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MARKET DESIGN OPTIONS FOR CCS IN EUROPE: CO2 TRANSPORT AND STORAGE REGULATION

March 2025

Catherine Banet

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Issue Paper

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info@cerre.eu – www.cerre.eu

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About the Author

Catherine Banet is a CERRE Academic Co-Director and Research Fellow. She is a Professor of Law at the University of Oslo and Head of the Department for Energy and Resources Law at the Scandinavian Institute of Maritime Law, Norway. Prof. Banet is a member of the Advisory Academic Group (AAG) to the International Bar Association (IBA), Section for Energy, Environment and Natural Resources and Infrastructure Law (SEERIL), and Chair of the Board of the Norwegian Energy Law Association.

1. Introduction

1.1 The Missing Regulatory Link

Carbon capture and storage (CCS), as well as carbon dioxide removal (CDR) techniques and technologies, will be necessary for the world to achieve net zero according to the latest reports from the Intergovernmental Panel on Climate Change (IPCC). Since the adoption of the CCS Directive 2009/31/EC,[1] the European Union (EU) and its Member States have invested significant efforts into developing value chains for CO_2 capture, transport, and permanent storage. The CCS Directive has been complemented by guidance documents, and, more recently, supplementary policy initiatives aimed at creating a market for CO_2 in relation to CCS activities.

The deployment of CCS and CCUS (with utilisation) technologies has entered a new phase during the past decade, with projects emerging in Europe, such as Northern Lights (Norway, part of Longship), the Teeside and Merseyside CO_2 clusters (United Kingdom) and Porthos (the Netherlands), as well as many others in the United States, Canada and Australia. According to the Global CCS Institute, in 2024, 50 facilities were in operation worldwide (3 of which are dedicated transport and/or storage projects) and 44 were under construction (7 of these are transport and/or storage).[2] Countries like Denmark have adopted or revised their legislation with the aim of enabling CCUS activities. As part of the next phase of its CCUS policy, the European Commission has released a sustainable carbon cycles strategy,[3] established a carbon dioxide removal certification scheme[4] and adopted an EU Industrial Carbon Management Strategy (ICM Strategy).[5] In parallel, legislation such as the EU Emissions Trading Scheme (EU ETS) Directive and the Monitoring and Reporting Regulation (MRR) has been amended to incentivise further CCUS activities under the EU ETS. The TEN-E Regulation was revised in June 2022 to make permitting for the selected cross-border projects more efficient.[6] Adopting supportive regulation on cross-border CO_2 transport and storage in Europe is considered to be the next necessary step to enable the free movement of CO_2 based on CCUS activities within Europe.

In the ICM Strategy, the Commission refers to plans for an **upcoming CO_2 transport regulatory package**. It points out the insufficient coordination and planning, particularly at the cross-border level, and refers to a proposal for a possible future CO_2 transport legislative package, with an EU-wide CO_2 transport infrastructure planning mechanism. It aims to address **the current lack of alignment between captured CO_2 volumes and storage availability**. Facilitating the development of CO_2 transport systems in Europe can address this shortcoming by bringing **flexibility** and **reducing risks** for both emitters and storage operators. Permanent storage at scale requires the utilisation of the best

[1] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide (CCS Directive).
[2] Global CCS Institute, Global Status of CCS 2024, Collaborating for a Net-Zero Future, section 3.1. Available at: https://www.globalccsinstitute.com/resources/global-status-report/
[3] Communication from the European Commission, Sustainable Carbon Cycles, COM(2021) 800 final, 15.12.2021.
[4] Regulation (EU) 2024/3012 of the European Parliament and of the Council of 27 November 2024 establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products.
[5] Communication from the European Commission, Towards an ambitious Industrial Carbon Management for the EU, COM(2024) 62 final, 6.2.2024.
[6] Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure.

storage sites in Europe, and thus some degree of legislative harmonisation across European borders. Having the necessary storage sites ready and mature on time requires anticipation, coordination, and investment. In October 2024, six Member States called upon the European Commission to urgently develop such a legislative framework at the beginning of its new mandate.[7] In the Clean Industrial Deal, the European Commission emphasises the need to build a business case for decarbonised products by creating a market for these products, thereby acting on the demand side.[8] **A flexible and multi-modal CO_2 transportation and storage system across the EU** will allow industries to avoid the cost of the ETS and remain competitive.[9]

The present Issue Paper aims to contribute to these efforts to shape a regulatory framework for a CO_2 transport and storage market in Europe.

Many current challenges faced by the EU when establishing a common market design around CCS operations relate to infrastructure regulation and market set-up. As in all network industries, the economic characteristics of the infrastructure play a central role. Taking the electricity, natural gas, and hydrogen markets as references, three fundamental decisions need to be made. These relate to: i) the role and regulatory regime of the different involved parties (asset owner, operator, third parties, and regulatory authority); ii) the matching of demand and supply, in which emitting third parties are interested in transporting their CO_2 for permanent storage, and storage site owners will need to finance the development and operation of the transport and storage infrastructures; iii) the appropriate level of steering for the development of the necessary transport infrastructures that will represent essential facilities in this upcoming infrastructure network. A significant challenge in designing markets for CCUS infrastructures is that the economic characteristics associated with the CCUS value chains are heterogeneous: storage operators, transport providers, emitters, and users have different investment needs and time horizons to work with. Another challenge is **balancing regulatory predictability with a nascent market**, which requires **flexibility** and **a gradually evolving regulatory approach**.

1.2 Areas of Regulatory Intervention

The Issue Paper analyses, step-by-step along the value chain, what should be the key tenets of the regulatory regime for CO_2 transport and storage infrastructures in the EU.

Important elements of this regulatory assessment include:

- A clear understanding of the successive segments in the CCUS value chain: capture, gathering, treatment/liquefaction, temporary storage, transport, possible utilisation, and permanent storage (see **Error! Reference source not found.**).

[7] Joint Statement on establishing an appropriate European framework for cross-border CO_2 transport infrastructure, available at: https://www.kefm.dk/Media/638641429486680968/JOINT%20STATEMENT.pdf

[8] European Commission, The Clean Industrial Deal: a joint roadmap for competitiveness and decarbonisation, COM(2025) 85 final, 26.02.2025.

[9] On competitiveness, both the Draghi report and the European Competitiveness Compass stress the need to continue investing in CCS to maintain the EU's technological edge in low carbon products and ensure the decarbonisation of energy intensive industries. (Mario Draghi, The future of European competitiveness, report to the European Commission, September 2024; Communication from the European Commission, A Competitiveness Compass for the EU, COM(2025) 30 final, 29.01.2025.)

- The key components of market design for transport infrastructures, i.e., ownership model, operatorship, access regime, regulatory oversight, taking into account the combination of different transportation modes along the CCUS value chain (i.e. not only using pipelines but also ships, canal boats, trucks and trains).
- The existing requirements and national regimes for third-party access (TPA) (including possible exemptions), and desirable evaluations for scaling up the CO_2 market based on CCS.
- An analysis of the points of interaction between market design regulation and commercial agreements for the transport and permanent storage of CO_2, taking into consideration that permanent storage is the ultimate goal to ensure the environmental benefits, and will be crucial to support market developments.
- The implications of standardisation efforts (ISO and CEN) for the transport and storage phases.

The paper focuses on infrastructure regulation (transport and storage) as essential components for the CCUS value chains and CO_2 market. Regulatory aspects related to the commodity market (CO_2) will be addressed only to a limited extent (e.g. through CO_2 specifications and standards).

This will provide an analytical framework to assess how the EU CCUS legal framework should evolve to further enable the deployment of a CO_2 market in Europe, based on CCUS activities, and for the purpose of permanent storage. Additionally, this analytical framework will define the economic signals associated with choices in the design of incentive schemes.

