# Regulating Carbon Capture and Storage in the European Union - An Economic and Legal Analysis

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**Abstract**

Capture of $CO_2$ produced during electricity and heat generation and the subsequent geological storage draws ever more attention in the discussion about emission reductions. This commentary discusses the importance of temporal and spatial system boundaries for competition among different $CO_2$ abatement options, in the context of the European Emission Trading Scheme. Referring to the recent proposals of the Commission presented on January 23, 2008, we conclude that the proposal stipulates a sound approach from a theoretical perspective; however, stringent procedures during implementation in practice will be of crucial importance. Consequently, uncertainty for investors is still high. The arguments might be of interest for upcoming trading schemes such as in the US, too.

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## I. Introduction: The carbon capture and storage process chain

The process chain of carbon capture and storage (CCS) has been documented sufficiently in literature by now. Below, the steps are described briefly. The interested reader is referred to other sources, most importantly to the "Special Report on Carbon Capture and Storage"[1] recently published by IPCC.

$CO_2$ can be captured during the process of energy transformation. This is done either prior to the combustion, after the combustion or using the so called oxyfuel-method. Thereby, the combustion takes place in an atmosphere consisting of nearly pure oxygen. Subsequent to the sequestration, the $CO_2$ is transported to its storage location and is compressed below ground. Today, the respective processes are mastered almost completely – at least on small scale project level.[2] Nevertheless, incidents or accidents could cause volatilisation of $CO_2$ back into the atmosphere. There are first experiences, especially in the US, with transportation of $CO_2$ in pipelines.[3] There is, however, little experience with long-term security of the geological storage sites and the storage areas. Many experts are unconcerned about large leakages[4], other studies call for more caution, though. [5] The causes of leakages are hard to determine ex ante and must be elicited over the years.

Currently, more and more pilot projects are taking off. In Germany, for example, a project near the town of Ketzin, where $CO_2$ is compressed below ground, is one of the most notable projects. The gas is compressed into an underground formation and the behaviour of the $CO_2$ in the reservoir is studied.[6] A full overview on ongoing projects is available in the IEA Greenhouse Gas

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1 Special Report on Carbon Dioxide Capture and Storage, IPCC Special Report, (Summary for Policy Makers); Available at: www.ipcc.ch.

2 If and at what costs scale-up for large power plants ist possible remains to be seen.

3 See e.g. Gale/Davison, Transmission of $CO_2$ – Safety and Economic Considerations, in: Gale/Kaya (eds), GHGT-6, Sixth International Conference on Greenhouse Gas Control Technologies, Kyoto (2003), Conference from 30 September - 4 October, 2002, [electronic version (CDrom) without page numbers].

4 Special Report on Carbon Dioxide Capture and Storage, IPCC Special Report, (Summary for Policy Makers), esp. chapter 5.7; available at: www.ipcc.ch/

5 Kharaka/Cole/Hovorka et al., Gas-water-rock interactions in Frio Formation following $CO_2$ injection – Implications for the storage of greenhouse gases in sedimentary basins, in Geological Society of America, Geology, Vol. 34, No. 7, Denver 2006, p. 577-580.

6 For details see URL http://www.gfz-potsdam.de/pb5/pb51/projects/CO2SINK-ORG/geninfo/theproject.htm; more information on the regulatory framework and former specific problems concerning the classification of the correct permit procedure of this project see Dietrich, $CO_2$-Abscheidung und Ablagerung (CAA) im deutschen und europäischen Energieumweltrecht, Baden-Baden 2007, p. 192.

R&D Programme project database.[7]

Even if the large-scale application of CCS is not immediately pending, the question arises today – especially in the context of emission trading schemes – how releases[8] of $CO_2$ after its capture can be dealt with. The question is: Who should be held responsible in case of such a release? One has to distinguish between the negative long-term effects of leakage on the climate on the one hand and the immediate danger to the surroundings (life and limb etc.) on the other hand. In the past neither national nor European legislation held a provision in case of releases because the consequences for the climate are so called long-term ecological damages. Given the novelty of the topic, administrative law was also not of much help in determining the system boundaries (i.e. boundaries of liability[9]) due to a lack of specific regulation. Only liability provisions for responsible polluters under public order law may be applicable in the case of incidents. In a judicial sense, these incidents under public order law are only concerned with damage to life and limb but not to long-term climate impacts[10] which are the focus of this commentary. In view of the energy and climate package published by the Commission on 23 January, 2008, more detailed information on possible regulation is available. Details are discussed below.[11]

From an economic point of view, the definition of system boundaries regarding potential releases and related damage claims possibly arising is of crucial importance. Whether or not the $CO_2$ producer is directly responsible for releases in a legal sense is not the main point. The point rather is whether legislation makes plant or site operators consider the risk of leakages and related monitoring costs during the decision process or not. The smaller risk and costs are, the more attractive is an option of reduction for the investor. From his point of view it is also important to know about his possible liability prior to the start of his investment in the capture and transport

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7 See URL <http://co2captureandstorage.info/search.php>.

