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FACTSHEET

CO_2-INFRASTRUCTURE REGULATION

Establishing CO_2 infrastructure poses regulatory challenges. These include safety, environmental protection and economic considerations. This factsheet will present areas with a need for economic regulation, as well as the approaches being discussed in Europe and Germany.

Political development of CO_2-infrastructure in Europe and Germany

Germany

In **Germany**, the pipeline transport and storage of CO_2 are regulated by the **Carbon Dioxide Storage Act (KSpG)**. Under its current version, the transportation of CO_2 via pipelines and its storage are not permitted. This restriction also applies to the export of CO_2.

In **February 2024**, the German federal government presented the key points of its Carbon Management Strategy, along with a draft for the revised version of the KSpG, now renamed the Carbon Dioxide Transport and Storage Act (KSpTG).1 The proposed new legislation allows offshore storage as well as opt-ins for individual federal states to allow onshore storage on their respective territories. After adoption, the revised law will also **enable the transport of CO_2 via pipelines**, except for CO_2 generated from coal combustion in power plants or heating plants.[1] This approach stems from the unique industrial landscape of **Germany**, where most industrial sites are inland. Onshore storage is not permitted under current or new legislation (currently in the parliamentary process) due to protests in the early 2010s.

The draft also includes a proposal to sign the London Protocol, which would allow crossborder transport of CO_2.

The new law would permit **storage within Germany's Exclusive Economic Zone (EEZ) under the North Sea**, provided that environmental and nature conservation areas are considered.[1] For onshore storage, the draft introduces an opt-in clause, giving federal states the option to allow onshore CO_2 storage within their territory. As of **December 2024**, the proposed law is in the parliamentary review process, but appears unlikely to be adopted before the new German government is formed in 2025.[1]

1 BMWK (2024) – Eckpunkte der Bundesregierung für die Carbon Management-Strategie, https://www.bmwk.de/Redaktion/DE/Downloads/E/240226-eckpunkte-cms.pdf?__blob=publicationFile&v=6, Entwurf eines Gesetzes zur Änderung des Kohlendioxid-Speicherungsgesetzes, https://www.bmwk.de/Redaktion/DE/Downloads/E/entwurf-eines-gesetzes-zur-aenderung-des-kohlendioxid-speicherungs-gesetzes.pdf?__blob=publicationFile&v=2, both accessed on 13/12/2024

Results from the modelling analysis of the Association of the German Cement Industry (vdz) show that a pipeline network with a length **of over 4,800 kilometres** is needed by **2045** for the captured volumes of CO_2.[2]

By **2030**, only a **few million tons of CO_2**, if any, are expected to be transported. Assuming a focus on hard-to-abate emissions, the transport volume is estimated at **45 million tons of CO_2 per year by 2045** with an additional **20 million tons** for transits from **Austria, Switzerland and France**.[2]

Open Grid Europe (OGE) is currently conducting a market survey in Germany for a CO_2 pipeline network and anticipates a transport demand of over **50 million tons of CO_2** in addition to transit volumes.[3]

EU Level

The storage of CO_2 has been regulated by the **CCS Directive since 2009**, setting rules for both operation and monitoring procedures (see Factsheet: Integration of CCU/S in Emissions Trading Systems).

The European Commission is planning a series of measures to create a unified CO_2 transport infrastructure within the EU, **establishing a "Single Market" for CO_2**. To achieve this, preparations are underway for a potential future regulatory package for CO_2 transport addressing market and cost structures, crossborder integration, uniform technical standards and investment incentives.[4]

In collaboration with Member States and the CCUS Forum, the European Commission will propose an **EU-wide planning mechanism for CO_2 transport infrastructure** to ensure coordinated development across Europe. As part of these efforts, emissions accounting rules will be developed within the EU Emissions Trading System (EU ETS) to account for all forms of CO_2 transport, including pipelines, ships and other modes.[4]

The European Commission will establish **minimum standards for the quality and composition of CO_2** streams designated for transport and storage, working in collaboration with relevant stakeholders. An assessment will be conducted to determine the feasibility of repurposing existing oil and gas pipelines for CO_2 transport, including the identification of necessary regulatory adjustments. The European Commission also plans to develop safety guidelines for CO_2 transport by sea, in cooperation with the International Maritime Organization (IMO), to ensure secure and compliant maritime transport.[4]

Finally, Member States are encouraged to launch an **Important Project of Common European Interest (IPCEI)** focused on Carbon Capture, Utilisation and Storage (CCU/S) to promote and support strategic, innovative projects in the field of CO_2 management.[4]

Within the framework of the Net-Zero Industry Act, a target has been set to achieve an **injection capacity of 50 million tons per year by 2030**. This goal is supported by various regulatory measures aimed at facilitating progress toward this target.[4]

The results of a study commissioned by the European Commission indicate that the transport network (ships and pipelines) could span up to **7,300 km**, with deployment costs amounting to **12.2 billion EUR**. By **2040**, this is projected to expand to **19,000 km**, with costs increasing to **16 billion EUR**. Overall, the modelling shows that up to **280 million tons** of CO_2 will need to be captured by **2040**, rising to **450 million tons by 2050**.[4]

Currently, almost no infrastructure for the transport of CO_2 exists in the EU. Therefore, to achieve the corresponding goals, the development of such infrastructure and appropriate regulation is needed.

