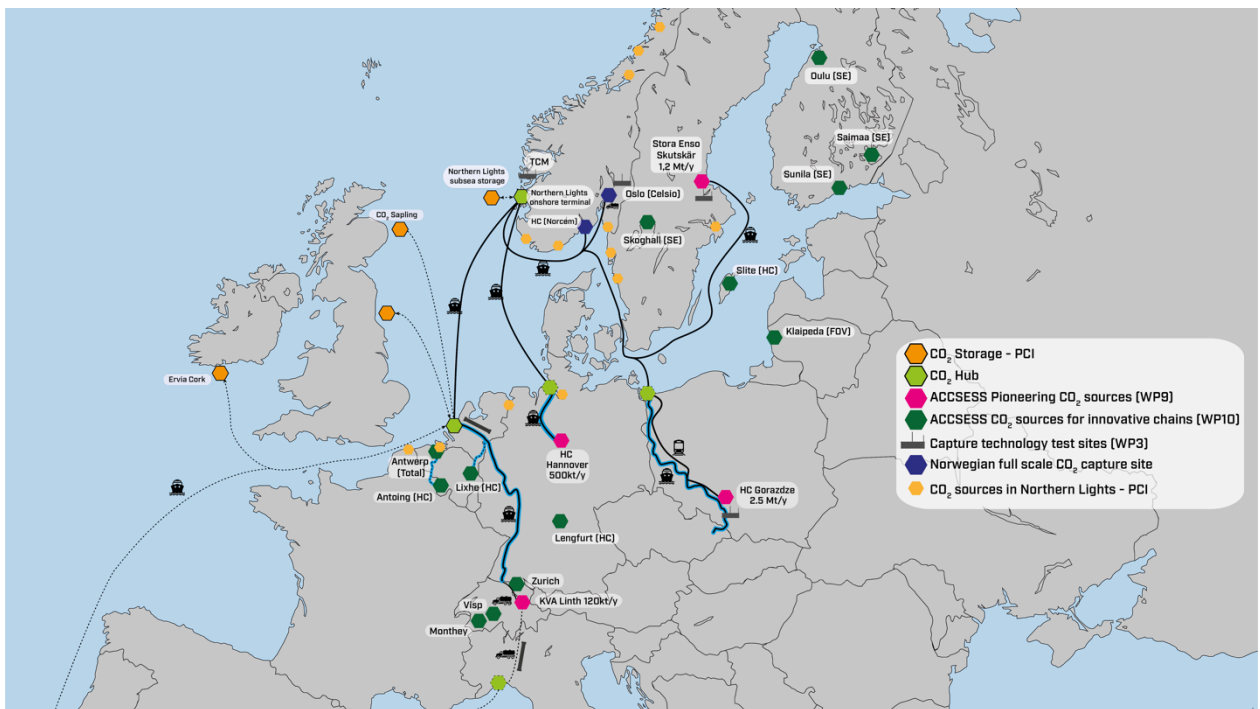


Fig. 1. ACCSESS Pioneering CCUS Chains from German, Polish, Swedish and Swiss emitters to storage in the Northern Lights site (Norway).

Within this landscape, we analyse the relevant legal and regulatory frameworks needed to implement CCS by both these emitters and the storage sites. The analysis is motivated by the observation that there is a disconnect between the clear success of demonstration and commercial CCS operations carried out worldwide in the past twenty years and more and the lack of widespread larger-scale deployment. CCS is available and feasible from a technological point of view; however, legal and regulatory aspects that need to be clarified still exist.

The CO₂ emitters and storage sites and the countries involved in the ACCSESS project provide representative scenarios for the deployment of CCS in Europe. First, the emitters represent the main hard-to-abate sectors that will still generate CO₂ after decarbonisation of power generation, mobility, households, etc., and will need CCS to curb their emissions. Secondly, ACCSESS partners emit today mostly biogenic CO₂, whose capture (using post-

combustion capture methods) and permanent storage (underground or in construction materials) can generate negative emissions. Finally, cross-border collaboration between different countries stirred by a project such as ACCSESS leads to innovation in the optimal design and future implementation of Europe-wide CO₂ value chains, and also to a potential acceleration of the national engagement for the deployment of CCS.

In recent years, several studies have been published on the legal and regulatory framework related to CCS within the European Union. Some of them dealt with the main treaties and legislation currently in force regulating the CCS context [6], while others developed legal analyses concerning the construction of a Europe-wide infrastructure [7] and, more recently, the challenges for transboundary trade, shipment, and storage [8]. Although the European Union is often taken as an example to challenge other countries' legal and regulatory barriers [9], several regulatory issues and legal questions need to be addressed to enable and facilitate the large-scale deployment of CCS in Europe. This is particularly important in a context where technical experts, i.e., engineers, geologists, etc., need to tackle new, sometimes unexplored, legal and regulatory aspects. Among these various existing aspects, we focus here on three broad categories of issues.