2. Choice of Regulatory Approach

2.1. Completing the CCS Directive, EU ETS Directive, TEN-E Regulation, NZIA, and the Hydrogen and Decarbonised Gas Market Package

For the purpose of **regulatory consistency**, any additional EU legislation on CCS must build upon the provisions of the CCS Directive, particularly the provisions on transport and storage. At present, no revision of the CCS Directive is anticipated, but the implementation of the directive is monitored through regular reports which can assist in identifying any shortcomings.[10] The revised Guidance Documents (2024), which are non-legally binding, also provide useful background information on implementation challenges.[11] Nonetheless, the CCS legislative framework must evolve to better support the deployment of CCUS activities. When the CCS Directive was adopted, the primary focus was on reducing emissions from thermal industrial plants. Since then, the scope of the CCUS value chains has expanded to include more transport solutions beyond pipelines, driven by the need to decarbonise additional sectors and enhance flexibility in market outreach. Any further regulation of CO_2 transport and storage should reflect this broad and evolving scope of application of the CCUS activities.

The regime defined in the CCS Directive encompasses three key elements:

- a **permitting regime** (site selection and exploitation; storage permit);
- the **obligations during operation** (acceptance of CO_2 streams, monitoring and reporting) and **third-party access** to transport facilities; and
- the **closure, post-closure obligations** (leakage monitoring and corrective measures) **and transfer of responsibility** for the storage site to the State on meeting certain conditions (financial security, financial contribution).

Other EU legislative acts, such as the EU ETS Directive[12] and the Environmental Liability Directive[13], indirectly influence the regulation of the CCUS value chains. A revision of the EU ETS Directive is expected in 2026. Therefore, the adoption of proposals for CO_2 transport and storage legislation should be closely coordinated with the revision of the EU ETS Directive given the critical importance

[10] Report from the Commission to the European Parliament and the Council on Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide, COM(2023) 657 final, 24.10.2023.
[11] The four Guidance Documents to the implementation of the CCS Directive have been updated in 2024. Those are: Guidance Document 1: CO_2 Storage Life Cycle and Risk Management Framework; Guidance Document 2: Characterisation of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures; Guidance Document 3: Criteria for Transfer of Responsibility to the Competent Authority; Guidance Document 4: Financial Security and Financial Contribution. Available at: https://climate.ec.europa.eu/eu-action/industrial-carbon-management/designing-and-implementing-industrial-carbon-management-projects_en
[12] 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, as amended.
[13] Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage, as amended.

of the carbon price level for investments in this market. Additionally, the Net Zero Industry Act (NZIA)[14] defines some fundamental requirements for establishing a cross-border CO_2 market, mainly centred around the following two objectives:

- **Increasing CO_2 injection capacity**: based on the EU-wide goal of achieving an annual CO_2 injection capacity of 50 million tonnes (Mt) by 2030.
- **Accelerating permitting and defining strategic net zero projects**: establishing a one stop shop in each country to coordinate the permitting of manufacturing projects, setting detailed timelines for permitting procedures, and giving priority status to "strategic" projects.

The NZIA identifies the **lack of infrastructures** related to "injection capacity" as "the single largest bottleneck for CO_2 capture investments". Beyond "injection capacity", the text insists that future efforts should focus on enhancing "transport capacity". This stresses once more the need for coordination in developing the value chains for CCUS across borders.

Regarding this aspect, the connection must be established with another EU legislative act, the TEN-E Regulation,[15] which covers cross-bounder CO_2 transport, including permitting and access to EU financing (via the Connecting Europe Facility). New CO_2 infrastructure legislation could trigger a revision of the TEN-E Regulation, among other factors.

Finally, for the same purpose of regulatory consistency, any new regulatory initiative must build on the market design legislation adopted in 2024 (directive[16] and regulation[17]) on renewable gases, hydrogen, and natural gas, unless specifics related to the characteristics of the CCS value chain(s) require other solutions.

2.2. The Specificity of CO_2: Not a Commodity like Others

There has been a shift in the narrative at the EU level regarding the need to facilitate a market for CO_2, including the establishment of CO_2 hubs. However, **CO_2 is not a commodity like any other**. It does not carry the same commercial value as other energy commodities, despite the prospects for CCUS. Also, the value of CO_2 within the context of CCUS activities is perceived differently among the various actors in the value chain. Certain actors will regard CCUS primarily as a regulatory compliance service, with the CO_2 price derived from the EU ETS working as a primary driver. The existence of ambitious decarbonisation targets acts as a strong incentive in this respect. Others will view CO_2 as a fluid to be captured and managed to prevent harmful effects on health and the environment, but that could also be utilised. This divergence of views -and, consequently, of economic opportunities and regulatory constraints- must be acknowledged by the legislators.

[14] 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.
[15] Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure.
[16] Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen.
[17] Regulation (EU) 2024/1789 of the European Parliament and of the Council of 13 June 2024 on the internal markets for renewable gas, natural gas and hydrogen.

Then, a preliminary question that any new proposal must address is whether the objective is to create a market for CO_2 as a commodity or a market for CO_2 transport and injection capacity more specifically.

Finally, the **specific characteristics of the CCUS value chain** must be taken into account in all their components. For instance, the flow of CO_2 will in most cases be **unidirectional**, i.e., from the capture source to permanent storage. This impacts the development and availability of transport and storage infrastructures and further highlights the need for planning. It also affects the business model for CCUS value chain components, such as investments in networks connected to captured sources.

2.3 Value Chains Subject to Evolution

While the main segments of the CCUS value chains — capture, transport, (potential) utilisation and storage — are well established, their detailed structure varies within each one of these segments. There are different sources of capture, such as industrial sources, and waste management. Transport modes have diversified, including pipelines, ships, canal boats, trucks, and trains, and they often operate in combination. Furthermore, the selection of storage sites requires a combination of transport and treatment solutions, which includes treatment facilities and terminals. Matching CO_2 sources from different origins with storage solutions will require the establishment of CO_2 hubs to enable efficiency, economies of scale, and cost-sharing.

In CCUS value chains, some segments of the infrastructure network may encounter more competition, while others exist as natural monopolies, necessitating a higher degree of regulation. For instance, transport pipelines, liquefaction terminals, and permanent CO_2 storage show characteristics of a natural monopoly. Conversely, the temporary storage segments of the value chain might experience more competition than the transport infrastructure to permanent storage sites. This calls for a differentiated regulatory approach and degree of regulatory intervention according to the specific segment in the value chain.[18]

The configuration of the CCUS value chains is still taking shape and will continue to evolve. As with other value chains in an evolving market, this necessitates a careful regulatory approach to avoid curbing innovation. In similar circumstances, CERRE reports have emphasised the need for a **dynamic regulatory approach** that allows greater flexibility during regulatory cycles and accounts for the rapidly changing nature of new technology and novel business models.[19]

[18] For an assessment of the expected degree of competition for each segments of the CCUS value chain, see: Commission de Régulation de l'Energie (CRE), Rapport de la CRE sur le cadre de regulation des infrastructures d'hydrogène, September 2024.

[19] Catherine Banet, Building Europe's Hydrogen and Renewable Gas Markets, CERRE, 2023 (https://cerre.eu/wp-content/uploads/2024/08/CERRE-Report_Building-Europes-Hydrogen-and-Renewable-Gas-Markets-FINAL.pdf). M. Pollitt, Towards a More Dynamic Regulation for Energy Networks, CERRE, 2024 (https://cerre.eu/publications/towards-a-more-dynamic-regulation-for-energy-networks/).