8 Depending on the point of release, these emissions are also called leakage or seepage.

9 Boundary of liability and "system boundary" are used interchangeably in the following. The term is used to separate those emissions along the CCS chain a certain player is liable for (emissions inside the system boundary) from those he is not liable for (emissions outside the system boundary).

10 Dietrich, $CO_2$-Abscheidung und Ablagerung (CAA) im deutschen und europäischen Energieumweltrecht, Baden-Baden 2007, p. 229.

11 Discussions on regulation of CCS already started in different member states. The German Government, for example, presented a study on the development of CCS-technologies in Germany and prospects for regulation in September 2007, see URL http://www.bmwi.de/BMWi/Redaktion/PDF/B/bericht-entwicklungsstand-und-perspektiven-von-ccs-technologien-in-deutschland,property=pdf,bereich=bmwi,sprache=de,rwb=true.pdf; in the UK the Energy Bill, part of the Energy White Paper: meeting the energy challenge proposes inter alia a regulatory framework to enable private sector investments in CCS projects, see URL http://www.publications.parliament.uk/pa/cm200708/cmbills/053/2008053.pdf

facilities.

One can assume that capture and transport to the storage site are done almost simultaneously. Hence, spatial system boundaries are the only relevant ones for these two operations. For the final step of the CCS chain, i.e. storage of $CO_2$ that is expected to last several thousand years, temporal system boundaries are of relevance, too. Temporal system boundaries determine for how long the site operator can be held responsible for the system's tightness. These two aspects are discussed regarding the emission trading schemes in the following sections.

## II. Regulation of CCS and the impact on its economics

Under the EU Emission Trading Scheme (ETS), many large, stationary emitters of $CO_2$ are obliged to hand in emission allowances with the authorities equivalent to their emissions in a certain time period. Currently, the allowances are initially handed out for free for a certain share of the emissions. The operator is free either to buy allowances on the markets for excess emissions or to reduce his emissions to the initial allocation of allowances. CCS has not yet been included into the national allocation plans because it has not been applied. The initial allocation of emission allowances to CCS-facilities already maintains investment in this option. For the sake of brevity this issue is not pursued here.[12] Rather the issue of releases after capturing the $CO_2$ and corresponding liability shall be discussed further.

As mentioned before, different system boundaries can be set (see Figure 1). The risk the operator must bear corresponds to the system boundaries in which he is liable for leakages. Narrow system boundaries (see Figure 1a) mean a smaller risk for the operator and conversely a higher incentive to invest in CCS. If the system boundary is set narrowly and the storage operator is not liable for possible releases, the costs for the operator are lower compared to a situation with wide system boundaries (see Figure 1b). The smaller the risk the smaller the costs for the emitter to reduce emissions by means of CCS. If the spatial system boundaries include the storage site as well, the temporal system boundaries, meaning the time period in which the operator is liable for leakages and responsible for monitoring, become relevant.

[12] For more details see Dietrich/Bode, $CO_2$-Abscheidung und -ablagerung (CAA) – Ordnungsrechtliche Aspekte und ökonomische Implikationen im Rahmen des EU-Emissionshandels, HWWA Discussion Paper No. 327, Hamburg 2005, pp. 29ff.

The issue is how to set system boundaries concerning CCS.[13] The following points should be taken into consideration with regard to determining system boundaries:

- If the risk of potential leakages is not taken into consideration by the producer of $CO_2$, and thus not in the costs of the reduction option, the market for emission reduction options will be distorted. Other permanent reduction methods, such as efficiency increases or fuel switch, will become relatively costlier which will distort the market for emission reductions.[14] That would require a justification of the distortion. Optimists declare the technology fairly safe against leakages. This in turn would suggest to provide wide system boundaries by law including the total leakage risk into the price as it is safe anyway.
  There are several ways to fully include the long-term risks and costs into the decision making process, as for example temporal emission rights[15] or compulsory insurance[16]. A low accuracy of monitoring might induce distortions as well. A large tolerance level of monitoring might benefit operators who can use CCS over operators who do not have the option of CCS and are subjected to emission monitoring with a low tolerance level.