The first refers to regulations and directives that need amendments or actions taken to be relevant and useful for the current developments of CCS, including CO₂ transportation. The two most significant cases are (i) the London protocol and the provisional application of the 2009 amendment to Article 6, and (ii) the European Union Emission Trading Scheme (EU ETS), which currently does not cover CO₂ transport modes other than pipelines. In both cases, the relevant authorities are proactive in amending the existing regulations; more details are provided below.

The second category refers to technical provisions within the CCS directive. Among others, we focused on: (i) the specifications of the CO₂ to be injected for geological storage, which must be “consisting overwhelmingly of CO₂”, and (ii) the potential “technical incompatibility” of a specific CO₂ stream that might lead to it not being given access to a certain CCS infrastructure, e.g., in another country. While the lack of a quantitative definition of these two features of the CO₂ stream might appear to be ineffective, it also grants flexibility to the operators and avoids overregulation in the early stages of CCS deployment. We believe that this consideration highlights the importance for the future of choosing any quantitative specifications on CO₂ with great care to avoid unintended negative consequences.

The third and last category refers to two aspects of the CCS Directive that may need clarification but are beyond the scope of this contribution. On the one hand, the CCS Directive is not specific enough when defining long-term liability, which might lead to uncertain or even unpredictable legal outcomes in case of litigation following CO₂ leakage from CCS infrastructure, particularly from a geological storage site. On the other hand, the CCS Directive lacks provisions on CCS data collection, retention and ownership, thus leaving this issue to the jurisdiction of the Member States, which may result inefficient in view of the widespread deployment of CCS in a world where digitalisation plays a bigger and bigger role.

Example: the London Protocol

The 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, (London Protocol), is a global agreement with the overall objective to protect the marine environment and effectively prevent all sources of pollution at sea [10]. Although the 2009 amendment to Article 6 of the London Protocol allows cross-border transportation of CO₂ for the purpose of geological storage, only six countries out of 53 ratified the amendment [11]. However, for the amendment to enter into force, at least two-thirds (36 out of 53) of the Contracting Parties need to ratify it. With the willingness of some countries to engage in CCS activities, in October 2019, a resolution for the provisional application of the 2009 amendment to Article 6 was adopted, allowing sub-seabed geological formations for CO₂ sequestration projects to be shared across national boundaries [12]. The provisional application allows transboundary export of captured CO₂ for storage on the fulfilment of two conditions:

- i. the exporting and receiving countries must deposit a unilateral declaration on provisional application of the 2009 Amendment to the London Protocol Article 6 to the Depositary (Secretary-General of the International Maritime Organization (IMO)); and
- ii. sign a bilateral agreement to define a stable framework for cross-border CO₂ transportation.

To date, four governments have deposited unilateral declarations of provisional application of the 2009 amendment (Denmark, Netherlands, Norway, and the Republic of Korea) [13]. The London Protocol may constitute an obstacle to the full-scale deployment of CCS unless actions are taken by its Contracting Parties, as explained above.

Example: CO₂ transport in the EU ETS

The EU ETS, established by the EU ETS Directive [14], regulates greenhouse gas emission reductions for installations within Europe. It requires installations to surrender emission allowances corresponding to the amount of CO₂ emitted unless captured for permanent storage as pursuant to the CCS Directive [15]. The EU ETS and the CCS Directive also apply in Norway as their implementation extends to the European Economic Area. [11] Weber, V. (2021) provides a comprehensive explanation of how CCS is dealt with in the EU ETS, CCS Directive and Monitoring and Reporting Regulation (MRR).

The specific example hereby discussed aims to highlight that the current EU ETS only includes the transport of captured CO₂ by pipeline [16]. This means that any CO₂ released (emissions and losses) during transportation by truck, train, ship, or barge remains under the responsibility of the last EU ETS operator handling it. As part of the 'Fit for 55' legislative package proposed by the European Commission on July 14th, 2021, the revisions of the EU ETS Directive seem to include multiple CO₂ transport modes for which the entities in charge will be considered EU ETS operators [17]. This will clarify the responsibility of the operator carrying the CO₂ and, accordingly, liability in case of emissions and losses. Nevertheless, a problem remains with the possibility for EU ETS operators to deduct the amount of CO₂ of fossil origin that is not released into the atmosphere but transferred out of the installation to another EU ETS operator. This issue is related to Article 49 of the Monitoring and Reporting Regulation (MRR), which allows a deduction only if the transfer occurs to any of the following installations:

- i. a capture installation for the purpose of capture, transport, and permanent storage.
- ii. a transport network for the purpose of transport and permanent storage.
- iii. a storage site for the purpose of permanent storage [11].