The need for regulating CCU/S infrastructure

The focus of this paper is on the economic perspective regarding the necessity of regulation. However, infrastructure regulation also encompasses ensuring safety, considering environmental protection, and ultimately promoting the sustainable development of CCS. In **Germany**, safety standards are already in place for the various modes of transport.[5] In the case of economic regulation, multiple reasons for regulating CO_2 transport methods and market participants exist and are being discussed:[6]

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2 Verband deutscher Zementindustrie (vdz) (2024) – Anforderungen an eine CO_2-Infrastruktur in Deutschland – Voraussetzungen für Klimaneutralität in den Sektoren Zement, Kalk, und Abfallverbrennung, https://www.vdz-online.de/fileadmin/wissensportal/publikationen/zementindustrie/VDZ-Studie_CO2-Infrastruktur-Deutschland.pdf, last accessed on 13/12/2024

3 OGE (2024) – CO_2-Overview, https://oge.net/en/co2/co2-overview, last accessed on 13/12/2024

4 European Commission (2024) – Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions towards an ambitious Industrial Carbon Management for the EU, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0062, last accessed on 13/12/2024

5 For pipelines, these include ISO 27913 (international standard for CO_2 transport via pipelines), the regulations of the German Technical and Scientific Association for Gas and Water (DVGW) (Code of Practice C260), as well as the KSpG and references to the Energy Industry Act (Energiewirtschaftsgesetz, EnWG).
For ships, relevant standards include the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), the Dangerous Goods Ordinance for Road, Rail and Inland Waterways (Gefahrgutverordnung Straße, Eisenbahn und Binnenschifffahrt, GGVSEB), and the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN). For trains and trucks, the Dangerous Goods Ordinance for Road, Rail and Inland Waterways (GGVSEB) applies.

6 Most of the statements originate from an expert report on the regulation of CO_2 infrastructure within the framework of the German Carbon Management Strategy

Why is regulation necessary?

Prevention of discrimination

From a regulatory viewpoint, **discrimination of market participants or technologies needs to be avoided** as fair competition, e.g., between different CO_2 transport methods, is key to achieving an economically efficient development. Regulation to prevent discrimination thus becomes necessary as soon as a market participant acquires a dominant position which entails risks of unfair competition and rising prices. In the case of building CO_2 infrastructure in **Germany**, it seems likely that transport providers could acquire a dominant position as transport routes are centralised via export corridors.

Compensation of market failure

An additional need for regulation arises from **market failure**, which leads to a **lack of investment in infrastructure**. Reasons for this may include uncertainties related to the development of CO_2 prices, future funding options and other regulations. Regulation can help reduce these uncertainties and create a level playing field for CCU/S.

Even if abuse of market power is not an issue, **governments can still step in to support efficient long-term investments**. Uncertainty and a lack of rules can make these investments seem riskier, and higher prices for early users could slow the ramp-up of infrastructure.

Other reasons

From an industrial policy perspective, an additional need for intervention may arise from the fact that **smaller plants and decentralised locations** face higher transport costs and require targeted support to maintain competitiveness both domestically and internationally.

When and for which parts of the infrastructure is regulation necessary?

In Germany and the EU, **in the start-up phase**, competition is expected between all available transport modes. Even if transport needs to be channelled via central hubs and terminals[7, 8], during the ramp-up phase, CO_2 hubs/terminals are incentivised to connect as many CO_2 sources as possible. Therefore, potential discrimination or the extraction of monopoly rents is not expected.

However, in the maturity phase, without regulation, hubs and terminals might be able to exploit an expected dominant market position in the long term. **Transport via long-distance pipelines**[9] is expected to gain a dominant position. Alternative transport methods are expected to only be competitive at decentralised locations.

At short distances, there is expected to be continuous competition between transport modes. However, this might change if regional networks connecting small sources are developed, channelling CO_2 streams via central connections (e.g., cases where many small sources are close to one hub). When it comes to near-distance transport in particular, the potential of repurposing gas pipelines may bear the risk of gas pipeline operators using cross-subsidies to gain a competitive advantage in CO_2 transport. Other horizontal cross-subsidies and discrimination might be possible for companies operating other parts of hubs and terminals eligible for CO_2 transport.

In the maturity phase of CCU/S development, all parts of the transport chain[10] might be able to exploit dominant market positions, which is why regulatory measures to safeguard competition should be considered.

What regulatory approaches are possible?

Regulation can fundamentally be divided into **ex-post** and **ex-ante** approaches. In the context of infrastructure regulation, **ex-ante** regulation aims to **prevent the abuse of a dominant market position in advance**. This proactive approach has already been applied in the regulation of gas and electricity networks.

In **ex-post** systems, regulatory intervention occurs **after a dominant market position has been exploited**. This approach is particularly used in situations where the likelihood of such exploitation, or even the emergence of a dominant market position, is low. This can be the case when there is a strong counterbalance to the network operator, reducing the risk of market power abuse.

Measures to prevent discrimination

The following section outlines the various approaches to prevent discrimination.