- In case of leakages, narrow system boundaries, especially temporally ones, would defer the burden to society because (renewed) efforts to reduce emissions in other areas would be required to achieve the overall emission target. The question arises why society should bear this risk while the producer does not bear any risk at all. According to the "polluter pays"-principle the risk should remain with the producer.
  In this context one should remember that the emission trading scheme is an instrument of neoclassical environmental economics. Hence, there is equilibrium of supply and demand and a single price for emission reduction methods. The marginal costs of the last supplier of

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13 It has been indicated that the storage operator should be liable only for a limited time period . A time period of 20 to 25 years has been suggested. Dr. G. Sweeney, Executive Vice President, Shell Renewables, Hydrogen and $CO_2$, during a panel discussion "Das Klima zwingt zum Handeln – $CO_2$ zurück in die Erde", Potsdam 30. Oktober 2006. A discussion paper of the same day reads: "We believe that a regulatory framework which leaves the market undistorted and gives companies assurance for long-term investments is indispensable for the commercial application of $CO_2$-storage" [author's translation].

14 For details see Bode, Sven, CO2-Ablagerung und Wettbewerb im EU-Emissionshandelssystem, in Wirtschaftsdienst, No. 1, Heidelberg 2006, p. 62-66.

15 Bode/Jung: Carbon Dioxide Capture and Storage (CCS) – liability for non-permanence under the UNFCCC, in International Environmental Agreements: Politics, Law and Economics, No. 6, Amsterdam 2006, p. 173-186.

16 See e.g. Edenhofer/Held/Bauer, A Regulatory Framework for Carbon Capturing and Sequestration within the Post-Kyoto Process, in Rubin/Keith/Gilboy (eds), Proceedings of 7th International Conference on Greenhouse Gas Control Technologies, Vol. 1, Cheltenham 2004

emission reductions determine the price. That is the the price all suppliers of emission reductions get. The costs of particular suppliers are irrelevant, meaning that all of them – including CCS suppliers – cannot only cover their costs but also make a profit. Profits are desirable and allow an efficient allocation of scarce resources. An issue is, however, whether or not it is desirable that profits accrue in the face of externalities e.g. leakages that are excluded from the costs of operators. Emission trading schemes explicitly aim at internalising external costs of $CO_2$-emissions.

The arguments about "competition distortions" and "profit possibilities" do not bear a normative character. Society may prefer certain technologies to others and relieve certain actors of their actions' consequences. However, this should be done explicitly and possible effects should be clarified in advance.

## III. CCS in the context of the EU Emission Trading Scheme

In the context of the energy and climate package proposed by the Commission on 23 January 2008, the situation became clearer. The three components of CCS – capture, transport and storage – were considered separately. For the purpose of geological storage, captured and transported $CO_2$ should be regulated under the (actually codified) IPPC-Directive (2008/1/EC, prior 96/61/EC) and the EIA-Directive (85/337/EEC). Indeed, there are suitable regulations in this Directive that must simply be adapted to the specifics of $CO_2$.

The proposal for a Directive of the European Parliament and of the Council on geological storage of carbon dioxide (CCS-Directive)[17] is of particular importance. In this proposal, the assessment of liability for long-term climate impacts (so called "climate damage") as a result of leakages is covered by the inclusion of storage sites in the ETS-Directive (2003/87/EC) which requires surrender of emission allowances for any leakages of $CO_2$.[18] But the CCS-Directive must be seen in the context of another important part of the proposed energy and climate package, particularly with regard to the proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to improve and extend the greenhouse gas emission allowance trading system

[17] amending Directives 85/337/EEC, 96/61/EC, Directives 2000//60/EC, 2000/80/EC, 2004/35/EC, 2006/12/EC and Regulation (EC) No 1012/2006

[18] cf. recital 23 of the proposal

of the Community (ETS-Directive-Proposal). Here, complementary references of the proposal for a CCS-Directive compared to the ETS-Directive-Proposal can be found.