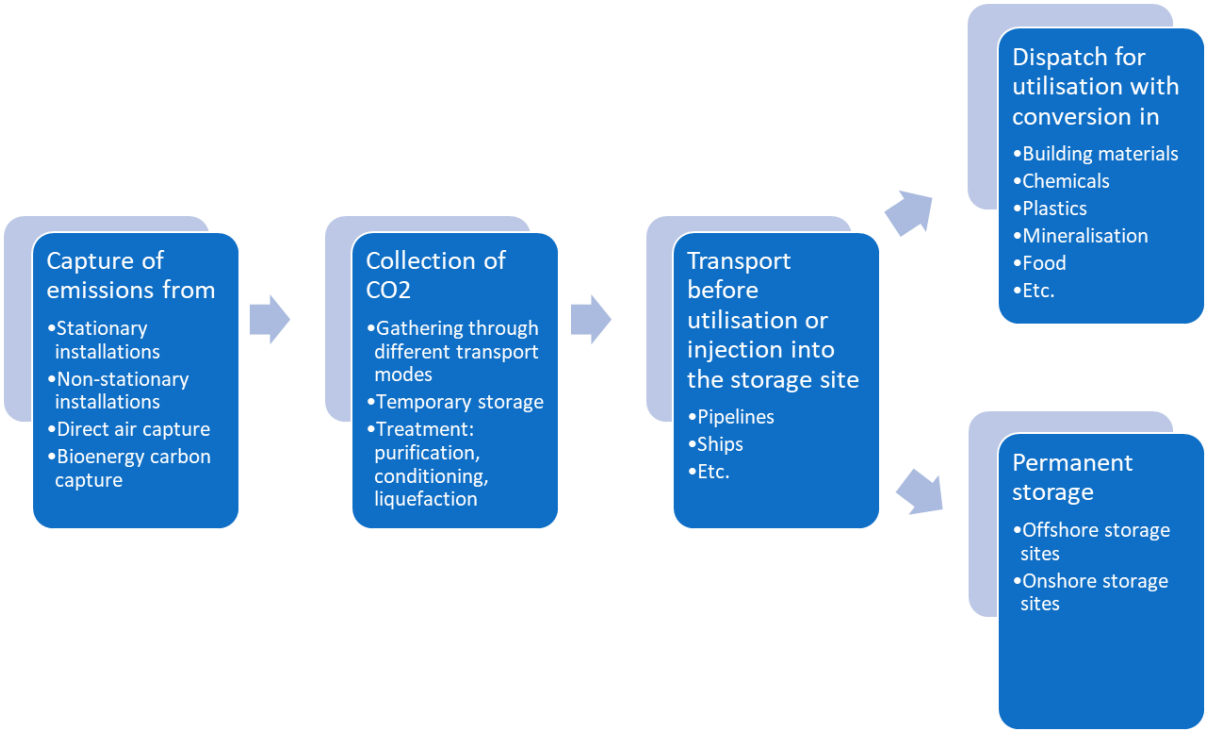

Figure 1: The Successive Segments of the CCUS Value Chain.

Author: Catherine Banet.

2.4. Risks and Cost Sharing among Actors

There are different types of risks specific to CO_2 transport and storage infrastructures.

Internal risks - The first category covers risks inherent to CCS operations (internal risks). This includes the risk of leakages along the value chain, such as those occurring during uploading/offloading operations, on-site transport and treatment operations, accidents, or leakages from storage sites. Then, CCS technologies have evolved significantly over the past decades, supported by innovation. Nevertheless, they still lay at different stages of maturity, notably tied to the diversity of CO_2 capture sources, and varying CO_2 concentration levels.[20] Additionally, the realisation of large-scale CCS value chains entails significant financial risk, particularly at the level of the capture and the CO_2 storage sites.[21] Concerning the latter, the CO_2 storage site needs to "mature", which requires substantial investments, and, at the other end of the value chain, necessitates finding clients for CO_2 storage capacity in a timely manner. Storage assets will compete with each other. For the 2030 NZIA target of 50 Mt injection capacity, at least 20 projects have already been identified. Considering a 2040 target of 250 Mt, at least 100 different projects could potentially be available, with varying equity partnerships competing on commercial, access, and capacity factors. Some forms of planning and coordination mechanisms that could assist in matching demand with supply of storage capacity could help reduce this financial risk (see section 3.11 below).

[20] Global CCS Institute, Advancements in CCS Technologies and Costs, January 2025.
[21] Ibid. The report includes an overview of the costs for capture and transport technologies and processes.

External risks - The second category of risks is external and includes policy priorities, lack of public support and the security of physical infrastructures.[22] Public perception and acceptance issues remain a concern in many countries. These can notably be mapped, addressed and mitigated at the level of strategic or project-based impact assessments.[23] The security of offshore and onshore energy infrastructures has become a priority for European governments, infrastructure operators and companies. The European Commission has proposed strengthening EU policy efforts and legislation on cable security, including with a review of the security of energy supply framework, with special attention to critical energy infrastructures.[24] When developing new cross-border infrastructures, greater consideration must be given to the model for and allocation of tasks concerning safety than was previously the case.

Risks and cost allocation - The level of knowledge and experience in addressing these risks still varies significantly among actors. This disparity causes delays in the deployment of the projects, and, consequently, affects the achievement of targets set for emissions reduction in the EU climate law and CO_2 injection in the NZIA. Building an infrastructure for the transport and storage of CO_2 requires a careful assessment of the models for risks and cost sharing, addressing both internal and external risks. The risks and costs are a common question for infrastructure operations, users and authorities.

Certain risks can be addressed through legislation, while others will be addressed through contracts between companies[25] (see Section 3.11 below for a discussion on the use of platforms to address market risks). Supplementary de-risking instruments of a more financial nature will still be necessary in the next phases of deployment of the CCUS operations (see Section 3.12 below).

2.5. Subsidiarity and Proportionality of EU Harmonisation Measures

Several Member States have already adopted rules on CO_2 transport infrastructure, are planning to adopt or revise current rules, and/or have published strategies around the regulation of CO_2 networks. There is consequently a need to ensure a level playing field around some key harmonisation provisions.

Some examples of national regulatory initiatives include:

- France, with the publication of a dedicated report by the National Regulatory Authority for Energy (*Commission de Regulation de l'Energie*, CRE) on the regulation of CO_2 transport infrastructure, and the work of CRE's Foresight committee (*Comité de prospective*): (i) CRE's

[22] The IPCC Report Working Group III highlighted several of these remaining barriers and deployment lags for CCS in its 2022 report: "Climate Change 2022: Mitigation of Climate Change", Working Group III Contribution to the IPCC Sixth Assessment Report.
[23] Industrial Carbon Management Forum, Working Group on Public Perception, Issue Paper (2024), published February 2025. See notably the list of recommendations in Section 5 on "Enhancing Public Perception".
[24] European Commission, Joint Communication to the European Parliament and the Council, EU Action Plan on Cable Security, JOIN(2025) 9 final, 21.2.2025.
[25] Alice O'Brien and Catherine Banet, 'De-Risking the Hydrogen-CCS Value Chain Through Law', European Energy and Environmental Law Review Volume 30, Issue 2 (2021) pp. 24 – 41

Report on the regulatory framework for hydrogen and carbon dioxide infrastructures;[26] (ii) Foresight Report *(Rapport de prospective).*[27]

- Denmark: has the necessary legislation in place to enable CO_2 transport, but has identified a need for new legislation, particularly regarding responsibilities in relation to pipelines.[28]
- Belgium: adoption of CO_2 pipeline decrees in March 2024.[29]
- Outside the EU, Norway has announced the revision of the CO_2 Storage Regulations and may propose a new CO_2 Storage Act.

CCS requires a cross-border, single-market approach to be an effective solution for industries in all Member States. This also necessitates coordinated action at the EU level, in accordance with the principles of subsidiarity and proportionality of the harmonisation level proposed. However, there is a "coordination failure" in which investments in capture are not aligned with the access to permitted geological storage sites. To address this, the NZIA stresses the need for timely operational availability of the CO_2 storage sites. This calls for the establishment of a single market for CO_2 transport and storage services to be used by large-scale CO_2 emitters. The next question concerns the regulatory approach as well as the priority topics and degree of EU harmonisation.