Vertical separation

One option to safeguard competition is through vertical separation. By separating companies' ownership or control over different stages of the production and distribution process, regulation **prevents integrated companies** from using their position in one part of the chain **to gain an unfair advantage** by discriminating access or setting excessive prices.

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7 Definition of CO_2 hubs: CO_2 hubs are defined as locations where CO_2 from various transport modes (train, inland ship, truck) is conditioned and temporarily stored for further transport, usually via pipelines.

8 Definition of CO_2 terminals: At terminals, CO_2 is conditioned and temporarily stored for transport via ship or offshore pipelines.

9 Definition of long-distance pipelines: This refers to the transport of CO_2 through main pipelines, which carry CO_2 from various facilities to terminals or storage sites.

10 Definition of connecting pipelines: Connecting pipelines connect facilities to main pipelines or CO_2 hubs.

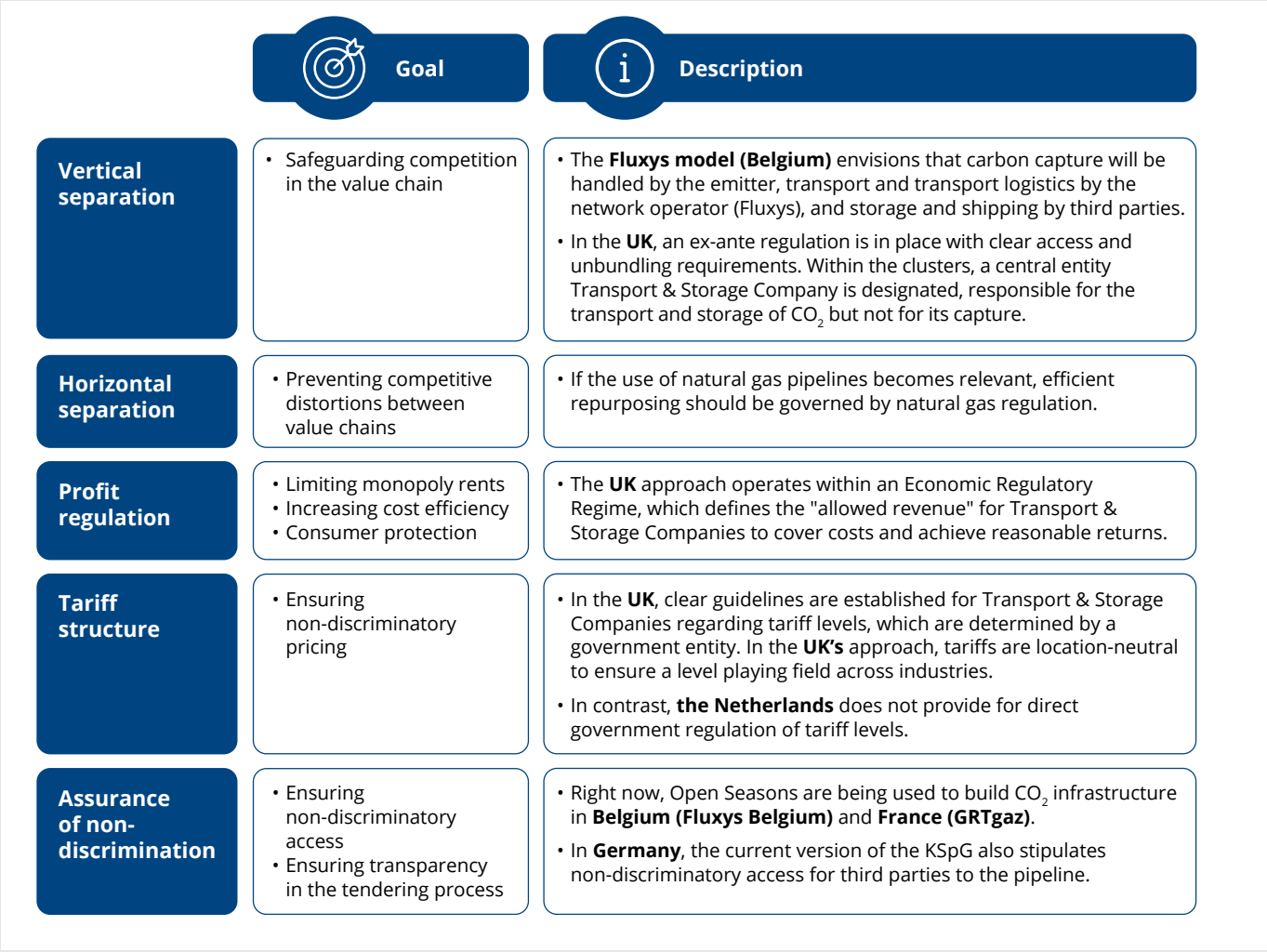

Figure 1: Overview of regulatory approaches in Europe for preventing discrimination. Source: dena

Vertical separation might not be needed initially but may be beneficial at a later point in time. Experience in the electricity and gas sectors has shown that retroactive unbundling involves high-transaction costs and, in **Germany**, may even be unconstitutional. Given this, it seems prudent to separate transport infrastructure operators from other stages of the value chain during the initial development phase.