A transport network is defined by the CCS Directive as a “network of pipelines, including associated booster stations, for the transport of CO₂ to the storage site” [18]. A revision of the EU ETS with the inclusion of all different transport modes would not be sufficient as the MRR would have to be revised accordingly.

Conclusion

CCS and cross-border CO₂ transport and storage are expected to play a key role in the next decades in meeting international climate goals. Although CCS is available and feasible from a technological point of view, there still exist legal aspects that need to be considered and regulatory gaps that need to be clarified to achieve its large-scale deployment. Among the various existing legal and regulatory issues, here we focus on two specific examples related to the lack of actions taken by countries towards the provisional application of the 2009 amendment to Article 6 of the London Protocol and the lack of inclusion of CO₂ transport modes other than pipelines in European legislation. As the European legal and regulatory framework around CCS is in continuous development with the EU ETS and the Guidelines to the CCS Directive being currently revised, this work aims at providing the European CCS community with an understanding of the international and national regulatory landscape relevant for the large-scale deployment of CCS.

Acknowledgement

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101022487 (ACCSESS project).

References

- [1] Intergovernmental Panel on Climate Change, Special Report on Global warming of 1.5°C, 2018.
- [2] OGE – Press release (2022) <https://oge.net/en/press-releases/2022/oge-and-tes-join-forces-to-develop-a-1-000-km-co-2-transmission-system>
- [3] Carbfix. (2022). <https://www.carbfix.com/awarded-large-eu-grant>. Innovation Fund: EU invests €1.8 billion in clean tech projects – Press corner. (2022). https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4402
- [4] Northern Lights – What we do. (2022). <https://norlights.com/what-we-do/>
- [5] ACCSESS – Providing access to cost-efficient, replicable, safe and flexible CCUS. (2022). <https://www.projectaccess.eu>.
- [6] Dixon, T., McCoy, S., & Havercroft, I. (2015). Legal and Regulatory Developments on CCS. *International Journal Of Greenhouse Gas Control*, 40, 431-448. doi: 10.1016/j.ijggc.2015.05.024.

- [7] Neele, F., Koenen, M., van Deurzen, J., Seebregts, A., Groenenberg, H., & Thielemann, T. (2011). Large-scale CCS transport and storage networks in North-west and Central Europe. *Energy Procedia*, 4, 2740-2747. doi: 10.1016/j.egypro.2011.02.176.
- [8] Gola, S., & Noussia, K. (2021). From CO₂ sources to sinks: Regulatory challenges for trans-boundary trade, shipment and storage. *Resources, Conservation And Recycling*, 106039. doi: 10.1016/j.resconrec.2021.106039.
- [9] Rocha, H., & de Medeiros Costa, H., K. (2021). Chapter 14 - Legal and regulatory barriers to CO₂ geological storage in Brazil: Lessons from the European Union. *Carbon Capture and Storage in International Energy Policy and Law*, 263-283. <https://doi.org/10.1016/B978-0-323-85250-0.00008-6>.
- [10] IMO (1996). Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1996 (LP), London, 7 November 1996, in force 24 March 2006, 36 ILM (1997) 1.
- [11] Weber, V. (2021). Are we ready for the ship transport of CO₂ for CCS? Crude solutions from international and European law. *Review Of European, Comparative & International Environmental Law*, 30(3), 387-395. doi: 10.1111/reel.12399.
- [12] Resolution LP.5(14) on the Provisional Application of the 2009 Amendment to Article 6 of the London Protocol (2019) available as Annex 2 in the report of the meeting LC41 on the IMO website.
- [13] IMO (2022). Status of IMO treaties, Comprehensive information on the status of multilateral Conventions and instruments in respect of which the International Maritime Organization or its Secretary-General performs depositary or other functions. <https://wwwcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%20of%20IMO%20Treaties.pdf>
- [14] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, OJ L 275 25.10.2003.
- [15] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006, OJ L 140, 5.6.2009.
- [16] Annex I. Directive 2009/29/Commission of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/Commission to improve and extend the greenhouse gas emission allowance trading scheme of the Community. (2009). OJ L 140, 63–87.
- [17] European Commission. (2021). Proposal for a Directive amending Directive 2003/87/EC. COM(2021) 551 final. European Commission.
- [18] Article 3(22). Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006. OJ L 140, 5.6.2009, p. 114–135.