2.6. Regulatory Approach

The regulatory models existing in mature infrastructure industries in the EU (e.g., regulated third-party access) provide incentives that might not be well adapted to a nascent industry, with variable value chain components. For instance, investment signals are weaker under regulated third-party access (TPA) than under negotiated access regimes. When investments are targeting specific users (as it would be the case in a decentralised CO_2 network), regulated third-party access to an asset base may hamper investment signals that would be otherwise obtained under a negotiated regime. On the other hand, negotiated third-party access may lead to inefficient investments, as assets are not planned jointly, and could put some actors in a weak negotiating position. At the level of CO_2 hubs development, several sources of CO_2 will be gathered, based on various transportation modes. Some of these modes will be characterised as natural monopolies (e.g., pipelines), while others will operate on commercial terms (ships, canal boats, trucks or trains). It seems too early to set a detailed regulatory framework applicable to CO_2 hubs, and it seems more appropriate to let actors organise themselves, based on negotiated access tariffs.

Overregulation should be avoided. In that respect, there are some useful lessons to learn from the adoption of the Hydrogen and Decarbonised Gases Package. Notably, **a phased approach** to the

[26] Commission de Régulation de l'Energie (CRE), *Rapport de la CRE sur le cadre de régulation des infrastructures d'hydrogène et de dioxyde de carbone*, September 2024. Available at: https://www.cre.fr/documents/rapports-et-etudes/rapport-de-la-cre-sur-le-cadre-de-regulation-des-infrastructures-dhydrogene-et-de-dioxyde-de-carbone.html

[27] Prospective de la CRE, *Le captage et la chaîne de valeur du dioxide de carbone*, June 2023. Available at: https://www.cre.fr/actualites/toute-lactualite/la-cre-publie-son-rapport-de-prospective-sur-le-captage-le-transport-le-stockage-et-la-valorisation-du-co2.html

[28] Act on Use of the Danish Subsoil (the Subsoil Act), Part 6a, as amended, and CCS Order (*Bekendtgørelse om geologisk lagring af CO_2 m.v*). Available at: https://www.retsinformation.dk/eli/lta/2016/1425

[29] *Decreet over het vervoer van koolstofdioxide via pijpleidingen*, 28 March 2024. Available at: https://www.ejustice.just.fgov.be/mopdf/2024/07/12_1.pdf#page=603

application of the full regulatory regime (e.g. on unbundling) could be applied. The choice between negotiated and regulated third-party access to the different segments of the transport and storage assets can also be inspired by lessons learned from the discussion on the hydrogen legislation. Again, a too strict regulatory approach on certain requirements such as unbundling and TPA may hamper instead of support CCS activities. A phased approach would also help balance the need for regulatory certainty (for all actors including investors) and flexibility. This argues in favour of a phased approach, based on adaptive regulation, in order to ensure flexibility.

Any regulatory intervention must take into account the **diversity of transportation modes**, where the need for regulation will differ significantly. It also requires **a "full value chain approach"** (capture, transport, utilisation, and storage). As mentioned previously, the CCS Directive focuses on CO_2 pipeline transport, whereas in practice, the current CCS projects combine a wide variety of transportation modes. Ship transport has already been included in most transportation routes in Northern Europe, combined with receiving terminals and pipelines. There is less need for regulation in these other transport modes (operating on commercial terms) than for pipelines. Nevertheless, a minimum level playing field must be provided, such as the choice of access regime for receiving and liquefaction terminals.

As mentioned above, several soft law instruments have been adopted, notably the Guidance Documents on the implementation of the CCS Directive. However, to ensure a level playing field in the EU and facilitate cross-border transport of CO_2, regulatory intervention should entail some binding rules, but in a targeted manner.

The need for **regulatory alignment** between infrastructure regulation for CO_2 and other gases might be relatively moderate at the start. Again, it will depend on how the value chains will mature. If regulatory alignment is needed, it must be based on practical experiences and addressed in a targeted manner.

Finally, in this process of supporting a nascent market for CO_2 transport and storage through legislation, it will be important to get the **legal definitions** right from the start. A new legislative package should include legal definitions of some key infrastructure types, such as the CO_2 network or CO_2 terminal. The definition of "operator" in the CCS Directive is limited to the operation or control over the storage site. The full CCUS value chain will involve new types of operators, which will need to be identified, and see their role defined. These legal definitions should be completed and built on the ones of the CCS Directive, notably on "CO_2 stream", "storage site", "storage complex", and "leakage".[30]

[30] CCS Directive, Art. 3

3. Regulatory Design Elements for a CO_2 Market in the EU

The following elements are identified as the building blocks of market design for the CO_2 market in Europe concerning CCS activities. These are discussed in the sections below.

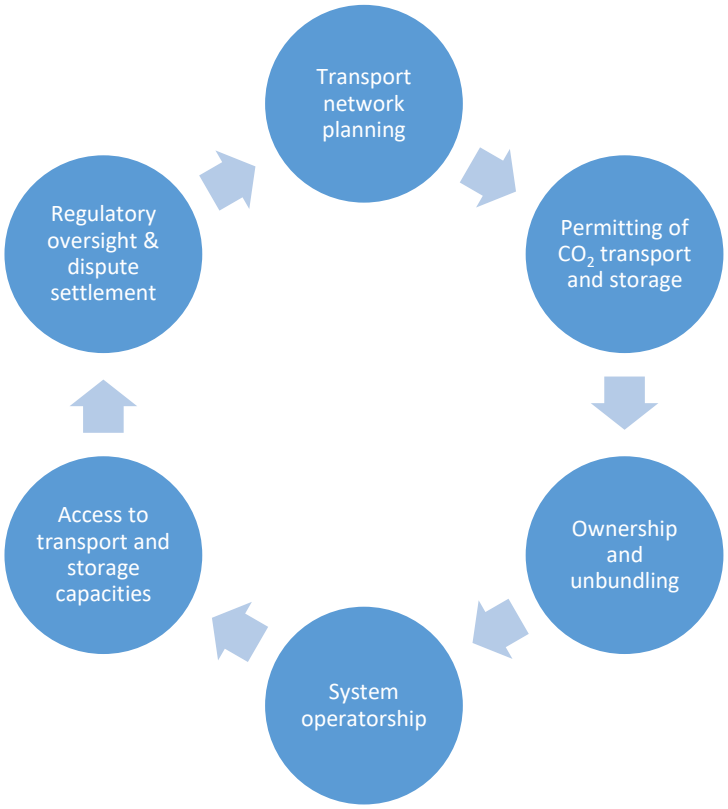

Figure 2: Building Blocks of Market Design for CO2 Markets for CCS Operations. Author: Catherine Banet

3.1. CO_2 Transport Network Planning

The adoption of new EU requirements on CO_2 network planning is driven by the need to address the lack of alignment between the different segments of the value chain, where access to transport capacity is instrumental. This justifies a focus on transport infrastructures, particularly its most central parts, as the value chain continues to evolve. Other transportation modes such as ships, canal boats, trucks or trains, do not rely on the same level of cost investments and are more flexible to adapt to customers' location by nature. These consequently do not need to be subject to planning requirements. The need to plan for the availability of some intermediary installations such as terminals, temporary storage sites and CO_2 hubs is more open, as discussed below.

Planning theorists define planning as "*a continuous process which involves decisions about alternative ways of using available resources with the aim of achieving some particular goals in future*".[31] Planning is not an end in itself. It is a purposeful action. It is both a means and a process to promote

[31] D. Conyers and P. Hills, *An introduction to development planning in the third world* (Wiley, 1984), 62.

development.[32] According to James Galbraith, planning, "*when properly conceived, deals with the use of today's resources to meet tomorrow's needs*".[33] This stresses a development perspective in the planning process, that is also relevant to the CCUS value chains. A more laconic definition of planning is "*the action of organising according to plans*",[34] where "*plans*" are strategic documents. In summary, planning is a *process* resulting in a document that is a *plan*.