- In **Belgium**, a proposal has been put forward by the gas network operator **Fluxys**. The model envisions that carbon capture will be handled by the emitter, transport and transport logistics (e.g., terminals/hubs) by the network operator (Fluxys), and storage and shipping by third parties.[11, 12]
- As described in the UK Regulation model box, in the **United Kingdom (UK)**, an ex-ante regulation is in place with clear access and unbundling requirements. Within the clusters, a central entity Transport & Storage Company (T&SCo) is designated, responsible for the transport and storage of CO_2, but not for its capture. Users of the infrastructure are granted access to the transport and storage network within the clusters.[11,13,14]

11 Polynomics, Frontier Economics, BAK (2024) – Optionen zur Regulierung von CO_2-Pipelines und CO_2-Untergrundspeichern in der Schweiz im Auftrag des Bundesamtes für Umwelt (BAFU), https://www.polynomics.ch/admin/data/files/publication/document/426/20240626_bafu_ccs_polynomics_frontier_bak_vischer.pdf?lm=1724673640, last accessed on 13/12/2024

12 Fluxys (2022) – Information Memorandum for CO_2 infrastructure, https://www.fluxys.com/en/projects/carbon-preparing-to-build-the-network, last accessed on 13/12/2024

13 Department for Business, Energy & Industrial Strategy (2022) – An update on the business model for Transport and Storage, https://assets.publishing.service.gov.uk/media/61d6f02ae90e07037c8d6001/ccus-transport-storage-business-model-jan-2022.pdf, last accessed on 13/12/2024

14 Clean Air Task Force (CATF) (2024) – Risk Allocation and Regulation for CO_2 Infrastructure – A UK case study, https://www.catf.us/resource/risk-allocation-regulation-co2-infrastructure/, last accessed on 13/12/2024

Horizontal separation

This approach seeks to **limit the concentration of market power** across different, but potentially interconnected, value chains. By preventing companies from gaining undue influence across multiple sectors, horizontal separation supports a more balanced and competitive market environment.

A **horizontal separation** between CO_2 transport infrastructure and other energy infrastructures does not appear necessary when solely building new CO_2 infrastructure. However, especially if repurposing natural gas pipelines for CO_2 transport is considered a viable option in the future, the regulatory framework should ensure competition avoiding inefficient crosssubsidies.

UK REGULATION MODEL

The UK initially relied on traditional investment support but has since moved towards a model centred around the **Transport and Storage Regulatory Investment Model (TRI)**, which is designed to attract investment while managing risks.

CO_2 transport and storage are managed by regional Transport & Storage Companies (T&SCos), which are private entities (often oil and gas companies or joint ventures), as already described. The system is regulated under an **Economic Regulatory Regime (ERR)**, which determines the "allowed revenue" for T&SCos to cover costs and earn reasonable returns. This revenue comes from user tariffs. The TRI employs the **Regulated Asset Base (RAB)** approach. In the RAB, investments are recovered through tariffs regulated by the government. This model reduces financial risks by guaranteeing returns on infrastructure investments.

Government packages such as the **Revenue Support Agreement (RSA) and the Government Support Package (GSP) provide protection against extreme scenarios** (e.g., underutilisation or CO_2 leakage). The **RSA** covers shortfalls in revenue caused by low network utilisation or delays, providing additional payments funded by taxpayers or energy consumers. The **GSP** addresses extreme risks such as stranded assets or CO_2 leakage by offering financial backstops. Mechanisms include mutualising costs across users, government subsidies, and adjustments to allowed revenues to manage risks like underutilisation, bad debts or delays.

The **regulator (Ofgem)** oversees licensing, price controls and performance targets, ensuring compliance and efficiency. While currently regulated, the model envisions a transition towards a more competitive market after **2035**, particularly for CO_2 storage, while transport may remain regulated.[14]

Profit regulation

Profit regulation is **designed to limit monopoly rents** (excessive profits that could arise from a lack of competition) and promote economic efficiency. This approach also serves to protect consumers by preventing unjustified price hikes and ensuring that prices reflect reasonable production and operational costs.

- An example of a profit regulation model is the **UK** model out-lined above. This approach operates within an Economic Regulatory Regime (ERR), which defines the "allowed revenue" for Transport & Storage Companies (T&SCos) to cover costs and achieve reasonable returns.[14]

Tariff structure

Setting tariffs is another regulatory measure that **aims to ensure non-discriminatory pricing** across different consumer groups. By structuring tariffs carefully, regulators can prevent preferential pricing and ensure that all consumers are treated equitably, regardless of their consumption level or other factors.

- The **UK** regulatory model outlined above establishes clear guidelines for tariff structures, set by a government entity. Users pay a mix of fixed and variable charges based on booked capacity and the volume of CO_2 transported. To promote a level playing field across industries, tariffs are location neutral.[14]
- In contrast, **the Netherlands** does not provide for direct government regulation of tariff levels. The government relies on market mechanisms, allowing operators to set prices within a competitive framework.[15]

Assurance of non-discrimination

To ensure non-discrimination, **third-party access** can be regulated. This refers to granting third parties (e.g. competitors) access to specific infrastructure they do not own but do require in order to deliver their services. Access can be mandated by the government or provided through voluntary commitments. Additionally, transparent tendering processes, such as **Open Seasons**[12,16] (see the Open Seasons box), can further support non-discrimination.