The Explanatory Memorandum of the ETS-Directive-Proposal declares that CCS should be included in the ETS because of the long-term potential for emissions reductions from CCS, and pending the implementation into national law. Article 24 of the ETS-Directive therefore offers an appropriate legal framework for unilateral inclusion of such installations pending the entry into force of the CCS-Directive, although CCS is not explicitly mentioned. CCS-activities should be explicitly mentioned in Annex I of the Directive, in order to provide clarity and necessity for incentives to geological storage of $CO_2$. Looking into the ETS-Directive-Proposal, Annex I to the ETS-Directive is amended in an important way in conjunction with the CCS-Directive. As a result, the category "Capture, transport and geological storage of greenhouse gas emissions" is added in Annex 1 in the Directive. The category comprises "Installations to capture greenhouse gases for the purpose of transport and geological storage in a storage site permitted under the CCS-Directive (xxxx/xx/EC)", "Pipelines for the transport of greenhouse gases for geological storage in a storage site permitted under CCS-Directive ( xxxx/xx/EC)", and "Storage sites for the geological storage of greenhouse gases permitted under CCS-Directive (xxxx/xx/EC)". This new category of activity should include all greenhouse gases listed in Annex II.

So far the Directive seems rather clear. Uncertainty, however, arises when it comes to the temporal system boundaries i. e. the question if and when transfer of liability for the stored $CO_2$ is possible. The proposal for the CCS-Directive foresees the possibility of transferring the responsibility for closed storage sites in general in Article 18. However, this is subject to conditions that are drafted in Article 17 CCS-Directive proposal. As a basic principle for a transfer Article 18 (1) formulates that a closed storage site should be transferred to the competent authority – on the initiative of the authority itself, or upon request from the operator –,

> *"…if and when all available evidence indicates that the once stored $CO_2$ will be completely contained for the indefinite future."*

Until now, it seems too early to say if, how and when such a proof of complete containment (i.e. no leakage) for an indefinite future can be verified at all. As mentioned above, this aspect is of crucial importance prior to the start of capturing the $CO_2$ at the plant for the plant operator.

Important in the context of the transfer of responsibility Article 19 describes a system of financial securities. By way of financial securities or other equivalents prior to the submission of an application for a storage permit member states should ensure that all obligations arising under the permit issued pursuant to the CCS-Directive-proposal, including closure procedures and post-closure provisions, as well as any obligations arising from inclusion under the ETS-Directive, can be met. This instrument is not a new one. In the Landfill-Directive (99/31/EC), for example, the financial security instrument is used, too. The commitment to deposit financial security can be a reasonable instrument of precaution. However, the CCS-Directive does not yield a pre-determinable point in time at which financial securities are returned to the obligated party. Financial security must rather be provided until the responsibility has been transferred. As previously mentioned, the transfer in turn depends on whether or not the operator can show that storage is safe. The IPCC guidelines for national greenhouse gas inventories 2006[19] may serve as a good starting point, also with regard to consistent approaches throughout the EU. Table 1 provides a summarising overview on the different steps in the CCS chain, relevant regulation and implications for investors. As can be seen, storage still raises most of the open questions that need to be answered in order to provide certainty. Given this lack of certainty, it is interesting to note that investors are granted permissions for new coal fired power plants under the condition of adding CCS once available, and that they seem to accept this uncertainty.[20]

Furthermore, the CCS-Directive schedules a comprehensive permit regime that distinguishes between site selection, exploration permits (Article 4 and 5) and storage permits (Article 6-11). This regime has to be implemented into national law by Member States. A predictable conflict will be the point at which the Commission should have to review and comment on the storage permission. The national authority should have to take into account the Commission`s opinion in making its permitting decision. It is unclear, whether or not such a wide and compulsory involvement of the Commission in national administrative decisions is compatible with the subsidiarity principle.

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19 IPCC guidelines for national greenhouse gas inventories 2006, Volume 2, Chapter 5, retrievable on: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm

20 See, for example, discussion on new coal-fired power plant to be set in in Hamburg by Vattenfall Europe oder in Lubmin by Dong Energs.

## IV. Conclusion

$CO_2$ capture and storage (CCS) potentially offers large scale $CO_2$ emission reduction options. There is a risk of $CO_2$ to escape into the atmosphere after its capture, though. Liability regulation for such leakages is of major importance concerning competition between different emission reduction methods, especially in the framework of emission trading schemes on installation level as the Emission Trading Scheme. If the risk of leakage is excluded from the costs of CCS-projects, CCS could gain an advantage over "conventional" reduction options such as efficiency increases or fuel switches. Such a distortion may be politically wanted but should be considered in the formulation of the respective regulation nonetheless. The recent proposal by the Commission provides a reasonable legal framework; however, implementation in practice by the competent national authorities will be decisive. Consequently clear signal for investors if and how long-term liability and thus financial risks are dealt with are still missing.