The main question raised below is the need for regulating in EU legislation the planning process related to CO_2 transport infrastructures as well as the scope of the planning requirements.

Under currently applicable legislation, i.e. the CCS Directive, the sole existing definition of a relevant CO_2 transport infrastructure is "*transport network*", defined as "*the network of pipelines, including associated booster stations, for the transport of CO_2 to the storage site*".[35] The definition clearly delimits transportation alternatives to pipelines, even if some associated assets necessary to the operation of the pipelines (such as booster stations) are included. The definition also delimits the types of infrastructures to the ones transporting the CO_2 to the storage site. It can be assumed that it limits the types of infrastructures to the ones having a direct connection to the storage site, but it is not clear from the wording of the directive.

The Guidance Documents elaborated by the European Commission provide further insight into the possible interpretation of this definition. The understanding of the scope delimitation for both the transport network and storage site is more extensive. Notably, Guidance Document 1 notes that "*The storage site includes the injection and monitoring wells. It may also include associated infrastructure such as pipelines, CO_2 conditioning systems, storage tanks, offshore platforms and floating (storage and) injection units*."[36] The Guidance Document further notes that the boundary of the "*surface and injection facilities" is not explicitly defined in the Directive. Based on a common understanding, these facilities "start where the transport system ends*". The term "*transport network*" is not commented on as such.

A key starting point for any infrastructure regulation is the need to differentiate between levels of transport infrastructure to tailor the applicable regulatory regime. The question, in this context, is whether there is a need to distinguish between the CO_2 transmission and distribution transport networks.

The strategic role of pipeline transport in relation to storage site and injection capacity argues in favour of a focus on pipeline transport in direct connection to the storage site in new EU regulatory initiatives. In addition, the national planning of transport pipelines from clusters of emissions sources to the main CO_2 transport network could be considered. Finally, many of these pipelines will be cross-border.

As concerns injection capacity, there is not the same need for planning, because storage capacity is subject to permitting processes. For instance, in Norway, which has implemented the CCS Directive

[32] A. Faludi (ed.), *A Reader in Planning Theory* (1973), Part 1.
[33] J. Galbraith, *The Predator State* (Free Press Publishers, 2008), 165.
[34] Dictionnaire de l'Académie Française, 9th edition.
[35] CCS Directive, Art. 3(22).
[36] Guidance Document 1, Section 2.4 – Interpretation of main terms, Table 2: Clarification of the key defined terms used in the CCS Directive.

through the European Economic Area (EEA) Agreement, the government is not using regular rounds to award exploration and exploitation permits, but an open-door policy. Awarding regular rounds would correspond to a more systematic approach to planning the availability of storage sites. This is not considered as necessary as of today. Although the development of CO_2 networks and the availability of storage sites cannot be steered in a centralised manner, it will be necessary to establish "coordination" tools between emitters and storage capacity providers, for matching demand and supply in an effective manner (see Section 3.11).

The scope of the planning requirement should not include other transportation modes, such as ships, trucks or trains, which are much more flexible by nature. However, since CO_2 shipping has become a fundamental source of flexibility, the specific needs of seaport infrastructure and receiving/treatment terminals should also be addressed.

Interactions with other networks (e.g., hydrogen) and a system integration perspective should be considered. A hub approach to infrastructure development should be further explored, both for CO_2 transport/storage hubs and developing infrastructures and services around industrial hubs where emissions will be reduced. The regulatory model for CO_2 hubs cannot be harmonised yet.

The European Commission has put forward a series of concrete proposals on CO_2 network planning tools as part of the ICM Strategy, notably the definition of **an "EU-wide CO_2 transport infrastructure planning mechanism"**. The largest sources of emissions are also known in advance, meaning that it might be possible to anticipate where there will be a need for developing transport infrastructures. This raises the question of the anticipation of industrial clusters and their longevity. Transport actors close to the emissions sources will need to have a minimum of certainty as to the future needs for transport to make the necessary investment in infrastructures. Planning might also help avoid risks of lock-in effects in the mid-to-long term.

The TEN-E Regulation already provides for planning obligations for cross-border electricity and gas transport infrastructures. The Regulation could be amended to include a mandate on CO_2 transport planning. The TEN-E Regulation defines specific planning tasks for national authorities and systems operators, but also for the dedicated association of TSOs, that has been established for electricity, natural gas and hydrogen (ENTSO-E, ENTSO-G and ENNOH respectively). The establishment of a similar organisation for CO_2, for example called ENTSO-C or ENNOC, might be considered. Such an organisation could notably be in charge of the elaboration of a Ten-Year Network Development Plan (TYNDP) for CO_2 transport and of drafting supplementary rules in the form of network codes and guidelines related to markets and connection rules. If such a comprehensive approach may seem disproportionate from the start, a lighter form of cooperation might be envisaged as a first stage, and, after a review process, a more comprehensive cooperation structure developed.

Because CCUS activities are tightly linked to the decarbonisation of industrial and hard-to-abate sectors, it will be necessary to ensure some coordination between planning processes for electricity, natural gas and hydrogen networks. Such criteria already exist as part of the TYNDP for gas and hydrogen and could be extended to CO_2 network infrastructures. Concerning natural gas infrastructures (pipelines or storage terminals), it could also help identify possible re-use and re-purposing opportunities.

Some level of planning of transport infrastructure may also be needed at a lower level than transmission and cross-boundary levels. New EU measures could include planning requirements at the distribution level, in close connection to emission clusters. Planning at the distribution level could include a cross-boundary dimension, when relevant.

There will be significant differences between the different segments of the value chain, as not all of them are **scalable**, and the prospects for an addition of new connections or even the permanence of original sources are uncertain. Much also depends on the permanence of emissions sources, as infrastructure depends on the location of industrial emitters. The potential for relocation of industrial sites and the impact of decarbonisation on industrial processes can weigh heavily on infrastructure development decisions. The bundling of emissions sources close to CO_2 transport solutions (CO_2 hubs or valleys) could in this context be a more cost-effective approach. Such considerations have to be taken into account in network planning processes.

To achieve the CO_2 injection targets defined in the NZIA, it will be necessary to rely on storage capacity in neighbouring countries like Norway and the UK. Switzerland has also made plans to participate in European CO_2 transport networks and even supported demonstration projects to send CO_2 by rail and ship to Iceland for storage into basaltic rocks.[37] Since these countries are not part of the EU, it will be necessary to clarify or create a legal framework to associate them with the network planning processes.

3.2. Permitting of CO_2 Transport and Storage Assets

The permitting regime plays an important role in defining a level playing field among actors active in the same market segment. With an expanding CO_2 transport services market and the prospects of additional cross-border projects, a minimum level of harmonisation in permitting rules for CO_2 transport should be considered.

Additional provisions on transport infrastructure permitting could enhance flexibility in the value chain and economic model through legal innovation. For example, pre-existing permits and land-use rights could be “re-used” to accelerate the permitting of CCS projects. This is particularly pertinent to the decommissioning and re-use/repurposing of infrastructures for CO_2 transport and storage.

In the case of cross-border transport infrastructure, it is important to address in the legislation the requirements under the London Protocol to the London Convention[38] and to consider the use of the provisional solution under the latter.