- For example, **Fluxys**, as a network operator, ensures non-discriminatory access in **Belgium**.[12]
- In **Germany**, the current version of the KSpG also stipulates non-discriminatory access for third parties to the pipeline.
- In **the Netherlands**, operators of CO_2 transport networks or storage facilities are required to grant third parties access under reasonable, transparent and non-discriminatory conditions under Dutch mining law. Furthermore, operators such as Aramis are expected to disclose their pricing structures to enhance transparency.[15]

15 Tweede Kamer der Staten-Generaal (2023) - BRIEF VAN DE MINISTER VOOR KLIMAAT EN ENERGIE EN DE STAATSSECRETARIS VAN ECONOMISCHE ZAKEN EN KLIMAAT, https://zoek.officielebekendmakingen.nl/kst-32813-1298.html, last accessed on 18/12/2024

16 GRTgaz (2023) – Open Season for CO_2 transport infrastructure in Dunkirk, https://www.grtgaz.com/sites/default/files/2023-02/memorandum-of-information-cei-co2-dunkirk.pdf, last accessed on 18/12/2024

OPEN SEASONS

Open seasons are market-oriented procedures designed to assess demand for capacity in infrastructure projects, particularly in the energy sector. These pro-cedures are often used to ensure that investments in new infrastructure projects (e.g., gas or electricity lines, hydrogen pipelines or CO_2 transport networks) are based on actual market demand.

Right now, Open Seasons are being used to build CO_2 infrastructure in Belgium (Fluxys Belgium) and France (GRTgaz).

Procedure

1. The infrastructure operator announces an Open Season, providing companies with the opportuni-ty to express their interest in new or expanded capacities.
2. Market participants, such as energy providers, industrial companies or traders, express their in-terest in capacities. The demand is typically speci-fied in binding or non-binding offers.
3. The infrastructure operator analyses the submit-ted requests and assesses whether the requested capacity justifies the planned investment.
4. If the conditions are met, the infrastructure is expanded or constructed, and capacities are allo-cated to the market participants. The allocation is carried out either at fixed tariffs or through an auction process if demand exceeds available ca-pacity.
5. National regulatory authorities often need to approve the results and terms of the Open Season to ensure transparency and market fairness.
6. Following the completion of the Open Season, construction of the infrastructure begins, provided the demand is sufficient and the business case is economically viable.

Open Seasons work well with ex-post supervision and give flexibility to add extra regulations later if needed, without requiring strict exante rules. This flexibility, especially with the uncertainties around CO_2 infrastructure, makes Open Seasons a good option.[12,13]

Measures to compensate for market failure

In cases where **price signals alone are insufficient to drive efficient investment**, government support can play a critical role. This involvement helps ensure that necessary investments are made to maintain infrastructure and service quality, even in situations where the private sector might not see immediate financial incentives.

The following provides an overview of the current discussed approaches for the efficient establishment of a CO_2 transport infrastructure in Germany and Europe:

Investment cost support

One of the most well-known options is investment cost support. In this approach, the state supports infrastructure operators in developing the infrastructure by providing grants.

- In the **European Union**, investment cost support is issued through TEN-E regulation (see the TEN-E regulation box) and Projects of Common Interest (PCI). In **2023**, the Member States approved four CO_2 transport and storage projects. The total funding amounts to nearly **480 million EUR**. These include two CO_2 export hubs, the CO_2 infrastructure at the Port of Rotterdam, and the Northern Lights project.[17]

Carbon Contracts for Difference (CCfD)

CCfDs provide financial support by compensating for the difference between the actual cost of carbon emissions and a pre-agreed price, ensuring that companies can decarbonise profitably (see Factsheet: Incentive Systems). CCfDs may increase planning security for infrastructure providers.

- For specific support and scaling-up efforts, **the Netherlands** has issued Transport-and-Storage-specific **CCfDs**.[18]
- Currently, CO_2 capture projects in **Denmark** must apply for subsidies with a plan for a full value chain including transport and storage; cross-chain risks are therefore handled commercially between the entities in the chain.[18]

Public-Private Partnerships (PPPs)

An alternative approach is Public-Private Partnerships (PPPs). In a PPP, the state contracts a private company to plan, finance, build and operate the transport infrastructure. However, PPPs are typically applied to mature infrastructures where technologies, regulatory frameworks and risks are well understood, thus limiting uncertainties.

- The regulatory model of the United Kingdom, as described above, can also be classified under the PPP approach, as the regulatory framework is established and secured by the state. Implementation, however, is carried out by the T&SCo.[14]
- In **the Netherlands (Porthos)** and **Norway (Longship Project)**, government action focuses on port infrastructure and the connection to offshore storage networks through PPPs.[11]

17 European Commission (2023) - Connecting Europe Facility: Nearly €600 million for energy infrastructure contributing to decarboni-sation and security of supply, https://energy.ec.europa.eu/news/connecting-europe-facility-nearly-eu600-million-energy-infrastructure-contributing-decarbonisation-2023-12-08_en, last accessed on 18/12/2024

18 Clean Air Task Force (2024) – Designing Carbon Contracts for Difference, https://www.catf.us/resource/designing-carbon-contracts-for-difference/, accessed on 27/11/2024

Amortisation account

The amortisation account is a **new form of tariff regulation including a state guarantee to provide assurances against uncertainties and high prices** for early users. This instrument has been developed and extensively debated in the context of securing hydrogen infrastructure in Germany. Building hydrogen infrastructure, similarly to building CO_2 pipeline infrastructure, requires large upfront investments and comes with high risks regarding unreliable CO_2 pricing and uncertain future regulation, which can lead to extra costs when financing investments.