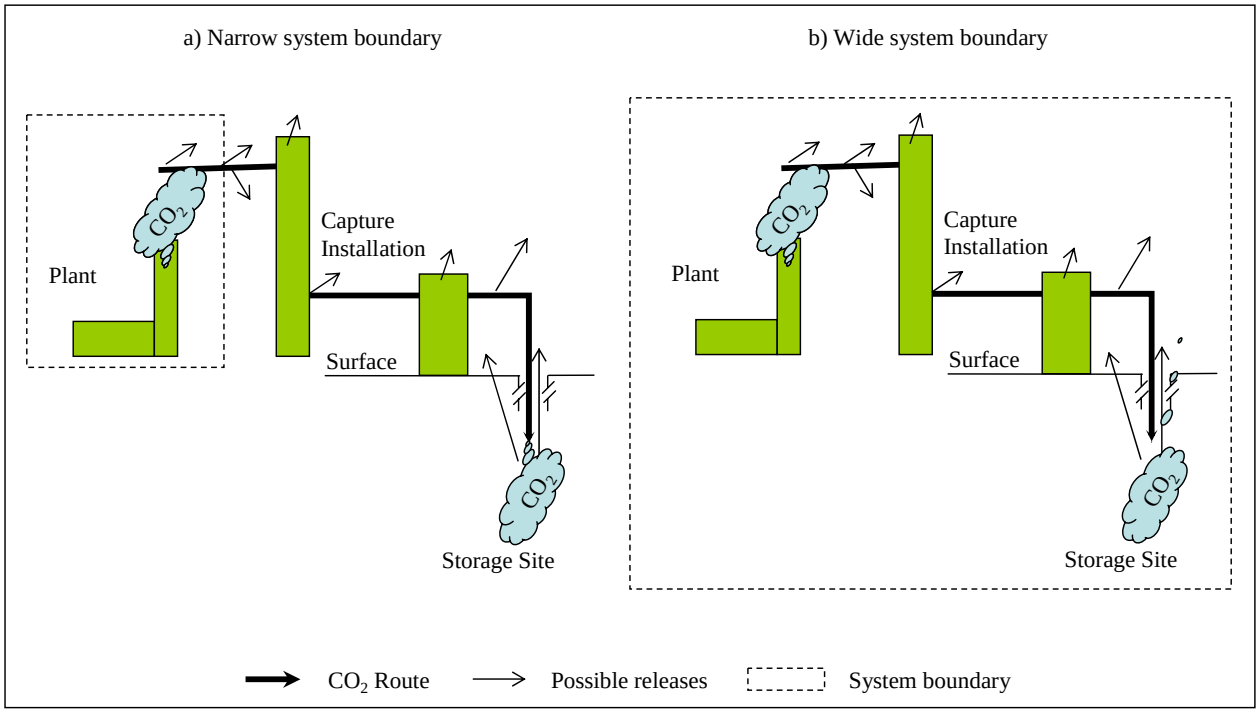


Figure 1: Spatial system boundary for CCS projects

Table 1: Regulation of CCS according to the proposals by the EU commission published on January 23, 2008

| | Capture | Transport | Storage | | |
|---|---|---|---|---|---|
| | | | pre-closure | post-closure | |
| | | | | pre-transfer | post-transfer |
| Permission requirements | -2008/1/EC (prior 96/61/EC, IPPC)<br>-85/337/EEC (EIA) | 85/337/EEC (EIA) | CCS-Directive-Proposal | CCS-Directive-Proposal | CCS-Directive-Proposal |
| Emissions trading | - Not yet included<br>- Added in ETS-Directive-Proposal (Annex I) | - Not yet included<br>- Added in ETS-Directive-Proposal (Annex I) | - Unilateral inclusion under ETS-Directive possible (Art. 24)<br>- Added in ETS-Directive-Proposal (Annex I) | - Unilateral inclusion under ETS-Directive possible (Art. 24)<br>- Added in ETS-Directive-Proposal (Annex I) | - Unilateral inclusion under ETS-Directive possible (Art. 24)<br>- Added in ETS-Directive-Proposal (Annex I) |
| Leakage | Surrender of allowances | Surrender of allowances | Surrender of allowances | Surrender of allowances | No recovery of costs |

ETS-Directive Proposal means: proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to improve and extend the greenhouse gas emission allowance trading system of the Community

CCS-Directive-Proposal means: Proposal for Directive (of…) on the geological storage of carbon dioxide and amending Directives 85/337/EEC, 96/61/EC, Directives 2000//60/EC, 2000/80/EC, 2004/35/EC, 2006/12/EC and Regulation (EC) No 1012/2006, Brussels, 23. 1. 2008