[37] Global CCS Institute, CCS in Europe: Regional Overview, November 2023. Available at: https://www.globalccsinstitute.com/wp-content/uploads/2023/11/CCS-in-Europe-Regional-Overview-Global-CCS-Institute-pdf.pdf

[38] 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (adopted 29 December 1972, entered into force 30 August 1975) 1046 UNTS 120 (LC). 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (adopted 7 November 1996, entered into force 24 March 2006) 36 ILM 7 (LP). The objective of the London Convention and its Protocol is to prevent marine pollution by dumping of wastes and other matter. The export of wastes – including CO_2 streams

Concerning storage sites, the CCS Directive already defines common rules for CO_2 exploration and storage permits. Member States have already implemented the CCS Directive, which limits the possibility of setting additional permitting requirements. Any new permitting requirements should, at the very least, build upon those already defined in the CCS Directive and consider the existing national permitting regimes. Indeed, the states that are already advanced in CCS activities have adopted a detailed framework of CO_2 storage permitting regime.

3.3. CO_2 Specifications

CO_2 specifications are important because of both quality management and market definition (both product and geographical markets).[39] CO_2 specifications must be tailored to the source (e.g., waste management, industry, etc.), as the degree of impurities in the CO_2 stream will vary. Some CO_2 specifications will be specific to a particular emitting site or asset. Therefore, they will follow different drivers such as system integrity, flow assurance, health and safety, or transport mode.[40] As such, having a single CO_2 specification appears overly restrictive and does not accurately reflect the diversity of CCUS activities.

CO_2 aggregation hubs are set to play an important role, as they will gather CO_2 from different sources with varying specifications. Any future EU legislation should facilitate their development. CO_2 hubs might charge additional fees for receiving and processing CO_2, raising the question of potential discrimination based on CO_2 specifications. Specification requirements will also need to be set at the storage site level (and at the injection facility prior to injection), with a parallel risk of some terminal or storage site operators setting too conservative CO_2 specifications. Where different levels of constraints on CO_2 specifications exist, some CO_2 storage sites may become more attractive than others, potentially excluding certain actors from acceding the asset.

A minimum CO_2 purity level will be needed to prevent market fragmentation, particularly in transport. Meanwhile, CO_2 specifications are closely linked to safety requirements, which could justify more detailed regulation, especially for storage site operators. In such cases, harmonisation in legislation may be less needed, and parties can agree on the terms bilaterally. At a minimum, CO_2 specifications must be set in a transparent and predictable manner, and subject to regulatory oversight.

- for the purpose of dumping or incineration at sea is prohibited in article 6 of the Protocol, but an amended to article 6 was adopted in 2009, which is still pending ratification by a sufficient member of Parties to the Protocol to enter into force. A provisional solution to the export prohibition was agreed upon through a resolution in 2019, subject to the conclusion of a bilateral agreement or arrangement between the relevant Parties (Resolution LP.5(14) on the Provisional Application of the 2009 Amendment to Article 6 of the London Protocol (adopted on 11 October 2019). In an Analysis Paper published in September 2022, the European Commission argued that CCS Directive and the EU ETS Directive, which bind all the EU Member States, can act as a relevant "arrangement" between the Parties in the meaning of Art. 6(2) of the London Protocol. Similarly, the EEA Agreement and the incorporation of the two directives into the Agreement provide the necessary arrangement with EEA partners, according to the Commission.

[39] Under EU competition law rules, market power assessment required to define the relevant product and geographical markets to assess whether a market actor is abusing its market position. See the European Commission Market Definition Notice on the definition of the relevant market for the purposes of Union competition law, C/2023/6789, OJ C, C/2024/1645, 22.2.2024.

[40] Report of the ICM Forum Working Group on CO_2 Standards, Towards EU-wide CO_2 specifications, February 2025.

3.4. Standardisation

There are various standardisation initiatives on both CO_2 specification and CO_2 transport, at the international (ISO), European (CEN) and national levels. Standards are not legislation but provide useful common grounds for realising projects, either as a contractual requirement between parties or supportive legal requirements, presuming conformity with legislative requirements. Their adoption is sometimes required by the EU legislation. In that respect, the ICM Strategy calls for the development of EU-wide CO_2 transport infrastructure interoperability rules, including minimum CO_2 quality standards. Such minimum rules are seen as fundamental to ensure that CO_2 can be traded as "a tradable commodity for storage or use within the EU's single market."[41] According to several stakeholders, minimum CO_2 stream quality standards, as well as factors such as composition, purity, pressure and temperature, will help prevent market fragmentation.[42]

Among the most relevant standards are those relating to CO_2 pipeline transport specifications, as they will set preconditions for the CO_2 being piped in. Interoperability standards will also be crucial in connecting the different sources of CO_2 to a joint transport infrastructure, such as CO_2 hubs, pipelines, or terminals. The interoperability of transport systems across borders will be fundamental in establishing an internal market for CO_2.

In 2024, the European Technical Committee (CEN/TC 474) was established with the task of developing European Standards across the CCUS value chain.[43] It will contribute to the definition of a unified CO_2 transport standard that can then be used as a reference.

Work on these standards should be pursued in a coordinated manner, as they lay an important foundation for a common CO_2 transport and storage market.

3.5. Ownership and Unbundling

3.5.1. Ownership Models for CO_2 Transport and Storage Infrastructures

As mentioned in Section 2.4, the realisation of large-scale CCS value chains is still subject to high economic risk. The ownership structure may allow to alleviate some of these risks, such as the ones based on the competences of members in a joint venture. However, the structure of the ownership model will vary greatly according to the value chain segment (transport or storage). Some countries have also set requirements in terms of public ownership (full or partial) in exploration and storage licenses, such as Denmark.[44] Ownership models for other related infrastructures, such as treatment, aggregation, and injection facilities, can follow alternative models.

[41] ICM Strategy, Section 3.
[42] Report of the CCUS Forum Expert Group on CO_2 Specifications, "An Interoperable CO_2 Transport Network – Towards Specifications for the Transport of Impure CO_2", September 2023.
[43] https://www.cencenelec.eu/news-and-events/news/2024/brief-news/2023-02-20-ccus/
[44] The Danish state is a co-owner of CO_2 exploration and storage licenses in Denmark through the public fund Nordsøfonden. According to Danish authorities, the Danish subsoil is a shared resource, and, as a co-owner of

3.5.2. Unbundling

This section explores which activities along the CCUS value chain can be combined or should/must be separated, to notably avoid the risks of cross-subsidisation. This raises the question of selecting the appropriate unbundling model.

Unbundling refers to the separation of activities that can be subject to competition (competitive activities like production and supply of energy) from activities where competition is not possible or allowed (monopolistic activities, like transmission and distribution, that are regulated monopolies in the EU). The joint operation of these activities by the same company can lead to discriminatory behaviour towards third parties, with negative effects on the use of infrastructure, management of production resources and final price for consumers. Unbundling these activities counts among the tools aimed at opening markets to competition.

There are traditionally two main approaches to unbundling: vertical unbundling and horizontal unbundling. There are different degrees of unbundling that can be applied either at the vertical level (separation of production from supply) or the horizontal level (separation from other network activities). From the least to the most restrictive, the unbundling regimes are the following: management and account unbundling, functional unbundling, legal unbundling, independent system operator model (ISO or ITO), and ownership unbundling.

The key question is which activities within the CCUS value chain can be combined (e.g. capture and collect/gathering with temporary storage) and which must be separated (e.g. liquefaction plant and permanent storage site). A central criterion will be the monopolistic nature of some of these activities and the risks of cross-subsidisation. This could suggest that transport operations (and temporary storage) should be separated from capture and permanent storage operations.

One of the main risks of the value chain is the misalignment between segments, prompting investors in one segment to invest in the preceding segment to secure access to their capacity. Typically, storage operators invest in some of the transportation assets connecting the customers to their infrastructure to mitigate the risk of their investment.