TEN-E REGULATION

The **TEN-E Regulation** governs the expansion and promotion of trans-European energy infrastructures. Its objective is to establish an integrated and competi-tive European energy system that is secure, sustainable and efficient.

Functionality

The regulation defines strategic energy infrastructure corridors and areas (e.g., electricity grids, gas networks, hydrogen networks and CO_2 transport). Infrastructure projects deemed significant for the entire EU are classified as **Projects of Common Interest (PCIs)**. These projects must involve at least two Member States or have substantial crossborder impacts. PCIs benefit from accelerated permitting processes and regulatory support. Additionally, they are eligible for funding through the **Connecting Europe Facility (CEF)**.

The regulation also distinguishes **Important Projects of Common European Interest (IPCEIs)**, which often focus on highly innovative industries, in contrast to PCIs, which primarily target infrastructure. The purpose of IPCEIs is to support innovation projects of straegic importance to the EU, addressing market failures.

Connecting Europe Facility

The **CEF** supports investments in transport, digital services and energy infrastructure, with a total budget of **33.7 billion EUR**, of which **5.8 billion EUR** is allocated to the energy sector.

In the area of CO_2 networks, the **6th PCI List**, adopted by the European Commission in **November 2023**, includes **14 projects**.

Working mechanism

To prevent very high initial fees, a start-up fee will be introduced, spreading the costs of building the network across current and future users until **2055**. The government will guarantee a loan to help network operators balance the difference between the actual network costs and the lower regulated fees in the first phase of the project.

In the second phase, more users will help cover the costs, allowing operators to repay the loan. If the account still has a deficit by **2055**, the government will cover most of it (**at least 76 percent**), with network operators responsible for the rest (**up to 24 percent**). If the government ends the financing model early, the network operators' share of the risk decreases to **16 percent**, and the government takes on a bigger share. If a network operator is financially unable to cover the shortfall in the amortisation account, the hydrogen core network operator must transfer its ownership of the hydrogen core network to the federal government in exchange for payment of the calculated residual value minus the operator's share of the shortfall (known as the right of first refusal by the federal government). This mechanism ensures that the risk of a total loss is mitigated.

- A final decision on using a state-backed amortisation account for CO_2 transport has not been made yet in **Germany**. Unlike hydrogen, the CO_2 market has not been studied as much.

Green lead markets

Creating a green lead market by quotas, green public procurement or promoting voluntary increase in demand, can significantly increase planning security (see Factsheet: Incentive Systems).

- In **Germany**, a concept for green lead markets was published in **2024**. Around the same time, the German Steel Federation also released a standard for the voluntary certification of steel (Low Emission Steel Standard).[19,20]
- Furthermore, at the **EU level**, quotas for renewable fuels of non-biological origin (RFNBOs), produced via CCU, exist under the EU Aviation and EU Maritime Fuel frameworks. These regulations create demand for CO_2 and provide corresponding incentives for the development of CO_2 infrastructure.[21]

19 BMWK (2024) – Leitmärkte für klimafreundliche Grundstoffe Konzept des Bundesministerium für Wirtschaft und Klimaschutz (BMWK), https://www.bmwk.de/Redaktion/DE/Publikationen/Klimaschutz/leitmaerkte-fuer-klimafreundliche-grundstoffe.html, accessed on 04/12/2024

20 WV Stahl (2024) – Low Emission Steel Standard (LESS), https://www.wvstahl.de/less/, last accessed on 18/12/2024

21 European Commission (2024) – The role of Industrial Carbon Management in climate policies, https://climate.ec.europa.eu/eu-action/industrial-carbon-management/legislative-framework_en, last accessed on 18/12/2024

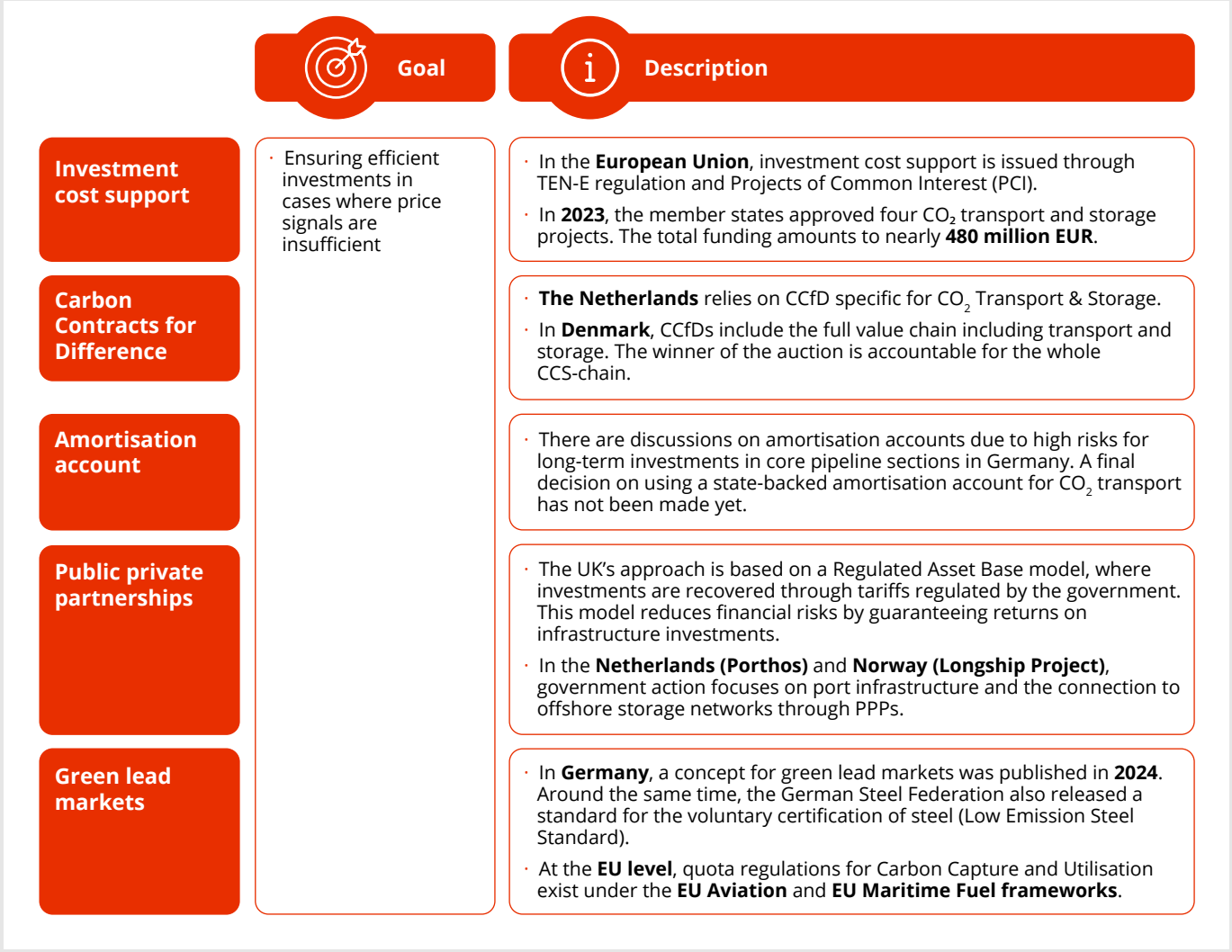

Figure 2: Overview of regulatory approaches for preventing market failure. Source: dena

Short overview of the regulation of storage infrastructure

The focus of this paper is on transport infrastructure. Nevertheless, the existing regulations regarding storage will also be examined. Often, the regulation of transport and storage infrastructure is interconnected.

The storage of CO_2 in Europe is governed by the CCS Directive and its respective implementation into national law (see Factsheet: Integration of CCU/S in ETS).

Overview on Germany

First, a brief look at **Germany**: Although the storage of CO_2 both onshore and offshore is not currently permitted, a regulatory framework already exists under the national **Carbon Dioxide Storage Act**. This framework establishes rules for monitoring, measurement and verification, as well as for obtaining a storage licence and the corresponding approval procedures. As part of the law, storage operators are obliged to pay a collateral to secure liability in case of an accident. However, the amount of the necessary collateral is yet to be determined.

Liability rules in Europe

The **EU CCS Directive** specifies that long-term liability for CO_2 storage sites transfers to the state after a minimum period of **20 years**. In **Germany**, this period is extended to **40 years**. In **Norway**, the licence holder of a storage site is generally liable for contamination resulting from CCS activities. In the **UK**, responsibility lies with the Transport & Storage Companies (T&SCos), which oversee the construction and operation of infrastructure and ensure safety and compliance with standards. If a CO_2 leakage occurs, the state (regulator) can revoke the T&SCo's storage licence.[14]

Overview of other regulatory approaches

In further analysis of the broader regulatory framework, attention should be directed towards the leading countries in this area, such as **Norway, the UK, the Netherlands and Denmark**.