Even more than for the hydrogen sector, a strict unbundling regime does not seem adequate in the early stage of development of the CCUS value chain. There is little knowledge yet about how the market will perform, and some activities will need to be supported through economies of scale along the value chain while avoiding cross-subsidisation. A minimum approach to vertical unbundling (management and account unbundling) is probably best as a first phase, under the supervision of the regulatory authority.

3.6. Network Operatorship

The role of the operator will be most prominent in the case of network transport based on infrastructures that represent natural monopolies. Therefore, the level of legal requirements (e.g., the

exploration and CO_2 storage licenses, the state is guaranteed insight and influence regarding subsoil activities. At the same time, state co-ownership ensures that society as a whole benefits from CO_2 storage. Source: Energistyrelsen, Licenses for exploration and storage of CO_2, including environmental consultation rounds, 2025.

need for an independent system operator) is expected to be higher for them than for operators of other types of infrastructure (e.g., terminals). It is necessary to designate and possibly certify a system operator distinguishing between the different infrastructures i.e., gathering infrastructure, temporary storage, liquefaction terminal, transport infrastructure, and permanent storage site.

It might be necessary for the operator to submit network development plans, and to ensure consistency with EU/regional development plans. This could be linked to: (i) National Energy & Climate Plans under the Governance System Regulation; and (ii) possible CO_2 planning requirements and existing permitting process for cross-border CO_2 projects under the TEN-E Regulation.

Beyond network planning, maintenance and capacity allocation, the role of operators could be extended to e.g. aggregation of different CO_2 sources.

In certain circumstances of a more developed network, the designation of a transport system operator (TSO) or independent system operator (ISO) should be considered and foreseen in the legislation. The role of the TSO must be clearly defined, as it could also operate intermediary infrastructures, such as the physical aggregation of CO_2. The role of the aggregator could extend to the signature of agreements with both emitters and storage site operators. Again, the development of these additional tasks must be subject to the supervision of the regulatory authority, based on a clear mandate.

3.7. Access to the Transport and Storage Capacities: Connection Rights and Third-Party Access

This section discusses the access regime to CO_2 infrastructures for transport, treatment and storage. A central question relates to the choice between negotiated and regulated access. Where the choice of a regulated access regime is made, the specific access terms and conditions (e.g., tariffs and tariff methodology) must be set.

The CCS Directive already provides some general criteria on which the access regime must be based, notably that access to infrastructure should be transparent and non-discriminatory. Member States have developed further the access regime as part of the national implementation of the directive. In some national legislation such as in France, the legislation defines the right for new emitters to be offered a connection to the main CO_2 transport network (connection right).[45]

The CCS Directive sets out basic criteria for access to CO_2 transport infrastructure, with a particular focus on pipeline transport. Several early movers' projects are also operating for a long time on an open source-basis (e.g., Norway, the Netherlands).

Certain segments of the CCUS value chain can be subject to competition and can therefore be subject to a negotiated regime like CO_2 gathering infrastructures. In other segments where competition is limited or absent, such as for a liquefaction terminal, transport infrastructure, and permanent storage sites, regulated access can be envisaged. Tariff regulation may be necessary on some of these CO_2

[45] Code de l'environnement, Art. L.229-48 to L.229-51.

backbone infrastructures in a situation of monopoly, where public investment is present to mitigate part of the risk, but not in segments exposed to competition.

Another criterion for defining a TPA regime is whether the segment or activities are scalable. In other words, can new connections be developed from the same network of infrastructure?

In the case of cross-boundary infrastructures, the applicability of the national TPA regime over the related infrastructures will need preliminary clarification.[46]

3.8. Regulatory Oversight

The CCS Directive requires Member States to establish or designate the competence authority (or authorities) responsible for fulfilling the directive's requirements.[47] This means that, in practice, all Member States must already have a competent authority in place. However, it appears that the attribution of competence in relation to the different areas of CO_2 regulation is not clear in all jurisdictions, prompting requests for explicit designation of these attributions.[48] In this context, it seems crucial to bring further clarity on the designation of competent authorities with a clear list of tasks in relation to the CCUS market and transport activities. In certain countries, such as Denmark, the national regulatory authority (NRA) for energy (*Energistyrelsen*)[49] has seen its competences extended to also cover CO_2. The degree of independence of the competent authority must also be provided in the legislation.

Among the tasks that a national regulatory authority could undertake are the following:

- review of access conditions to the different transport infrastructures and storage sites, including prices and tariff methodology;
- request for third-party access and possible denial;
- security issues;
- interoperability criteria.

A dispute settlement mechanism should be available through the NRA, and provisions for dispute settlement for cross-border projects should be introduced.

3.9. Need for Supplementary Legislation: Network Codes and Guidelines (Role of ACER)

There might be a need to adopt supplementary legislation in the form of network codes and guidelines. Some existing network codes and guidelines might already be relevant to CO_2 transport, liquefaction and storage facilities. The EU Agency for Cooperation of Energy Regulators (ACER) could

[46] Based on common practice, the applicable jurisdiction over cross-boundary infrastructures is clarified through framework international agreements or project specific agreements.
[47] CCS Directive, Art. 23.
[48] E.g., the request formulated by CRE in their report: Commission de Régulation de l'Energie (CRE), Rapport de la CRE sur le cadre de regulation des infrastructures d'hydrogène, September 2024
[49] https://ens.dk/forsyning-og-forbrug

also see its competences extended to CO_2 transport, mirroring its competences within electricity and gas.[50]

While it would be premature to foresee the adoption of network codes and guidelines in relation to CO_2 transport and storage in the short term, it is needed to provide a legal basis for it in the new legislation. The most relevant code families will probably be the ones in relation to market and connection.

3.10 Liability for Storage and Cross-Border Effects

The CCS Directive defined a series of obligations related to, among others, the quality of the CO_2 stream, the risk of CO_2 migration, the monitoring of possible leakages from injection facilities and the storage complex, the surrendering of allowances under the EU ETS, and the monitoring, reporting and corrective measures for closure and post-closure operations. These obligations concern a relatively limited number of actors and focus primarily on the storage site operator, the competent authority, and the Member States. There are other liability questions that will arise along the CCUS value chain that will involve a larger number of actors.

The level of liability is not equally shared among actors, which creates an unbalance which currently requires to be compensated by regulatory or financial incentives. Some insurance schemes are also developed to address these specific risks. Storage operators bear an important liability, which is currently compensated by a transfer of liability to the state after a period of 20 years.[51] In order to de-risk the different activities, some additional regulatory incentives could be provided through the EU legislation, such as risk allocation mechanisms and delimitation of liability.

3.11. CO_2 Transport and Storage Agreements: Platform for Demand Assessment and Demand Aggregation, and Selling Arrangements

As mentioned in Section 2.4, certain risks inherent to the CCS activities can be addressed through legislation, while others will be addressed through contracts, between actors. Market risks count among the risks that are better addressed through contracts. However, the fact that the CO_2 market around CCS is still at an early stage has triggered a reflection on the need for public intervention and market facilitation.[52] In addition, the need for certainty for both emitters and storage providers raises the question of the need for more bundled products associating transport and storage services.

A platform for Demand Assessment and Demand Aggregation

A public body or an organised platform might be necessary to coordinate the matching of supply and demand, thereby addressing the lack of alignment between capture and storage, as referred to

[50] As defined in Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators.
[51] CCS Directive, Art.18.1(b).
[52] As a matter of example, a classic take-or-pay contract as known from the petroleum industry may not be applicable to the CCS activities.

above.[53] This misalignment is perceived more at the decision-making level rather than being a matter of product alignment. This explains why harmonisation of CO_2 specifications is not necessarily required at the EU level, but a common approach to matching capture and storage is needed.

A platform for demand assessment and demand aggregation for CO_2 transport or storage services, combined with an investment atlas of potential CO_2 storage sites based on a common storage-readiness-level format, could be considered. This is indeed announced in the ICM Strategy of the European Commission. A platform can also address the difference in risk perception between emitters and storage providers, where emitters may want more flexibility, and storage providers may want more certainty (and so in favour of long-term commitments). A platform approach might help find a balance.

A platform can also better capture the diversity of the projects, with different sizes of emitters, and storage that can be offered both offshore and onshore.

Selling Arrangements

To de-risk investments in infrastructure and bring more certainty to emitters and storage capacity providers, a solution could be to develop bundled products which associate transport and storage. Providing bundled products around two activities that could be subject to unbundling requirements needs a careful assessment under competition law. The risk of uncompetitive behaviour could be mitigated by setting conditions, such as a threshold as to the share of these products on the market. There is also an inherent risk of having very different approaches to the combination of bundled products in Europe, which could hinder CO_2 trade across Europe. The exchange of information between undertakings must also be organised in such a way that it does result in anti-competitive behaviour.[54]

Operations on the platform can be supported by template agreements and arenas for public-private partnerships. For example, in the Netherlands, public-private partnership initiatives around the Aramis project have been facilitated through a joint task force under the umbrella of the Dutch Ministry for Climate Policy and Green Growth. As public-private partnership takes time to negotiate, government authorities, at the national and regional level between Member States, could facilitate the process.

3.12. Investment and Financial Support

The coverage of investment and operative support to CO_2 transport and storage infrastructures is a key factor for enabling CCUS value chains. Several financial measures already exist, such as EU financing mechanisms (e.g., EU Innovation Fund, Connecting Europe Facility, Recovery and Resilience Facility) and state aid rules (Guidelines on State aid for climate, environmental protection and energy).

Some costs, such as the costs of capture and of storage site maturation, might not be sufficiently covered. It may require additional financial mechanisms in the form of state support schemes, including e.g. carbon contracts for difference (CCfD), or public-private partnership as described above.

[53] See Section 1.1 above.
[54] Art. 101, TFEU.

To enable access to such schemes in all Member States, new EU measures could be adopted as part of a CO_2 infrastructure package.

Finally, some barriers to accessing the EU market for third and associated countries could arise with the application of the Carbon Border Adjustment Mechanism (CBAM).[55] This should also be considered.

3.13. Dispute Settlement among Regulatory Authorities and for Grid Users

As for other energy market design legislations, there should be an obligation to set up a dispute settlement mechanism, building on similar provisions in the electricity and gas sectors. Among the questions to be subject to dispute settlement, should be infrastructure access conditions (including price/tariffs). In certain Member States, the national regulatory authority for energy has already been given to mandate to address these issues.[56]

[55] Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism.
[56] For example, Cordis in France.

4. Summary and Recommendations

This Issue Paper aims to provide input to the upcoming **EU CO_2 transport and storage regulatory package**, as announced in the Industrial Carbon Management Strategy. Adopting supportive regulation on cross-border CO_2 transport and storage in Europe is considered the next necessary step to allow the free movement of CO_2 based on CCUS activities. It can address the current lack of alignment between captured CO_2 volumes and storage availability, and support the achievement of the emissions reduction targets set in the EU Climate Law and the CO_2 injection targets set in the Net Zero Industry Act.

The Issue Paper analyses, step-by-step along the value chain, what should be the key tenets of the regulatory regime for CO_2 transport and storage infrastructures in the EU. It serves as an initial appraisal of the core legal and regulatory issues to be addressed and offers a general mapping of the landscape. Additionally, the Paper formulates some first recommendations on specific issues.

When the CCS Directive was adopted in 2009, the focus was on reducing emissions from thermal industrial plants. Since then, the scope of the CCUS value chains has expanded to include more transport solutions beyond pipelines, driven by the need to decarbonise additional sectors and enhance flexibility in market outreach. Any future regulation of CO_2 transport and storage should reflect this broad and evolving scope of application of the CCUS activities, as well as the diversity of transportation modes. It also requires a **"full value chain approach"** (capture, transport, utilisation, and storage) to balance the different risks among actors along the chain. **A flexible and multi-modal CO_2 transportation and storage system across the EU** will allow industries to avoid ETS prices and remain competitive.

For the purpose of **regulatory consistency**, any additional EU legislation on CCS will need to build on the provisions of the CCS Directive, particularly on transport and storage. There is nevertheless a need for an evolution of the CCS legislative framework. At the time of the adoption of the CCS Directive, the efforts focused on the reduction of emissions from thermal industrial plants. Since then, the scope of the CCUS value chains has widened, including more transport solutions beyond just pipelines. Any new CCS legislation should prioritise regulatory alignment with existing electricity and gas market design frameworks to enhance consistency and interaction.

The regulatory models existing in mature infrastructure industries in the EU (e.g., regulated third-party access) provide incentives that might not be well adapted to **a nascent industry** like CCUS, with variable value chain components. Overregulation should therefore be avoided. There are some useful lessons to learn from the adoption of the hydrogen and decarbonised gases package. Notably, **a phased approach** to the application of the full regulatory regime (e.g. on unbundling) should be applied.

The following main building blocks for a future market design for CO_2 in Europe for CCS activities were identified:

- Transport network planning
- Permitting of CO_2 transport and storage
- Ownership and unbundling

- System operatorship
- Access to transport and storage capacities
- Regulatory oversight & dispute settlement

Some main recommendations related to this market design approach are that:

- A new legislative package should include some new legal definitions of key infrastructure types, such as "CO_2 network" or "CO_2 terminal".
- The need for adopting EU requirements on planning is driven by the need to address the lack of alignment between the different segments of the value chain, where access to transport capacity is instrumental. This justifies a focus on transport infrastructures, and on the most central parts of it, as the value chain is still evolving. In the ICM Strategy, the European Commission is proposing an EU-wide CO_2 transport infrastructure planning mechanism, that remains to be shaped. The planning requirements for CO_2 transport could mirror the ones for electricity, methane gases and hydrogen, such as the TYNDP, the NDP at the national level and cooperation between TSOs at the EU level (in a new organisation called ENTSO-C or ENNOC).
- At the time of the adoption of the CCS Directive, only pipeline transport was envisaged. Since then, the transport solutions have diversified. There is not the same need for EU regulation among these different transport modes, and therefore the question is to determine the correct level of regulatory intervention at the EU level. Key criteria are related to the need to ensure a level playing field among EU actors, and protect the rights of market actors (e.g., shippers, third parties).
- For transport, the key will be to build a flexible and multi-modal transportation system between the industrial clusters, the export infrastructures and the storage sites, to ensure cost-effective and timely development of CCS value chains and risk mitigation along it. Some transportation modes (e.g. shipping) will compete on a purely commercial basis between various loading ports and storage destinations, while other transportation modes, such as pipelines, will be in a situation of natural monopoly, where regulated intervention to ensure fair and transport actor to other actors than the owners.
- The role of the system operator must be clearly defined and should be adapted to the types of transport and storage infrastructures.
- Overregulation should be avoided. There are some valuable lessons to learn from the adoption of the Hydrogen and Decarbonised Gases Package. Notably**,** a phased approach to the application of the full regulatory regime (e.g. on unbundling and TPA) could be applied.
- In order to accompany the development of the market, it could be envisaged to propose a bundled product in the initial phase, i.e. combining transport and storage capacity.
- While it would be premature to foresee the adoption of network codes and guidelines in relation to CO_2 transport and storage in the short term, it is needed to provide a legal basis for it in the new legislation.
- More clarity is needed on regulatory oversight (designation of entity, tasks), as well as the availability of dispute settlement mechanisms, as required for the electricity and gas sectors.

cerre Centre on Regulation in Europe

Avenue Louise 475 (box 10)
1050 Brussels, Belgium
+32 2 230 83 60
info@cerre.eu
www.cerre.eu

Centre on Regulation in Europe (CERRE)
CERRE Think Tank
CERRE Think Tank