Norway issued its first storage site approval under the **Longship Project**. The system is modelled after the framework for natural gas and oil production, with processes divided into screening, exploration, production and injection. Screening of the continental shelf does not require approval.[11]

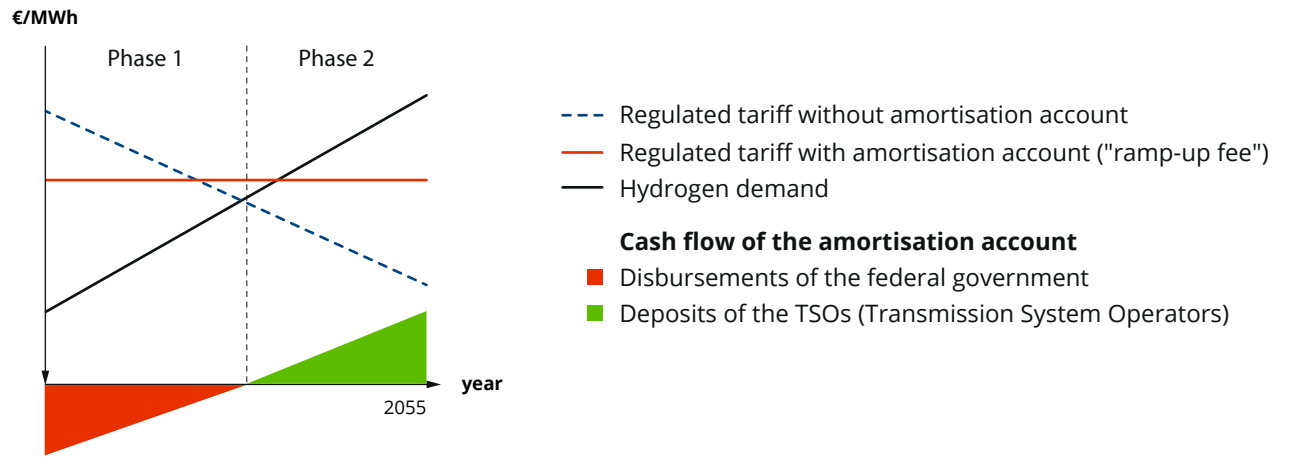

Figure 3: Functioning of the amortisation account. Source: dena

The **UK's** focus on CCS clusters is also evident in the way approvals are issued. Approvals are granted to the T&SCo of the CCS cluster. In **September 2023**, the first CO_2 storage licences were issued, with **14 companies** receiving 21 approvals. These licences allow for CO_2 storage in depleted oil and gas reservoirs.[14]

In **Denmark** and **the Netherlands**, state actors (e.g., Nordsøfonden in Denmark and EBN in the Netherlands) retain an ownership role in storage projects, whereas the UK model relies more heavily on private companies.[11]

Denmark holds a 20 percent ownership stake in storage projects through the state-owned oil and gas company Nordsøfonden, which already has a 20 percent share in the country's three existing storage exploration licences.[11]

With regard to funding, CCfDs in both **the Netherlands and Denmark** include storage in the support mechanisms. In **Norway**, the transport and storage infrastructure of **Northern Lights** has been supported by state funding covering **80 percent** of the total project costs.[22]

Learnings from experiences in Europe

In **all European countries** studied, as well as in ongoing discussions in Germany, it is evident that government intervention is seen as necessary, and state support is being discussed or implemented across Europe to facilitate the initial ramp-up of CO_2 infrastructure.

In **Norway, Denmark, the Netherlands and the UK**, the state is involved in the initial projects to mitigate risks. The degree of involvement varies depending on the specific conditions of each country and the goals of the initial projects.[23]

In **the Netherlands**, the government focuses on supporting infrastructure at the Port of Rotterdam. By providing CCfDs, the aim is to lower risks for infrastructure developers while limiting regulatory oversight to expost regulation. Similarly, in **Denmark**, CCfDs are structured so that the winner is responsible for the entire CCS chain, providing additional certainty. Moreover, both countries are also involved in storage projects through state-owned companies, contributing to risk mitigation.

22 Rosjorde & Carpenter (n.y.) – The Norwegian Full-scale CCS project, https://netl.doe.gov/sites/default/files/netl-file/20CCUS_Carpenter.pdf, accessed on 27/11/24

23 The assessment is based on the concluding statements from the CATF (2024) study – "Risk Allocation and Regulation of CO_2 Infrastructure."

A different approach is observed in the **UK**. Initially focused on a marketbased model, it shifted to a strongly state-regulated model after a project failed in 2015 due to investment risks. This shift is also driven by the UK's attempt to connect multiple facilities and establish a broader portfolio. The new approach focuses on clusters where a company licensed to provide transport and storage services (**T&SCo**) manages the infrastructure and builds on government support (CAPEX) and clear guidelines for tariff design.

In **Germany**, unlike the cluster-focused approaches in the Netherlands and UK, focus is on building **long-distance pipeline infrastructure**. This approach stems from the unique industrial landscape of Germany, where most industrial sites are inland. As a result, Germany will be dependent on export terminals and storage sites in the North Sea for the short to medium term. This necessitates connecting projects to these export points.

Potentially, CCU or legal approval for onshore storage could shift the regulatory focus. However, CCU depends on the development of hydrogen infrastructure and potential buyers for products that are initially uncompetitive. For onshore storage, protests might lead to significantly higher costs, negating transport savings. **Germany** has not yet decided on taking any further ex-ante regulatory measures, despite the proposed amendment of the Carbon Dioxide Storage Act. So far, **Germany** focuses governmental support on CO_2 capture facilities.

Overall, **state support is being discussed or implemented across Europe** to facilitate the initial ramp-up of CO_2 infrastructure. It is also becoming evident that there is no clear consensus on which approaches should be prioritised for regulating CO_2 infrastructure. Moving forward, it remains to be seen how these approaches will evolve and whether best practices can be derived from them.

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